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Characteristics of Red-shouldered Hawk nests in southeast Ohio.—Studies have examined nest-site habitat of Red-shouldered Hawks (*Buteo lineatus*) in Iowa (Bednarz and Dinsmore 1981, Bednarz and Dinsmore 1982), Maryland (Titus and Mosher 1981), and southwestern Quebec (Morris et al. 1982, Morris and Lemon 1983). Red-shouldered Hawk (RSH) nesting habitat has not been studied extensively in Ohio, where the species is listed as potentially threatened (Ohio Dept. Natural Resources 1982). Here I describe the nesting habitat of RSH in southeastern Ohio, and compare habitat in Ohio with that used by this species in Maryland.

The 34-km^2 study area is mixed mesophytic forest (Braun 1961) in Hocking, Athens, and Vinton counties in the unglaciated Allegheny Plateau of southeastern Ohio. The area is characterized by deciduous forest, pine plantations, and strip mines. Topography ranges from 680 to 1010 m in elevation and is dissected by small rivers and streams. Riparian habitats are dominated by sycamore (*Platanus occidentalis*), American beech (*Fagus grandifolia*), silver maple (*Acer saccharinum*), and river birch (*Betula nigra*).

Active nest sites were found during March and April, 1979–1982, following the techniques of Craighead and Craighead (1956). Nest-site habitats were sampled during late summer 1983, using a variation of a standardized method for sampling raptor nesting habitat (J. Mosher, pers. comm.). Habitat variables were measured in 3 0.04-ha (11.3 m radius) circular plots. One plot was centered at the nest tree (nest plot) and the other 2 plots (satellite plots) were positioned randomly to the north and south or to the east and west of the nest. The distance between the center of the satellite plots and the nest tree was selected randomly between 1 and 75 m.

Twenty habitat variables were measured in nest plots and 15 variables were measured in satellite plots (Table 1). Canopy heights, nest-tree heights, and nest heights were measured by triangulation with a range finder. Distances from the center of the plot to the nearest permanent water and to the nearest forest opening (minimum size 100 m^2) were measured directly when <100 m, and they were measured on 7.5-min U.S.G.S. quadrangle topographic maps when >100 m. Percent canopy cover and percent understory cover were calculated from a total of 20 ocular tube sightings (James and Shugart 1970) for each measurement. Sightings were made along 2 perpendicular transects.

Paired t-tests (Freund 1971) were used to test for significant differences ($P < 0.05$) between the means of variables common to nest and satellite plots. The average values of the 2 satellite plots were used in these comparisons. Principal axis factoring with a varimax rotation (Harman 1967) was used to determine which variables best characterized nest-site habitat. I used Student's t-tests (Freund 1971) to compare nest-site characteristics of Ohio-nesting RSH with those nesting in Maryland.

Twelve of the 15 nests in the study were found in sycamore trees and one each was found in a tulip tree (*Liriodendron tulipifera*), a white oak (*Quercus alba*), and a river birch. Sycamore trees were used as a nest tree at a significantly higher proportion than other tree species of similar size (binomial test, $P < 0.01$).

Factor analysis revealed that 8 factors were important in characterizing RSH nest sites. The first factor accounted for 17% of the variation, and represented the number of trees with a DBH of less than 50 cm. Factor 2 explained 15% of the variation and represented nest height and percent nest height. The third and fourth factors explained 12% of the variation, respectively. Factor 3 represented trees with DBH greater than 50 cm and factor 4 represented distance to permanent water. Factor 5 explained 10% of the variation and represented canopy height and canopy cover. Factors 6, 7, and 8 together explained 28% of the variation and represented number of trees with DBH less than 50 cm and canopy height.

TABLE 1
HABITAT VARIABLES MEASURED AT STUDY PLOTS IN SOUTHEASTERN OHIO

Variable mnemonic	Description
Variables measured only at nest plots	
ALTITUDE	Altitude of plot (m).
DBH	Diameter (cm) of nest tree at breast height.
NESTHT	Nest height (m).
HTNSTTRE	Nest tree height (m).
PNSTHT	Percentage nest height − (nest height/nest tree height) × (100).
Variables measured at all 3 plots[a]	
CANHT	Canopy height (m); average of 5 measurements of canopy height in each plot.
WATER	Distance (m) to nearest permanent water.
DISFOROP	Distance to nearest forest opening.
CANCOV	Percentage total canopy cover.
UNDCOV	Percentage total understory cover.
DBH 4–8	Number of trees of 4–8 cm dbh in plot.
DBH 9–12	Number of trees of 9–12 cm dbh in plot.
DBH 13–16	Number of trees of 13–16 cm dbh in plot.
DBH 17–20	Number of trees of 17–20 cm dbh in plot.
DBH 21–25	Number of trees of 21–25 cm dbh in plot.
DBH 26–50	Number of trees of 26–50 cm dbh in plot.
DBH >50	Number of trees of >50 cm dbh in plot.
OVERTR	Number of overstory trees in plot.
UNDERTR	Number of understory trees in plot.
SHRUBDEN	Shrub density.[b]

[a] The 3 plots include the nest plot and 2 satellite plots.
[b] See James and Shugart (1970) for details.

Although Red-shouldered Hawks frequently nest in trees that emerge from the canopy, percent nest height (60%) indicates that RSH placed their nests either in or slightly below the canopy. Morris et al. (1982) suggested that this nest placement may render the nest less visible to potential predators after the appearance of foliage. Nesting within the canopy may make nesting RSH less vulnerable to avian predators such as Great Horned Owls (*Bubo virginianus*).

Another selective advantage of nesting within the canopy may be moderation of the thermal environment of the nest (Ricklefs and Hainesworth 1969, Calder 1973). The moderation of the thermal environment may involve decreased wind velocity, and, as a consequence, decreased convective heat loss to the environment. Bednarz and Dinsmore (1982) have suggested that RSH may be forced to nest in the subcanopy because of a minimum branch size required to support the nest structure.

The importance of distance to nearest permanent water to breeding Ohio RSH may reflect the dietary habits of RSH, which include small rodents, birds, snakes, insects, and particularly amphibians.

Mean values of canopy height, canopy cover, understory cover, and number of trees with

TABLE 2

SAMPLE MEANS (± SD) AND PAIRED *t*-TEST VALUES FOR RED-SHOULDERED HAWK NEST SITES AND SATELLITE PLOTS IN SOUTHEASTERN OHIO

Variable	Nest plot (N = 15)	Satellite plot (N = 15)	*t*-value
CANHT	24.9 ± 7.3	18.9 ± 5.9	2.69[a]
WATER	41.0 ± 77.8	50.1 ± 81.2	2.03
DISFOROP	20.0 ± 23.4	24.2 ± 32.9	0.05
CANCOV	84.0 ± 8.9	64.7 ± 20.9	2.91[a]
UNDCOV	71.0 ± 14.1	57.0 ± 21.0	2.38[a]
DBH 4–8	11.8 ± 9.5	14.2 ± 8.4	0.54
DBH 9–12	4.6 ± 3.0	5.4 ± 3.4	0.78
DBH 13–16	3.2 ± 2.0	3.0 ± 1.5	0.32
DBH 17–20	1.9 ± 1.4	1.9 ± 1.6	0.09
DBH 21–25	1.6 ± 1.5	1.7 ± 1.3	0.30
DBH 26–50	3.6 ± 2.6	2.7 ± 1.5	1.60
DBH >50	2.0 ± 1.4	0.6 ± 0.7	3.61[b]
OVERTR	4.6 ± 2.3	6.4 ± 3.4	1.58
UNDERTR	24.8 ± 14.0	23.2 ± 12.8	0.41
SHRUBDEN	27.9 ± 28.0	29.1 ± 21.4	0.18

[a] $P < 0.05$ using a paired *t*-test.
[b] $P < 0.01$ using a paired *t*-test.

DBH greater than 50 cm were significantly greater for the nest plots (Table 2) than for the satellite plots. Greater canopy height and percent canopy cover were associated with the greater number of overstory trees with DBH greater than 50 cm in the nest plots, indicating that RSH nesting habitat was not homogeneous.

Comparison of common habitat variables in Ohio and Maryland using Student's *t*-tests revealed that distance to forest opening was significantly greater ($P < 0.01$) in Maryland. Percent canopy cover and number of trees with DBH greater than 50 cm were significantly greater in Ohio ($P < 0.05$). The greater distance to forest opening in Maryland probably reflects a difference in study sites. The Maryland study site is extensively forested. The Ohio study site is characterized by small residential communities, primary roads, secondary roads, and large wood lots. Large contiguous forested tracts in southeastern Ohio typically occur only along rivers and streams.

This study indicates that Ohio RSH place their nests in mature riparian forests where they use large diameter trees for nesting and have large open hunting areas in close proximity.

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Sprig delivery by Broad-winged Hawks.—Adults of many species of nest-building Falconiformes place fresh green sprigs on their stick nests (Wimberger 1984). Although numerous functions for greenery on nests have been proposed (Olendorff 1971, Newton 1979), there are few published accounts of sprig delivery, and these records are based primarily on incidental observations. This report provides details of sprig delivery by Broad-winged Hawks (*Buteo platypterus*), and supplements previous observations (Burns 1911, Matray 1974, Bush and Gehlbach 1978, Rosenfield 1982).

Methods.—The study was conducted during the 1981 and 1982 breeding seasons in Allegany and Garrett counties, Maryland. Study sites and Broad-winged Hawk nest-site habitat are described in Titus and Mosher (1981).

We used a 15–60× spotting scope, and monitored sprig deliveries from blinds at three nests from 11 days posthatch until nestlings first left the nest (31–33 days). Hatch dates (±24 h) were known at one nest, and an age-estimation model (Lyons and Mosher 1983) was used to determine the age of nestlings at two nests. Observation periods of 275 min were randomly prescheduled between 06:00–21:00.

We distinguished individuals of a mated pair either by the presence of blue dye on breast feathers or by naturally occurring plumage characteristics. The sex of birds was determined by comparing observed parental behavior with that described by Matray (1974), who sexed trapped birds according to the presence or absence of a brood patch.

In addition to these observations, eight nest trees each were climbed from 1–12 times (47 total visits) from late incubation to fledging in 1981, and the presence of fresh greenery in nests was recorded. Twelve different nests each were visited 1–13 times (66 total visits) over