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ROOSTS OF NORTHERN SAW-WHET OWLS IN SOUTHERN WISCONSIN[1]

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Abstract. We described 623 roosts of Northern Saw-whet Owls (*Aegolius acadicus*) in southern Wisconsin from 1986 to 1990. Roosts were in seven species of trees, with 97.9% in white (*Picea glauca*) and Norway (*P. abies*) spruces, red (*Pinus resinosa*) and jack (*P. banksiana*) pines, and eastern red cedar (*Juniperus virginiana*). Mean roost height was 4.05 ± 2.21 m (range 0.15–11.20 m) in a 9.15 ± 3.40 m tall tree. Roosts averaged 46.6 ± 43.4 cm from the trunk on a 150.4 ± 69.6 cm long limb. Roost characteristics varied according to tree species, size, and shape. Mean roost height ranged from 1.5 ± 0.4 m in eastern red cedars to 6.9 ± 1.3 m in red pines. Roost height correlated positively with tree height and negatively with distance of roost from trunk. Distance of roost from trunk correlated positively with limb length. Directions of roosts relative to the trunk were random. Mean roost height and height of roost tree increased with time. Most roosts afforded good cover from above and most sides. Saw-whet Owls chose roosts that provide concealment, not those of a particular height. Roosts conferred thermal benefits on owls. Behavior of roosting Saw-whet Owls suggests that the owls' motionlessness when approached by humans is a camouflaging strategy.

Key words: Aegolius acadicus; *concealment; Northern Saw-whet Owl; roost site; Wisconsin.*

INTRODUCTION

Northern Saw-whet Owls (*Aegolius acadicus*) inhabit many types of forests across their range throughout the year (Johnsgard 1988). Most studies of their roosts (e.g., Bent 1938, Austing 1958, McCabe 1973, Grove 1985, and reviewed in Johnsgard 1988) have concluded that Saw-whet Owls usually roost low in trees or tangles, almost always <5 m above the ground. However, Hayward and Garton (1984) and Swengel and Swengel (1987) found some roosts much higher (>7 m) than those previously reported. Saw-whet Owls choose roosts that afford considerable cover (Hayward and Garton 1984, Grove 1985, Swengel 1987). We studied Saw-whet Owl roost site selection in different species and sizes of trees to determine how roosts were placed with respect to tree geometry and foliage density. We examined whether either of two hypotheses explains Saw-whet Owl roosting behavior: (1) Saw-whet Owls prefer low (<4 m) roosts; or (2) Saw-whet Owls choose roost sites for concealment.

METHODS

We studied Northern Saw-whet Owl roosts at 22 sites in four areas of Sauk County, Wisconsin (43°23′ to 43°34′N, 89°41′ to 89°49′W) from 17 March 1986–4 April 1990. About 37% of Sauk County is forested, and less than 5% of this is coniferous forest (Lange 1990). Nearly all of our research occurred in coniferous stands, however. Three study areas were in the Baraboo Hills, a range of bluffs and hills up to 150 m high in Sauk and Columbia Counties. The Baraboo Hills contain large, diverse forest tracts (Mossman and Lange 1982). The Baxter's Hollow study area is a stream gorge in the western Baraboo Hills containing mixed deciduous-coniferous forest. The Devil's Lake State Park south shore study area encompasses rugged terrain with deciduous and mixed deciduous-coniferous forests and some open areas. The Steinke Basin in Devil's Lake State Park contains wet meadow and prairie with scattered pine plantations and oak and oak-white pine (*Pinus strobus*) forest on the perimeter. A fourth study area in Mirror Lake State Park, immediately north of the Baraboo Hills, consists of a jack pine-oak-red cedar (*Juniperus virginiana*) barren with adjacent pine plantations and oak forests. Our previous (Swengel and Swengel 1987) and ongoing auditory censuses have revealed a dense population of Saw-whet Owls in our study areas.

We located Saw-whet Owl roosts by systematically walking or crawling through forests dur-

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ing the day to search for pellets and fecal whitewash, then following the whitewash pattern upward to the roost site. Most searches were done between 10:00 and 14:00 CST to enhance visibility. Searching bias within sites was minimal since we covered the same area on each visit. We visited a site no more than once per two weeks, and recorded roosts that were new since the last visit, even if they were in trees used by owls previously. We searched for roosts in all months, but more than 90% of our effort was between November 1–April 15. After 1987 we stopped searching several stands that had low owl usage and began visiting sites less frequently so that more roosts could accumulate between visits. Because we visited some sites only 1–2 times per winter, we could not usually determine in which month roosts were used. From January 1987 we recorded the time spent on searches. We learned identifying characteristics of Saw-whet and other owls' pellets by studying pellets immediately beneath a roosting owl and from the literature. After several years of finding only Saw-whet Owl pellets in one dense white spruce (*Picea glauca*) plantation, we identified Saw-whet Owl roosts there on the basis of the pure white feces of the owls.

For each roost we recorded tree species, tree height (to nearest 0.5 m), roost height, roost limb length (limb length), distance of roost from trunk (trunk distance), direction of roost limb (roost direction; one of 16 directions: N, NNE, NE, ENE . . . to NNW), diameter of tree at breast height (DBH; beginning in 1987), and presence of owl on roost. Roost height, trunk distance, and roost direction provided three-dimensional coordinates for the roost site. Sufficient whitewash was not always present to determine all roost characteristics. Since 1987 we attempted to climb to all roosts. We minimized disturbance of owls seen during the study by leaving a site immediately after we quickly estimated their roost variables. We did not approach owls once we saw them.

Data are reported as mean ± standard deviation (SD), except where noted. Analysis of variance (ANOVA) was used to detect differences in roost characteristics among tree species (using species as categories) and among years (using years as categories). Study years ran 1 July–30 June. Because of possible multicollinearity among roost variables, we used stepwise linear regression to analyze relationships among roost parameters and independent t-tests to test for significant relationships. We grouped roost directions into quadrants and performed statistical tests on several quadrant groupings (e.g., one of four possible quadrant groupings was N to ENE, E to SSE, S to WSW, and W to NNW; the second grouping begins NNE to E, and so on) to assure robust results. We used the chi-square goodness-of-fit test (chi-square test) to test for nonrandomness of roost directions on all four ways of grouping directions into quadrants. We used analysis of variance (ANOVA) to test two (rotated 45° relative to one another) of the four possible quadrant groupings for differences in roost characteristics among roosts in different quadrants. The ABstat (Anderson-Bell Corp.) program was used for all statistical analyses.

Because our study sampled the same sites several times, our sampling may contain more repeated measures than is desired in ecological studies (Beal and Khamis 1990, Potvin et al. 1990). We were unable to perform repeated measures ANOVA on our data because of uncertainty about which individual owls used specific roosts and because sample sizes at some sites were too small. Although the number of sites (20 producing data) and owls (>25) (Table 1) in our data set may be large enough to mitigate some of the statistical problems of repeated measurements, we reduced the degrees of freedom in all statistical tests to lessen the chance of Type I errors. After obtaining F or t values, we calculated probabilities using the number of sites, not roosts, to determine degrees of freedom.

RESULTS

ROOST CHARACTERISTICS

All roosts. We found 623 Saw-whet Owl roosts at 20 sites. Sight and auditory evidence showed that each site probably contained a different individual owl and that five sites hosted at least two individual Saw-whet Owls (Swengel and Swengel 1987, and unpubl. data). Assuming no emigration, immigration, or mortality in Saw-whet Owls, and no more than two owls at any site (although some sites might have had more), we sampled roosts from a population of at least 25 owls. In 1990, we heard seven Saw-whet Owls calling simultaneously in and near three sites that are close together but far removed from other sites.

Roosts were in seven species of coniferous trees:

TABLE 1. Number of sites and minimum number of owls represented in roosts found in each year of the study.

Year	Sites searched	Sites where roosts found	Min. n owls
1986	14	12	14
1987	14	14	17
1988	8	8	10
1989	7	6	9
1990	9	9	12
Total	22	20	>25

white spruce (n = 301, 7 sites), red pine (*Pinus resinosa*) (n = 186, 11 sites), jack pine (n = 58, 3 sites), eastern red cedar (n = 50, 3 sites), Norway spruce (*Picea abies*) (n = 15, 2 sites), eastern white pine (n = 12, 6 sites), and eastern hemlock (*Tsuga canadensis*) (n = 1, 1 site). In 1987-1990 we searched ca. 52% of the time in red pines, 32% in white spruces, 6% in jack pines, 4% in eastern red cedars, 4% in Norway spruces, 2% in white pines, and <1% in hemlocks. We searched deciduous forests in 1986, but did not record the time spent.

Roosts were in concealed places (Fig. 1). Nearly all roosts had dense cover above them. Although most roosts were on bare branches, they were surrounded by foliage, typically blocking the view from three-fourths of all directions. Most roost sites were not visible from ground level at 5 m horizontal distance. Roosts >6 m high were usually invisible to us from the ground, but we could find them using whitewash trails.

Roosts averaged 4.05 ± 2.21 m high (range 0.15–11.2 m, n = 429) in 9.15 ± 3.40 m tall trees (range 1.5–22 m, n = 591) with an average DBH of 15.9 ± 6.3 cm (range 1–48 cm, n = 472), and were 46.6 ± 43.4 cm from the trunk (range 2–185 cm, n = 442) on 150.4 ± 69.6 cm long branches (range 3.4–338 cm, n = 372). Roosts averaged 45.5 ± 15.6% of the roost tree's height (range 3.8–81.3%, n = 424) and were situated 30.9 ± 22.2% of the roost limb's length out from the trunk (range 1.3–100%, n = 372).

Roost height was positively related to tree height ($r = 0.7441$, $t_{19} = 22.1291$, $P < 0.001$), and covaried negatively with trunk distance ($r = -0.1926$, $t_{19} = -5.7221$, $P < 0.001$). Roost height was not significantly related to limb length or DBH ($P > 0.05$). Trunk distance correlated positively with limb length ($r = 0.5766$, $t_{19} = 11.7439$, $P < 0.001$) and tree height ($r = 0.2025$, $t_{19} = 2.5722$, $P < 0.05$), and negatively with roost

FIGURE 1. Typical tree shape, foliage density, and Saw-whet Owl roost locations in five tree species, from left to right: eastern red cedar, white spruce, jack pine, red pine, and Norway spruce. Arrows indicate mean roost height and distance of roost from trunk.

TABLE 2. ANOVA table showing the significant year effects of roost height in all roosts. Denominator df for significance testing represents (n sites − 1) instead of (n roosts − 1).

Source of variation	n	SS	MS	F	df	P
Years	5	312.936	78.234	16.427	4	0.0000
Among roosts	452	2,147.9	4.751		19	

height ($r = -0.3372$, $t_{19} = -5.1961$, $P < 0.001$). Trunk distance showed no relationship to DBH ($P > 0.05$). When all variables were included in stepwise regression, limb-percent (trunk distance/limb length) correlated positively with trunk distance ($r = 0.7566$, $t_{19} = 41.7474$, $P < 0.001$) and negatively with limb length ($r = -0.6503$, $t_{19} = -22.5095$, $P < 0.001$). In stepwise regression excluding trunk distance and limb length, limb-percent covaried positively with tree height ($r = 0.1709$, $t_{19} = 2.1528$, $P < 0.05$) but was negatively related to roost height ($r = -0.3180$, $t_{19} = -4.007$, $P < 0.001$).

Most roosts in red cedars were in the same part of one tree, so we excluded this tree species from analyses of roost direction. Roost directions of Saw-whet Owls in other tree species did not differ from random (chi-square test, 19 df, $P = 0.33$–0.84 in four tests). No roost measurements varied significantly by quadrant in two different quadrant configurations ($F_{3,19} = 0.4119$–2.8478 in 10 ANOVAs, $P > 0.06$ in all tests).

Roost height varied significantly among years ($P < 0.001$, Table 2), increasing steadily from 3.11 ± 1.29 m ($n = 42$) in year 1 to 5.12 ± 1.82 m ($n = 98$) in year 5 ($P < 0.005$ for 5 of 10 year-pair comparisons). Roost tree height ($F_{4,19} = 24.2247$, $P < 0.001$) also had significant effects among years, increasing each year from 6.77 ± 2.37 m ($n = 42$) in year 1 to 10.25 ± 3.16 m ($n = 98$) in year 5 ($P < 0.005$ for 6 of 10 year-pair comparisons). Although DBH ($F_{3,16} = 5.213$, $P < 0.01$) and limb-percent ($F_{4,19} = 6.0659$, $P < 0.01$) displayed significant effects among years, neither had a pattern to its variation. Trunk distance did not vary significantly among years ($F_{4,19} = 3.3432$, $P > 0.05$).

Variation among tree species. Typical white spruce roosts were located inside the canopy of foliage where cover was greatest, not among the needles. Most trees where Saw-whet Owls roosted in plantations were so close together we could not see more than 3 m at eye level. Norway spruces averaged taller than white spruces, yet provided equally good roosting cover. This created opportunities for very high roosting by owls. As in white spruces, the best cover was proximal to the foliated branch tips.

In mature, tightly planted red pine plantations, roosts were high in the most concealed spots available. Because they were planted in tight rows, red pines had relatively narrow crowns. The lowest branches with adequate foliage cover for roosting Saw-whet Owls were usually >5 m high. The best cover in red pines was out among the needles.

Roosts in jack pines were in trees of all sizes. Most roost trees grew in dense clumps, although some were large sprawling trees with many intersecting limbs. Jack pines had similar foliage density over most of their height, resulting in good cover relatively low to the ground. Like red pines, jack pines afforded the most cover among the open foliage rather than interior to the foliage.

At Mirror Lake owls roosted in red cedars that were scattered across a grassland or on the edges of jack pine stands. Only the largest red cedars were chosen, and roosts tended to be at or lower than the tree's widest point. Most roost sites were well out in the foliage (Fig. 1). Most red cedar roosts were in one large tree (88–96% of roost variates); nearly all roosts were on the W to NW side.

Most roost characteristics varied among the five most important roost tree species (Table 3). Roosts we found in white and Norway spruces may be skewed low, since high roosts were difficult to detect in these trees. All roosts in red pines were high, so roost heights are probably not strongly biased in this tree. Because roosts of different heights in eastern red cedars and jack pines seemed similarly detectable, we believe our sample from these trees is not biased toward low roosts. Relationships of roost variables to one another were relatively consistent among tree species in spite of differences in tree size and roost height. For example, while roost height, trunk distance, and limb length varied by factors of 5, 4, and 3 among tree species, ratios of trunk

TABLE 3. Mean (±SD) measurements of Saw-whet Owl roost variables (in cm, except where noted) in five tree species. Means lacking similar letters after them are significantly different (ANOVA, $P < 0.05$). Trunk distance = distance of roost from trunk. Numbers in parentheses are sample sizes.

	White Spruce	Red Pine	Jack Pine	E. Red Cedar	Norway Spruce
Tree ht (m)	8.8 ± 3.3A	11.6 ± 1.7B	6.1 ± 2.4C	5.3 ± 0.6C	11.3 ± 2.2B
Range	1.5–22 (291)	8–18 (169)	2.7–11 (57)	3.3–6.1 (50)	7.6–15 (14)
Roost ht (m)	3.9 ± 1.6A	6.9 ± 1.3B	2.0 ± 0.7C	1.5 ± 0.4C	4.1 ± 1.8A
Range	0.3–11.2 (225)	3.8–10.0 (92)	0.2–4.3 (57)	0.5–3.1 (44)	1.9–7.3 (9)
Limb length	125 ± 52A	160 ± 46B	155 ± 87BC	259 ± 41D	84 ± 60AC
Range	22–320 (196)	30–250 (77)	3–338 (47)	61–298 (42)	25–220 (8)
Trunk dist.	30 ± 30A	44 ± 33BC	58 ± 49C	117 ± 38D	44 ± 45ABC
Range	2–185 (223)	5–175 (101)	2–184 (54)	12–167 (47)	8–155 (10)
Limb—percent	25 ± 20A (196)	29 ± 21AB (77)	41 ± 26C (47)	48 ± 13C (42)	44 ± 24ABC (8)
DBH	14.0 ± 5.3A (241)	18.4 ± 5.3B (159)	16.5 ± 8.0AB (24)	14.4 ± 2.6A (33)	16.6 ± 5.3AB (10)

distance to limb length and roost height to tree height varied only by a factor of 2. Trunk distance was highly variable (CV = 75–102%) in all trees except eastern red cedars (CV = 32%).

Red pines and eastern red cedars had less variable roost limb lengths than the other three major roost tree species (CV = 29% and 16%, respectively, vs. 42–71% for the other three species), but for different reasons. Most red pines were 1.5–2 m apart both within and among plantation rows, resulting in a cylindrical tree shape with limbs varying little in length from the lowest foliage to 2–3 m below the tree top (Fig. 1). Eastern red cedars probably had consistent roost limb lengths only because 88–96% of roost variables were from one tree.

Variation among years in red pine roosts. Although roost measurements changed over time in both white spruces and red pines (Table 4), our sample permitted us to analyze this variation only in red pine roosts. Red pines displayed significant year effects on roost tree height ($F_{4,4} = 12.9406$, $P < 0.05$), DBH ($F_{3,4} = 10.9831$, $P < 0.05$) and roost height ($F_{4,4} = 11.2733$, $P < 0.05$). Means of these three variables increased during the study. We conducted post-hoc tests among means of these variables between all pairs of years, with critical probabilities of 0.005 (0.05/10 year pairs) for roost and tree heights and 0.0083 (0.05/6 year pairs) for roost tree DBH. Only tree heights between years 2 and 4 were significantly different ($F_{1,4} = 32.1738$, $P < 0.005$). Red pine roosts lacked significant year effects on roost limb length, distance of roost from trunk, and roost direction.

OBSERVATIONS OF SAW-WHET OWLS

During our study we saw 17 roosting Saw-whet Owls. Their roost characteristics were similar to those of the entire sample of roosts. Saw-whet Owls seen in white spruces ($n = 13$) roosted 3.3 ± 1.3 m high and 24.8 ± 20.3 cm from the trunk on a 115.6 ± 30.2 cm branch. Owls seen roosting in red pines ($n = 4$) were 7.2 ± 1.0 m high and 82.3 ± 69.0 cm out on a 160.6 ± 59.9 cm branch.

TABLE 4. Comparison of Saw-whet Owl roost characteristics (mean ± SD, in cm except where noted) in years 1 and 5 of the study in a white spruce plantation and years 2 and 5 in 3 similar red pine plantations. DBH values are from years 2 and 5 for both trees. Study years were 1 July–30 June. Trunk dist. = distance of roost from trunk. Numbers in parentheses are sample sizes.

	White spruce roosts		Red pine roosts	
	Year 1	Year 5	Year 2	Year 5
Tree ht (m)	6.2 ± 1.0 (50)	9.4 ± 1.3 (68)	11.0 ± 1.5 (111)	12.1 ± 0.9 (26)
Roost ht (m)	2.8 ± 0.7 (28)	4.7 ± 1.0 (61)	6.4 ± 1.0 (47)	7.3 ± 1.4 (19)
Limb length	105 ± 31 (6)	115 ± 44 (61)	153 ± 45 (40)	183 ± 51 (19)
Trunk dist.	31 ± 22 (25)	27 ± 26 (61)	41 ± 32 (58)	38 ± 24 (19)
Limb—percent	18.5 ± 17.2 (6)	24.1 ± 18.4 (61)	30.4 ± 19.7 (40)	23.9 ± 17.1 (19)
DBH	11.7 ± 2.5 (54)	13.8 ± 3.5 (68)	17.3 ± 4.1 (106)	20.8 ± 4.9 (19)

We saw only one Saw-whet Owl for every 22.6 man-hr (9 owls/203.22 man-hr) of daytime searching during 1987–1990. During 1986, when we searched extensively but did not record observer effort, we found eight individuals. We found five times as many owls per unit time in white spruces as in red pines. However, auditory censuses did not indicate a higher density of owls in white spruces than in red pines. The owls' high roosts in red pines were nearly invisible from ground level. Only one Saw-whet Owl in a red pine was found from ground level without the assistance of mobbing birds.

Owls we saw at close range exhibited fear by opening their eyes wide, moving on the perch, and sometimes stretching tall their bodies, as described by Catling (1972). Owls in one white spruce plantation became progressively more difficult to find; in 1986 they became more agitated with each sighting (n = 7). The only two owls that flushed from their perches were at this site. In the next four years we found only four Saw-whet Owls there, although there was pellet and auditory evidence of regular owl occupancy. The owl(s) might have chosen higher, more concealed, roosts as a result of our disturbances.

DISCUSSION

ROOSTS

Our grand mean roost height (4.05 m) is similar to the highest mean roost height reported for Saw-whet Owls, 4.2 m (n = 15) (Hayward and Garton 1984). Most published roost heights are 1.5–4 m (Bent 1938, Randle and Austing 1952, McCabe 1973, Grove 1985), with a few roosts of 5.0–5.5 m (Randle and Austing 1952, Grove 1985). We routinely found 6–8 m high roosts in red pines.

Our results are consistent with a hypothesis that Saw-whet Owls choose roosts with good cover rather than roosting at a certain height. Nearly all roosts were concealed from above and from most lateral directions. Roost sites were adapted to the particular crown, canopy, and foliage characteristics of each tree species. In trees with no foliage below 3–5 m high, Saw-whet Owls roosted high (>6 m), where there was adequate cover. In trees where good cover was available close to the ground, such as eastern red cedars, jack pines, and some white spruces, owls chose lower roosts. Owls roosted a significant distance from the foliage periphery in all species of trees (means of 41–142 cm), perhaps making them less visible to predators from without.

Tree geometry and foliage explain most of the positive and negative covariation among roost variables. Roost height correlated with tree height in part because high roosts are not possible in short trees. Second, many tall roost trees (nearly all red pines and some white and Norway spruces) had no foliage for the lowermost several meters. This precluded owls from roosting below 4 m without sacrificing most of the cover found in higher branches. Trunk distance correlated with limb length because limb length places an upper limit on trunk distance and because cover improved away from branch tips in most trees. High roosts were closer to the trunk because limbs become shorter near the tops of conifers.

As the study progressed, owls roosted higher in taller trees. This reflects the growth of the trees during 1986–1990, and a corresponding increase in the height of the best roosting cover. Sometimes, however, the owls may have roosted higher to avoid our intrusions. Evidence for this was our sighting (after it was mobbed by birds) of an owl 7 m high in a red pine in late 1986, within 20 m of several white spruces in which we saw Saw-whet Owls roosting 2–4 m high a few months earlier. Although some of the changes over time in the data set could be caused by differential sampling of tree size classes and sites among years, these trends held even within sites (Table 4).

Concealment appeared to be more important in Saw-whet Owl roost site selection than roost height. Roost characteristics that relate to foliage cover around the owl, such as trunk distance and limb-percent, varied less among trees and among years than tree height and roost height, which are greatly influenced by available tree sizes and their growth characteristics.

The dense cover around Saw-whet Owl roosts provided a wind break and would decrease convective heat loss relative to an exposed site. These characteristics would give the owls thermal advantages (Walsberg 1986). Most roosts were away from plantation or forest edges, where we could feel only a tiny proportion of the wind's force on windy days. We found no evidence, however, that owls chose roosts principally for their thermal characteristics.

Owls eluded our searches with their camouflaged roosts. We found roosting Saw-whet Owls only rarely, in spite of a density of 5.0 calling owls/km² in our three Baraboo Hills study areas (Swengel and Swengel 1987) and similar numbers calling in 1989–1990. The large number of pellets (1,148) and roosts we found at 20 sites also indicates intense owl usage of the area.

Differences among tree species. Roosts in white and Norway spruces had similar characteristics, corresponding to the similar shape and foliage of these two trees. Roosts were about the same height in jack pines and eastern red cedars, perhaps due to their similarity in several important crown and canopy features—they grew in rather open habitat at the same sites, were relatively short, had long branches, and had similar foliage characteristics over most of their height. Because red pines had no low cover, all roosts in this tree were >4 m high.

Limb-percent was much lower in trees that were in plantations (white spruces and red pines) than in the other species (Table 1), even though the long needles on red pine branch tips provide good cover. Limb-percent values were depressed in red pine plantations because limbs from neighboring trees intersected at 30–50% of their length and roosts were rarely past this intersection point. Probably because jack pine needles are small and offer even less cover than those of red pines, owls chose roost sites far out on the branch in places with high needle density.

Comparison with previous studies. Roosting patterns we observed are consistent with two other recent studies (Hayward and Garton 1984, Grove 1985), in that Saw-whet Owls picked sites in good cover away from the tree trunk, sometimes roosted high, and were difficult to see. Although these studies were conducted in western forests different from ours, both stressed the concealed nature of Saw-whet Owl roost sites. Catling (1971) emphasized the importance of canopy cover to Saw-whet Owls, and Hayward and Garton (1984) found that Saw-whet Owl roosts in Idaho had better canopy coverage above them than those of Boreal Owls (*Aegolius funereus*) or Western Screech-Owls (*Otus kennecottii*). We believe that the low roosts reported in most studies of Saw-whet Owls (Bent 1938, Austing 1958, Catling 1971, McCabe 1973) could be in part caused by the owls having mostly small conifers from which to choose good roosts and from the difficulty in detecting Saw-whet Owls roosting more than 4 m above the ground. For example, Austing (1958) found his highest roosts (5.5 m) only in pines that lacked obstructing foliage on their lowest 4.5 m, while the remainder of the roosts were 2.4–4.3 m high in short trees.

Others have found that Saw-whet Owls frequently roost away from the trunk (Randle and Austing 1952, Hayward and Garton 1984, Grove 1985). Most Saw-whet Owls seen roosting close to tree trunks (Austing 1958, Mumford and Zusi 1958, McCabe 1973) were in deciduous trees in winter, which have as much cover next to the trunk as out on a branch. Shrubby tangles also offer good cover for Saw-whet Owl roosting (Bent 1939, Randle and Austing 1952).

Studies of other small owls demonstrate that the owls choose roosts likely to be concealed from predators. In Kentucky, Belthoff and Ritchison (1990) recorded Eastern Screech-Owl roosts even higher (mean = 10.2 m) than our red pine roosts, and found that the owls selected concealed roosts. Screech-Owls in that study preferentially roosted in eastern red cedars. Smith et al. (1987) noted that Eastern Screech-Owls in Connecticut that responded to tape-recorded calls chose perches that concealed them from predators even while the owls were singing. The roosts averaged 4.65 m high ($n = 151$) and were usually on horizontal limbs. Hayward and Garton (1984) found that Boreal Owls and Western Screech-Owls roosted next to the trunk, where their relatively large silhouettes were less conspicuous than if the owls roosted away from the trunk.

Some high, concealed roosts of small forest owls might be undetectable from ground level unless the owls were radiotagged and the researcher persisted in searching for the owls, as done by Hayward and Garton (1984) and Belthoff and Ritchison (1990). We believe that our results, and those of many previous studies, are skewed toward low roosts. However, roosts detectable by our methods provide a good picture of the important characteristics of Saw-whet Owl roosts, even if the mean roost height is skewed low. Furthermore, the disturbance caused by radiotagging and radiotracking could cause owls to change their roosting behavior more than foot searches such as ours. Some Eastern Screech-Owls might have chosen new roost sites on most days, rather than reusing roost sites, in part to avoid the researchers (Belthoff and Ritchison 1990).

Thermal benefits of roost sites are probably more important to owls in winter than at other seasons. Studies of winter roosts of Eastern Screech-Owls (e.g., Merson et al. 1983) reveal a significant percentage of roosts in cavities, in contrast to summer studies where cavity roosts are rare (Belthoff and Ritchison 1990). Northern Spotted Owls (*Strix occidentalis*) also appear to choose some roosts for their thermal advantages, but these function to remain cool in summer rather than warm in winter (Forsman et al. 1982). If Saw-whet Owls in our study area roosted in cavities, we would not have detected this.

Saw-whet Owl observations. Saw-whet Owls usually allow humans to approach closely before flushing, making the owls seem tame (Bent 1938, McCabe 1973). However, some Saw-whet Owls are difficult to approach (Mumford and Zusi 1958). We believe Saw-whet Owls remain motionless when found to escape attention and possible predation. Austing (1958) noted that the motionless stance of Saw-whet Owls he distracted during capture operations was probably an attempt to escape detection. Owls that flushed as we walked nearby or when songbirds mobbed them would become more conspicuous than those staying on the perch (Swengel 1987). Both owls we saw being mobbed by small birds remained motionless throughout the mobbing incidents.

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