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HABITAT, FOOD HABITS, AND PRODUCTIVITY OF NORTHERN GOSHAWKS NESTING IN CONNECTICUT

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Abstract. We documented active nests of the Northern Goshawk (*Accipiter gentilis*) at 16 different areas in Connecticut from 1997–1999. A total of 176 prey individuals were identified from remains found under goshawk nests and prey-plucking posts. Birds represented the dominant component of diets (70.5%) with a lower contribution from mammals (29.5%). Overall, Connecticut goshawk diets were dominated by sciurids and Ruffed Grouse (*Bonasa umbellus*). Productivity calculated from 15 known nesting attempts totaled 32 young for an average of 2.13 young per nesting attempt (range 1–4 young). Goshawks nested in large tracts of mature forests with high levels of canopy cover (82%). The nest site topography was consistent with previous studies finding that goshawks avoid southern slopes. Tree densities in the larger size classes and basal area were characteristic for mature forest. Goshawks constructed their nests in large diameter trees, which averaged 41.7 cm in diameter at breast height. Patch size of contiguous forests surrounding goshawk nests revealed a very high mean of 324.5 ha, thus suggesting that large forest patch size may be important for nesting by this forest interior species. Analysis of 202 ha circles centered on each nest revealed that total forest cover averaged 156.1 ha, which was comprised of 65.2 ha for conifer forest, 75.6 ha for deciduous forest, and 17.4 ha for mixed forest. Overall, the post-fledgling family areas for these nests were dominated by forest cover (>75%). Our results suggest that goshawks usually prefer isolation and little human disturbance at the nest site, but some exceptions were noted. Given the highly fragmented and urbanized landscape of Connecticut, we suggest that goshawk management should focus on providing large tracts of mature forest at least 300 ha in extent.

Key Words: *Accipiter*, Connecticut, forest, fragmentation, habitat, Northern Goshawk, nest sites, productivity, prey, site fidelity.

HABITAT, HÁBITOS ALIMENTICIOS Y PRODUCTIVIDAD DE ANIDACIÓN DEL GAVILÁN AZOR EN CONNECTICUT

Resumen. Documentamos nidos activos de Gavilán Azor (*Accipiter gentilis*) en 16 áreas distintas en Connecticut, de 1997–1999. Un total de 176 individuos de presas fueron identificados de los restos encontrados de bajo de los nidos de gavilán, y de los postes donde las aves despluman a sus presas. Las aves representaron el componente dominante de las dietas (70.5%) con una contribución menor de mamíferos (29.5%). Las dietas de los gavilanes de Connecticut estaban dominadas sobre todo por ardillas y Grévoles engolados (*Bonasa umbellus*). El total de la productividad calculada de 15 intentos de anidación conocidos fue de 32 jóvenes, de un promedio de 2.13 jóvenes por intento de anidación (rango 1–4 jóvenes). Los gavilanes anidaron en espacios grandes de bosques maduros con un alto grado de copa forestal (82%). La topografía del sitio del nido fue consistente con estudios previos, encontrando que los gavilanes evitan laderas sureñas. Las densidades de los árboles en las clases con los tamaños más grandes y área basal, fueron característicos de los bosques maduros. Los gavilanes construyeron sus nidos en árboles con mayor diámetro, con un promedio de 41.7 cm de diámetro a la altura del pecho. El tamaño del parche del bosque contiguo que envuelve los nidos de gavilán, reveló una media muy alta de 324.5 ha, sugiriendo que grandes tamaños de parches de bosque quizás sean importantes para la anidación de estas especies del interior de bosque. Análisis de 202 ha como punto central en cada nido, revelaron que el promedio del total de la cobertura forestal fue de 156.1 ha, el cual incluía 65.2% de bosque de coníferas, 75.6 ha de bosque deciduo, y 17.4 ha de bosque mixto. Sobre todo, los nidos en las áreas con familias de post-volantones fueron dominados por una cobertura forestal (>75%). Nuestros resultados sugieren que los gavilanes usualmente prefieren aislamiento y poco disturbio humano en el sitio del nido, pero algunas excepciones fueron encontradas. Dada la alta fragmentación y el paisaje urbanizado de Connecticut, sugerimos que el manejo del gavilán se debiese enfocar en la provisión de largos tramos de bosque maduro de al menos 300 ha de extension.

The Northern Goshawk (*Accipiter gentilis*, hereafter goshawk) is an uncommon permanent resident and migrant in Connecticut. The Connecticut Breeding Bird Survey (Smith and Devine 1994), conducted between 1982–1988, found breeding evidence in 13.8% of all blocks surveyed in the state. Of these, 46.3% were confirmed breeding, 18.3% were listed as probable, and 35.4% were considered as possible.

Despite its occurrence, surprisingly little is known about the ecology and distributional status

of this species within the state. The goshawk was considered a rare species in New England for most of the last century. Forbush (1925), for example, listed the goshawk as rare to casual in summer while, a decade later, Bagg and Eliot (1937) considered it to be exceptionally rare throughout New England. Similarly, Sage et al. (1913) reported only a single instance of goshawk breeding in Connecticut and further indicated that the species was a rare and irregular visitor in winter. The increased breeding population of the goshawk in the past 30 yr may be due to extensive reforestation, the growth of existing forest providing mature forest that they seem to prefer for nesting.

Most published studies on the nesting ecology and behavior of goshawks in the Northeast have been conducted in New Jersey and New York (Meng 1959, Speiser and Bosakowski 1987, Bosakowski et al. 1992, Bosakowski and Speiser 1994). However, Root and Root (1978) and Becker and Smith (2000) describe some aspects, mostly qualitative, of nesting ecology in Connecticut. The objectives of this study were to measure habitat and landscape features, describe food habits, and document productivity.

STUDY AREA

The study was conducted throughout much of the state of Connecticut in order to provide the most thorough coverage of goshawk nesting distribution and associated habitats. The landscape ecology of Connecticut is described in a number of books and articles (Devine and Smith 1996). Connecticut landscapes range from seashore habitats such as salt marshes that occur along the coast to hilly and wooded terrain in the interior, especially in the northwest and northeast sectors of the state.

Forests throughout the state are primarily deciduous or mixed conifer-deciduous that are dominated by northern red oak (*Quercus rubra*), sugar maple (*Acer saccharum*), birch (*Betula* spp.), ash (*Fraxinus* spp.), maples (*Acer* spp.), hickories (*Carya* spp.), and other hardwoods. Important understory and shrub layer components of these hardwood landscapes include witch hazel (*Hamamelis virginian*), flowering dogwood (*Cornus florida*), mountain laurel (*Kalmia latifolia*), spicebush (*Lindera benzoin*), blueberry (*Vaccinium* spp.), serviceberry (*Amelanchier* spp.), and seedlings and saplings of dominant tree species. Conifers such as white pine (*Pinus strobus*) are important components of these forests especially in the more northern sectors. Stands of red pine (*Pinus resinous*) and Norway spruce (*Picea* abies) can add an element of evergreen variety to these habitats as well. In interior locales where conditions are wetter and cooler, such as rocky ravines or north facing slopes of steeper hills, hardwoods are replaced by eastern hemlock (*Tsuga canadensis*) groves which may also include smaller amounts of red maple (*Acer rubra*), yellow birch (*Betula lutea*), and white birch (*Betula papyrifera*).

Most Connecticut forest land suffers from varying degrees of fragmentation and development. Roadways, power lines, gas pipelines, and other intrusive features of development fragment existing forest into various smaller tracts. Similarly, residential development has made heavy inroads on Connecticut's otherwise extensive forested areas.

METHODS

Locating Breeding Pairs and Nests

A literature search and discussions with local birders and wildlife professionals provided information on past breeding territories and nest sites of goshawks in Connecticut. Follow-up searches were made of all of these known traditional nesting territories, beginning in February and continuing at monthly (or more frequent) intervals through June. Goshawks produce loud alarm calls, and will usually attack or mob human intruders that walk within 100 m of an active nest with young nestlings (Bosakowski 1999). By following-up reports of aggressive hawks that attacked hikers, joggers, and mountain bikers, we were able to locate many active nesting territories.

We also conducted extensive field searches of forests for new potential nest locations throughout much of rural Connecticut from 1997–1999. State parks and forests, wildlife management areas, public reservoirs, and private rural areas with extensive forest cover were surveyed on foot. Several tactics were employed during these searches. During each search, we stopped at periodic intervals to listen for communications between the members of a pair, which often occur as they establish and maintain a nesting territory. Survey efficiency was increased on days with multiple field observers. One territory was discovered during a vocal territorial dispute between a goshawk and Cooper's Hawk *(Accipiter cooperii*).

If a pair was discovered occupying a breeding territory, it was kept under observation to ascertain evidence of breeding behavior. Identification of breeding behaviors was followed up by intensive and extensive searches for the nest site. Even with

the large nests that goshawks build, nest searches were more productive before the leaf-out period in deciduous-dominated forest. At selected locations, tape-recorded calls were broadcast following the methods described in Bosakowski and Smith (1997), but no goshawks were found with this method. Field surveys become increasingly more difficult during incubation because both males and females tend to be quiet and secretive at this time. Active nests were confirmed by the presence of an incubating female on the nest and/or observations of young on the nest. Observations of productivity were made from the ground by observing the number of late stage nestlings in each of 15 nests. Diets of goshawks were determined by examining prey remains found below goshawk nests and at prey-plucking posts following the methods outlined by Reynolds and Meslow (1984).

Nest Site Measurements

Nest site parameters were measured using a 0.127 ha plot based on a 20-m radius centered on the nest tree. This plot size was chosen as representative after careful visual inspection of all located nest sites. This plot size is considerably larger than the standard 0.04-ha plot (James and Shugart 1970) which Speiser and Bosakowski (1987) considered to be too small to accurately assess habitat for a bird as large and mobile as the goshawk. All trees within the plot were identified by species and measured for diameter at breast height (dbh) using measuring tapes or calipers. Saplings <2 cm dbh were not recorded. From these measurements, the following nesting habitat variables were calculated: tree density (number/hectare) of live and dead trees, basal area of trees (meter^2/hectare), and tree densities by 10-cm size classes.

Basal area of the nest stand was taken using a plotless method by use of a ten-factor angle gauge to estimate basal area at five systematically-spaced points: at the base of the nest tree and at the four cardinal directions positioned 50 m away from the nest tree. During these tree tallies, the number of conifers was noted and percent of conifers was subsequently calculated. The presence of shrubs and canopy was measured along a compass line in each of the four cardinal directions from the nest tree. In each cardinal direction, five sampling points at 5-m intervals produced a total of 20 samples for both shrubs and canopy for each nest site. The canopy cover presence (+) or absence (-) was determined using an ocular sighting tube (James and Shugart 1970). Shrubs and saplings (<10 cm in dbh) were grouped together because they are structurally similar (Collins et al. 1982). Shrubs and saplings were recorded as present if they were within arm's length of each sampling point (Collins et al. 1982).

Nest Tree Measurements

The nest tree was identified to species and the dbh was measured. Height measurements at the nest tree included canopy height of the nest tree, height of the nest from the ground, and the height of nest relative to the lower canopy. All height measurements of nests were made with a hand-held Accuscale altimeter. Geographic location of the nest tree was recorded using a hand-held global positioning system (GPS) unit.

Topography and Macrohabitat Features

These variables were centered at the nest site and included measurement of distances to edge, paved road, and human habitation. All measurements were taken from the nest site and measured with tape (<30 m) or paced (>30 m) from the nest tree. When distances to these variables were too great to be measured in the field, calculations were made from 1:1200 aerial photographs and USGS quadrangle maps. The variable of forest edge has been discussed by Giles (1978), Thomas (1979), and Forman and Gordon (1981) and is described as the juncture of two types of cover. Since coniferous and deciduous forest cover types are sometimes intermixed, the fragmented patches of deciduous and coniferous cover were grouped as representing the forest, and edges occurred where forest met a cover change, i.e., agricultural fields, residential-urban establishments, abandoned fields that have begun the succession process, large stretches of water bodies (lakes, rivers), human transportation corridors, and utility corridors. Patch size of contiguous forest was also calculated around each of the 16 nests.

Landscape Descriptors

Black-and-white low-altitude aerial photographs with a scale of 1:12,000 were obtained from Connecticut Department of Environmental Protection records. These photographs were taken in April 1996. We measured predominant land use patterns within a 202-ha plot circle centered at the nest tree. The 202-ha plot size was chosen to correspond with the post-fledgling family area estimated from telemetry data by Kennedy et al. (1994). Measures of land use within the 202-ha circular plot included total forest

cover, amount of deciduous cover, coniferous cover, and mixed forest cover, area of residential-urban development, agricultural fields (pasture land, crop land, orchards), open water (lakes, rivers, reservoirs), wetlands, and recreational areas such as public open space, campgrounds, and picnic areas.

RESULTS AND DISCUSSION

During the study period, active nests of goshawks were documented at 16 different areas in Connecticut. Land use around nest sites showed that six of the 16 nesting territories were located on city water supply land, five were in state forests, one was in a state park, one was on town land, one was on a nature center, and two were located on private sanctuaries. Several factors probably effect the selection of most breeding locations in sanctuaries and state lands. First, logging and other disruptive activities are usually nonexistent, minimal or regulated, therefore, these locales support older and more extensive forests in which goshawk may nest. A second contributing factor is the relative degree of protection and isolation afforded goshawks nesting in these sanctuary forest lands. A third factor is that virtually all large contiguous forests (>200 ha) are on public lands, which cannot be subdivided for suburban housing developments. In a densely populated and heavily urbanized state like Connecticut, these sanctuaries provide island habitats set in a sea of urbanization.

Food Habits

A total of 176 prey individuals were identified from remains found under goshawk nests and prey-plucking posts (Table 1). Birds represented the most frequent component of diets (70.5%) with a lower frequency of mammals (29.5%). No reptiles, amphibians, fish, or invertebrates were represented in the diet as was also the case for the New Jersey-New York Highlands (Bosakowski et al. 1992). In Connecticut, Ruffed Grouse (*Bonasa umbellus*) and Mourning Dove (*Zenaida macroura*) were most numerous among the 24 bird species taken, followed by Common Crow (*Corvus brachyrhynchos*), Blue Jay (*Cyanocitta cristata*), Mallard (*Anas platyrhynchos*), and Northern Bobwhite (*Collinus virginianus*). Among the nine species of mammals taken, tree squirrels were most numerous. Overall, frequency distributions of goshawk diets in this study were dominated by sciurids and Ruffed Grouse which is similar to that found in the New Jersey-New York Highlands (Bosakowski et al. 1992). Meng (1959) found common crows to predominate the goshawk diet in New York and Pennsylvania, but the nesting habitat was in an agricultural-woodland matrix.

Productivity

In this study, productivity from 15 known nesting attempts in Connecticut totaled 32 young for an average of 2.13 young per nesting attempt (range 1–4 young). In northwestern Connecticut, Root and Root (1978) conducted a study on 20 goshawk nests and reported a mean of 1.75 young per nest attempt (N = 17). Both Connecticut studies revealed an apparently higher rate than reported by Speiser (1992) for 36 nesting attempts in the New Jersey-New York Highlands (1.4 young/nesting attempt). The present study compares well with higher productivity rates of 2.2 reported for several western localities in Arizona, Nevada, and Oregon (summarized in Bosakowski 1999). Factors that caused nesting failures in Connecticut included human interference and predation by Great Horned Owls (*Bubo virginianus*) on adults or young. Female goshawk are very vulnerable to attack when incubating eggs or brooding nestlings.

Nesting Habitat

Field surveys yielded 16 goshawk nesting areas, all located in extensively forested habitats. Ten active territories were dominated by conifers; of these, eight stands were dominated by white pine and two by eastern hemlock. Four nesting areas were in mixed forest of eastern hemlock and hardwood species. Of these, one stand was predominantly eastern hemlock-red maple, and the remaining three were eastern hemlock-yellow birch stands. Two of the 16 nesting areas were located in pure deciduous forests. One of these sites was comprised mostly of yellow birch and white ash (*Fraxinus americana*), and the other site consisted primarily of red maple forest. In total, all but one nesting site were in stands of mature trees. The one exceptional nest was located in a young deciduous stand consisting of young (65%) and mature trees (35% of total trees). Overall, nest stands were dominated by conifers which averaged 66.1% (Table 2). The number of tree species within the majority of nest site plots was low ($\overline{x}$ = 7.9 species) but ranged between 5–14 tree species. The maximum tree species richness of 14 was the result of goshawks nesting in a young stand.

Overall, tree densities in the larger size classes and basal area were characteristic for mature forest (Table 2) and were consistent with forest structure

Table 1. Prey of Breeding Northern Goshawks in Connecticut.

Prey species		N individuals	Percent by number
Short-tailed shrew	*Blarina brevicauda*	1	0.6
Eastern chipmunk	*Tamias striatus*	13	7.4
Red squirrel	*Tamiasciurus hudsonicus*	10	5.7
Gray squirrel	*Sciurus carolinensis*	15	8.5
White-footed mouse	*Peromyscus leucopus*	5	2.8
Muskrat	*Ondatra zibethicus*	1	0.6
Woodchuck	*Marmota monax*	1	0.6
Eastern cottontail	*Sylvilagus floridanus*	4	2.3
Snowshoe hare	*S. transitionalis*	1	0.6
Unidentified rodent	—	1	0.6
Total mammals	—	52	29.5
Mallard	*Anas platyrhynchos*	6	3.4
Northern Pintail	*Anas acuta*	2	1.1
Wood Duck	*Aix sponsa*	1	0.6
Cooper's Hawk	*Accipiter cooperii*	2	1.1
Wild Turkey	*Meleagris gallopavo*	1	0.6
Ruffed Grouse	*Bonasa umbellus*	21	11.9
Northern Bobwhite	*Collinus virginianus*	6	3.4
Guinea Fowl (domestic)	*Numida meleagris*	2	1.1
Ring-necked Pheasant	*Phasianus colchicus*	4	2.3
Chicken (domestic)	*Gallus gallus*	5	2.8
Ring-billed Gull	*Larus delawarensis*	2	1.1
Rock Dove	*Columba livia*	5	2.8
Mourning Dove	*Zenaida macroura*	20	11.4
Northern Flicker	*Colaptes auratus*	3	1.7
Hairy Woodpecker	*Picoides villosus*	3	1.7
Downy Woodpecker	*Picoides pubescens*	1	0.6
Blue Jay	*Cyanocitta cristata*	7	4.0
Common Crow	*Corvus brachyrhynchos*	8	4.5
American Robin	*Turdus migratorius*	2	1.1
Thrush spp.	—	1	0.6
American Redstart	*Setophagia ruticilla*	1	0.6
House Sparrow	*Passer domesticus*	3	1.7
Red-winged Blackbird	*Agelaius phoeniceus*	1	0.6
Common Grackle	*Quiscalus quiscula*	2	1.1
Song Sparrow	*Melospiza melodia*	2	1.1
Unidentified small–medium Bird	—	13	7.4
Total birds	—	124	70.5
Grand total	—	176	100.0

found at nest sites across North America (see Table 1 in Bosakowski 1999). Canopy cover of nest stands in Connecticut averaged 82.1% and ranged from 65–100% (Table 2). Goshawks tended to select sites with a high canopy cover which is consistent with other regions (Bosakowski 1999). Canopy cover provides protection and concealment from aerial predators and may also provide cooler microclimates beneath the canopy to aid in thermoregulation of adults and to prevent desiccation of the nestlings. Shrub cover at northern goshawk sites averaged 52.8% which was moderately high. Bosakowski et al. (1992) found shrub cover ($\bar{x}$ = 28.3%) was significantly lower at nest sites in the New Jersey-New York Highlands compared to random sites.

Most goshawk nest sites were located on gentle slopes (five) or relatively flat terrain (five), but the remaining six nests were on steep slopes. Of the 16 nest sites, eight were in uplands, four were in riverine settings, three were in or near wetlands, and one was located on a ridge-top plateau. In the New Jersey-New York Highlands, Speiser and Bosakowski (1987) noted that goshawk nests were generally situated on lower slopes and flat bench-like areas. In Connecticut, most of the goshawk nest plots (81.8%) sloped mainly to the north or east, and

Table 2. Habitat Variables at Northern Goshawk Nests (N = 16) in Connecticut.

Variable	Mean	SD	Minimum	Maximum
Live trees (>10 cm/ha)	617.1	174.2	370.1	999.1
Total trees (>10 cm/ha)	716.5	219.4	456.7	1228.3
Live basal area (m^2/ha)	47.3	12.1	25.9	71.4
Total basal area (m^2/ha)	51.0	12.5	26.8	73.8
Live trees (<10 cm/ha)	630.9	596.3	189.0	2370.7
Live trees (10–19 cm/ha)	182.2	142.0	8.6	603.9
Live trees (20–29 cm/ha)	162.5	99.8	39.4	425.2
Live trees (30–39 cm/ha)	132.4	68.0	39.4	291.3
Live trees (40–49 cm/ha)	67.4	36.2	7.8	133.9
Live trees (50–59 cm/ha)	32.5	31.9	0	86.6
Live trees (60–69 cm/ha)	5.9	10.9	0	39.8
Live trees (70–79 cm/ha)	2.0	4.5	0	15.7
Live trees (80–89 cm/ha)	0.5	2.0	0	7.9
Nest stand basal area (m^2/ha)	39.1	7.2	20.2	51.4
Decadence percent	7.2	5.0	1.4	16.7
Species richness index	7.9	2.3	5	14
Conifer trees percent	66.1	23.6	15.9	94.6
Shrub cover percent	52.8	26.7	0	95
Canopy cover percent	82.2	9.8	65	100
Distance to human habitation (m)	413.3	260.4	57.1	971.5
Distance to paved road (m)	399.0	314.5	59.7	1,142.9
Distance forest edge (m)	200.3	163.5	38.1	609.6
Forest patch size (ha)	324.5	298.4	27.9	1,180.9
Nest tree dbh (cm)	41.7	10.1	22.0	60.0
Nest tree height (m)	26.4	4.1	18.0	36.6
Nest height (m)	14.9	2.1	9.8	18.3
Percent nest height	56.6	4.8	48.3	65.9

southerly aspects were almost totally avoided (Fig. 1). Similarly, Speiser and Bosakowski (1987) noted that southern slopes were also avoided by goshawks nesting in the New Jersey-New York Highlands.

The distance to the nearest house or building averaged 413.3 m, but ranged between 57.1–971.5 m. Since most homes are built along paved roads, the distance to the nearest paved road was similar, averaging 399.3 m (range = 59.7–1,143 m). In the New Jersey-New York Highlands, Bosakowski and Speiser (1994) noted that goshawk nests were much further from paved roads ($\bar{x}$ = 1,171 m) and human habitation ($\bar{x}$ = 1,052 m) than Connecticut goshawk nests. This regional difference may be due to land use and forest fragmentation patterns, which tend to differ between the states.

Distance from the nest to the nearest edge such as residential areas, fields, power line cuts, highways, and open bodies of water averaged 200.3 m and ranged between 38.0–609.5 m in Connecticut. It is interesting to note that Bosakowski and Speiser (1994) reported a similar distance ($\bar{x}$ = 264 m) to forest openings (>1 ha) in the New Jersey-New York Highlands, which was not significantly different than that found for 70 random sites. Thus, the nearest forest edge is a function of the nature of available forest, and there has been no selection documented neither for nor against this variable.

Landscape around Nests

In light of the well documented effects of forest fragmentation on breeding bird declines (Galli et al. 1976, Robbins 1979), we determined patch size of contiguous forest around goshawk nest sites using aerial photographs. Patch size of forests surrounding goshawk nests revealed a very high mean of 324.5 ha (SD = 298.4, range 27.9–1,180.9), indicating that large forest patch size may be an important parameter for nesting by this forest interior species. Similarly, Bosakowski et al. (1999) reported that three goshawk nests in Washington were in a similar mean patch size of contiguous forest, averaging 396.7 ha (SD = 175, range 210–559). No other investigators have reported patch size for goshawks.

In another landscape comparison, we examined land use patterns within a 202-ha circle around the nest, which was hypothesized by Kennedy et al. (1994) to represent the post-fledgling family area (PFA). In this study, analysis of 202 ha circles

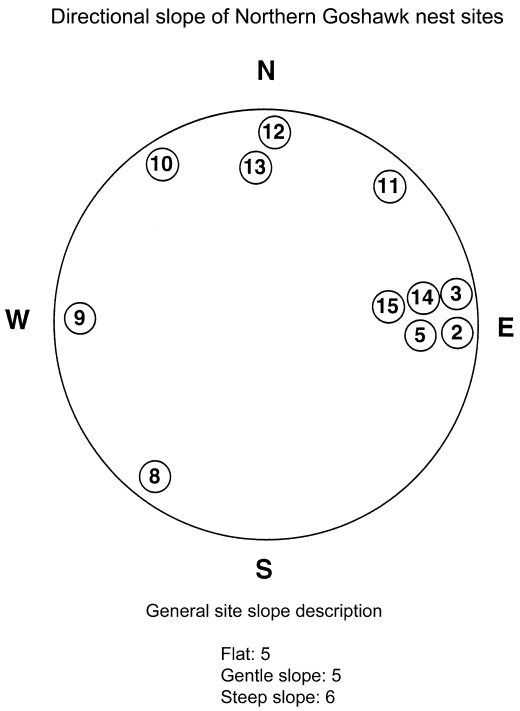

FIGURE 1. Slope aspects of Northern Goshawk nest sites in Connecticut. Five of 16 nest sites had no discernible slope aspects and are not shown.

centered on each nest (N = 16) revealed that total forest cover averaged 156.1 ha (SD = 22.7), including 65.2 ha for conifer forest (SD = 46.6), 75.6 ha for deciduous forest (SD = 39.1), and 17.4 ha for mixed forest (SD = 13.9). Overall, the PFAs for these nests were dominated by forest cover (>75%). These results support previous observations from the New Jersey-New York Highlands (Speiser and Bosakowski 1987; Bosakowski and Speiser 1994) which noted that goshawks were restricted to extensive areas of contiguous forest. Given the highly fragmented and urbanized landscape of Connecticut, we suggest that goshawk management should focus on providing large tracts of mature forest at least 300 ha in extent. This recommendation is based on mean patch size, which also provides an adequate area for the inclusion of the hypothesized 202-ha PFA. In conclusion, this study corroborates that the goshawk is an area-sensitive species (Bosakowski and Speiser 1994), and should also be considered a forest-interior species as well.

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