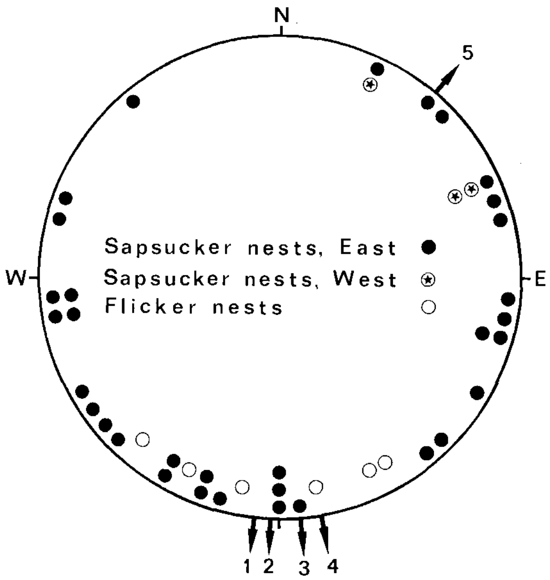

FIGURE 1. The circular distribution of nest entrance holes. Mean directions are indicated as follows. #1 = mean for all nests; #2 = mean for all flicker nests; #3 = mean for sapsucker nests on the east side of the valley; #4 = mean for sapsucker nests; #5 = mean for sapsucker nests on the west side of the valley.

3.5 cm in diameter, and did not exceed 4.0 cm. Those built by flickers were invariably 5 cm or larger in diameter.

Orientation of nest entrance holes was nonrandom (fig. 1). The mean orientation for all nests was close to due south (table 1). Because there was no prevailing wind in the study area, orientation was unlikely to correlate with wind direction, but may have been correlated with the position of the sun. The East River Valley runs principally north–south in the vicinity of Gothic. Thirty-nine of 42 nests were on the east side of the valley. The orientation of the three on the west side suggests that the mean orientation may have differed for nests from the east side of the valley and the west side (table 1). A tendency to nest along the edges of aspen forests or the edges of clearings also increased the amount of incident solar radiation.

By measuring temperatures inside the trunk of an aspen tree at an elevation of 9300 ft in Colorado, Derby and Gates (1966) determined that temperatures are significantly higher in the part of the tree facing the sun during daylight hours. The temperature difference between the two sides of the tree is as much as 12°C. Although these results were obtained before leaves emerged, enough difference might persist after the leaves grew to affect the thermal economy of adults and nestlings in hole-nesting species. The importance of direct solar radiation might also influence the choice of nest trees on the edges of forests. The benefit conferred upon incubating birds or nestlings by a nest that receives a maximum amount of sunlight through the entrance may thus be of some importance in their energy budgets.

Sapsuckers constructing a nest might also feed on the sap that flowed from around the hole. Sap flow would presumably be greatest on the warmer south side of a tree (Crafts and Crisp 1971, Canny 1973). Because insect food is presumably scarce early in the season when sapsuckers are beginning to build nests, sap may be an important source of food during the long task of nest construction.

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SHARP-SHINNED HAWK NESTING AND NEST SITE SELECTION IN UTAH

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During the breeding seasons of 1971 and 1972, I examined 27 nestings of Sharp-shinned Hawks (*Accipiter striatus*) in Utah. An additional 34 Utah nests have been described in the records of egg collectors and in published works (Johnson 1897, Osprey 1:150; Westbrook 1913, Oologist 30:66–67; Wolf 1928, Oologist Record 8:90–102; Behle et al. 1958, Univ. of Utah Biol. Ser. 11:1–92; Frost, pers. comm.).

The second-hand reports noted the kinds of trees used for the hawk nests. Of these, 44% were in coniferous trees (*Abies concolor, Juniperus scopulorum, Picea* sp., and *Pseudotsuga menziesii*), 21% in cottonwood trees (*Populus angustifolia*), 12% in maple trees (*Acer grandidentatum, A. glabrum*), 12% in oak trees (*Quercus gambelii*), and 12% in four other deciduous trees (*Acer negundo, Prunus virginiana*, var. *melanocarpa, Salix* sp. and "a bush").

I recorded data on community composition for the

27 nests I found. Eighty-five percent of these were also in conifers, but 65% of the conifers used were in small groves in the midst of a deciduous stand, not in predominantly coniferous stands. Of the four nests in deciduous trees, only one was situated in a tree of the predominant species around the nest site.

I found no nests in lone trees or even in open stands. Nest sites were characteristically in dense stands with a well-developed canopy, but below the top of the canopy. Nest trees consistently had dense foliage; conifers are evidently selected for this reason. Two of the deciduous trees used were diseased, with abnormally dense growth. Two trees growing with their trunks nearly touching were used in three instances. The most common nesting site I found consisted of grouped or scattered conifers in a stand of taller deciduous trees.

Adult Sharp-shinned Hawks appeared at the nest sites up to four weeks before eggs were laid. On the southern border of Utah (Washington County), the hawks began nesting 15–20 days earlier (second week of May) than those 350 miles north (Cache County). In central Utah (Beaver and Utah counties), eggs were laid during the fourth week in May, while in northern Utah (Cache and Box Elder counties) eggs were laid during the first week of June. Laying dates for the same territory in consecutive years have been known to vary as much as seven days. In only one case was the same nest used in consecutive years. However, groves are commonly re-used and may contain as many as five old nests.

In the 34 nests reported before my studies, average clutch size was 4.3 (range 3–5) eggs. Eggs are laid on alternate days, but hatching of five eggs may occur within a period of 36 hours, indicating that incubation does not begin until the clutch is complete. At two nests that were examined before the clutch was complete, hatching occurred 30 days after the last egg was laid (K. Tuttle, pers. comm.). This is six days longer than the maximum period suggested by Bent (1937, Life histories of North American birds of prey, Pt. 1, U. S. Nat. Mus. Bull. 167, p. 99).

Young males fledged when 24 days old while females required 27 days.

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THE INFLUENCE OF EARLY LEARNING ON NEST SITE SELECTION IN THE HOUSE SPARROW

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The use of open tree sites for nesting in the House Sparrow (*Passer domesticus*) appears to be related to the availability of other more protected sites, although it is also more common in the warmer portions of the species' range (Summers-Smith, The House Sparrow, Collins, London, 1963). Building of tree nests in the absence of suitable nesting cavities is not always the case, however. Tree nests have been built when holes were readily available (Greve, Ornithol. Mitt. 10:176, 1968). One testable hypothesis that might help to explain this exception is that fledgling sparrows become imprinted on, or learn the characteristics of, the nest they are reared in, or the type of structure supporting the nest, and they in turn tend to build that type of nest as breeding adults. To test this hypothesis, I conducted the following experiment.

A colony of 40 nest boxes was erected on out-buildings on a farm about five miles NNE of Lawrence, Kansas, in Jefferson County during the spring of 1973. House Sparrows had already been nesting there in cedar trees and in cracks and crevices of out-buildings. A similar colony of nest boxes was already in place on a farm about one-half mile south of this location on the University of Kansas Nelson Environmental Studies Area. Nestlings banded here served as controls.

I categorized nests on the study area as box, tree or crevice. I considered crevice nests distinct from box nests because often they were not totally enclosed on four sides and could be either domed over or not. They were sufficiently different from either tree or box nests in construction and placement that they might provide nestlings with different learning cues. Nestlings of the same age (usually less than one week) were transferred from one type of nest to another. Different colored markings were applied to the tarsi of nestlings with felt-tipped pens so that they could be distinguished from one another. Colored plastic leg bands were applied as the nestlings became large enough. Brood size was not altered in any of the nests. Notes were kept on brood size, desertions, rejections of transferred nestlings, survival of young and dispersal of juveniles in late summer and fall. I observed the banded individuals in the following breeding season to determine the type of nest they occupied.

One hundred fifty nestlings (50 from each nest type) were transferred and banded. An equal number from each nest type were banded in the control area. Fledging success was surprisingly high (70.7% for experimentals and 76.7% for controls) but the number of juveniles returning to breed on the two areas was small (24.7% and 30.7%). Mortality and a high emigration rate appear to be the primary sources of loss for the two areas. There was only one desertion and only two nestlings were known to have been thrown out of the nest of a foster mother. Table 1 summarizes the outcome of the experiment.

Fledging success of sparrows in tree nests was slightly lower than from either box or crevice nests (66% vs 74% and 72% in the experimentals; 72% vs 80% and 78% in the controls). Hence, fewer sparrows that might have learned the characteristics of the tree nest were contributed to the population. This difference is not significant however (chi square test, $P > 0.05$), and approximately the same number of House Sparrows from each nest type were found in the breeding population the next spring.

The difference in numbers between sparrows choosing the natal type of nest site over other types in the experimental population appears to be negligible. Considering the males and females together the differences for all nest types were not statistically significant ($\chi^2 = 0.887$, df $= 2$). Similarly, there were no significant differences between nest types chosen