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Utilization of Nest Boxes by the Southern Flying Squirrel, *Glaucomys volans*, in Central Arkansas

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ABSTRACT

Thirty-five nest boxes were placed 4.5-5.5 meters above the ground in an eight acre mixed pine-hardwood plot 20 km SE of Bryant, Saline County, Arkansas. These boxes were monitored from February, 1972, to May, 1975. Flying squirrels used the boxes between October and May, probably returning to den trees during the hotter period of the year. A total of 30 squirrels (18 males and 12 females) were marked by ear notching during the three year period. The winter population of the study area was estimated to be between 10 and 15 squirrels. It was not uncommon to find eight or more squirrels in one nest. There were five litters born in nest boxes during the study, with an average of two young/litter. Examination of other females during January and February, together with these litters, indicated that all spring litters were born during March. Boxes served either as nesting areas or feeding stations. Nests were composed of shredded bark with a moss base and often filled a box to a depth of 8 or more centimeters. Acorns were the major food item, with sweet-gum balls, immature pine cones, and insects also being utilized. Between April and October, the boxes were utilized most extensively by gray tree frogs, red wasps, dirt-dauber wasps, wood roaches, wrens, and black rat snakes.

INTRODUCTION

Studies dealing with various aspects of the natural history of the southern flying squirrel, *Glaucomys volans*, point out some differences between the northern and southern populations, particularly in the areas of reproduction and food habits (Sollberger, 1940, 1943; Booth, 1946; Moore, 1947; Jordan, 1948; Goertz, 1965; Muul, 1965, 1968, 1969, 1970; Avenoso, 1968; Weigl, 1969; and Goertz *et al.*, 1975). This study was begun in 1972 to provide information on the biology of the flying squirrel from the southwestern part of its range which, except for the work of Goertz *et al.*, (1975) in Louisiana has received little attention.

STUDY AREA

The study area consisted of an eight acre portion of a pine-hardwood forest located 20 km SE of Bryant, Saline County, bordered by a tributary of Duck Creek 90 m to the west and a road 50 m to the east. The forest overstory (trees in excess of 10 m) consisted of approximately 525 trees proportioned as follows: 67% oak (*Quercus* sp.), 17% sweetgum (*Liquidambar styraciflua*), 10% pine (*Pinus* sp.), 3% black gum (*Nyssa sylvatica*), 2% Maple (*Acer rubrum*), and 1% hickory (*Carya* sp.). The following vines were present: pipe vine (*Aristolochia tomentosa*), muscadine (*Vitis rotundifolia*), and wild grape (*Vitis palmata*). The understory (trees and shrubs between 1 and 10 m) consisted of approximately 950 trees, with the most numerous being sweetgum, maple, oak, elm (*Ulmus* sp.) and ironwood (*Ostrya virginiana*). A few hickory, black gum, ash (*Fraxinus* sp.) and sassafras (*Sassafras albidum*) were also found. Ground cover (seedlings, shrubs and herbs less than one meter in height) consisted primarily of honeysuckle (*Lonicera* sp.), poison ivy (*Rhus radicans*), and saw briar (*Rhus* sp.) with holly (*Ilex opaca*), cane (*Arundinaria giganka*), fern (Div. Pterophyta), huckleberry (*Gaylussacia* sp.), and muscadine vines scattered and in small numbers throughout the area. This low vegetation covered 36% of the total area. The remainder was littered with decaying leaves and branches.

METHODS AND MATERIALS

Thirty-five nest boxes were placed in the study area in a grid pattern consisting of 7 rows (5 boxes per row) extending from the north edge to the south edge of the area. The boxes were spaced approximately 8 meters apart at an average height of 4.5-5.5 meters in various species and sizes of trees. Nest boxes, constructed of rough oak, had inside dimensions of 30 x 30 x 15 centimeters. The front was

hinged for easy inspection and a hole 4 cm in diameter was drilled 5 cm from the top of the door.

The boxes were set out in February, 1972, and monitored through May, 1975. Between September and June of each year they were checked every two weeks; however, during the remaining months they were only spot-checked as the squirrel usage decreased drastically. Utilization of the boxes was categorized as follows:

1. No Use - if the boxes were never utilized by the squirrels or if less than 5 middens per box per inspection were found.
2. Feeding Station - if numerous remains of food were found and continued use over 3-4 months was observed.
3. Nesting - if the squirrels constructed and used nests in the box.
4. Changing Use - If the use of the box changed over a several month period.

When captured, the squirrels were anesthetized with ether and marked by ear notching. Both general and reproductive conditions were noted, and the weight and standard measurements were recorded. Other pertinent information was also noted, such as other squirrels present. The squirrels were then returned to the box from which they were removed.

RESULTS AND DISCUSSION

Movements and Grouping

During the course of this study a total of 30 squirrels (18 males and 12 females) were marked. Several more were observed but not marked for various reasons such as their escaping capture. Nineteen of the marked animals were recaptured during the study. Three of these were young and, after weaning, were never again observed. Of the other 16 (8 males and 8 females), the males were recaptured an average of 4.0 times/squirrel; the females, an average of 6.0 times/squirrel. This latter figure is somewhat misleading since one female squirrel was recaptured a total of 17 times between March, 1972, and May, 1974. If this squirrel is not included in the total, the females were recaptured an average of 4.4 times/squirrel.

Squirrels were captured in all parts of the area with no apparent preference for size or type of tree. Goertz *et al.* (1975) found a habitat preference for pine-hardwood over trees in pastures and strictly hardwood areas. This might explain the high and apparently stable population of squirrels (estimated at between 10-15 animals) in the study area.

During the hottest part of the year (June-August) no squirrels were captured in the boxes. Other forms of box utilization (e.g. feeding) also decreased during this time. Between September and May, squirrels were found in groups of 1-12 with a mean of 3.9 squirrels. Howell (1918) has reported cold weather aggregations of up to 50 squirrels in one nest. Muul (1970) found up to 19 adults in one nest during cold weather with average groupings of 5.7 in cold weather and 1.3 in warm weather. Goertz *et al.* (1975) found a maximum of 10 in cold weather with an average of 3.2 adults per group. The data from this study closely parallel Goertz's and both probably reflect the difference in overall climate between the northern and southern parts of the squirrel's range.

Nesting and Reproduction

Table 1 summarizes the use of boxes for nesting purposes by the flying squirrels. Nest construction was similar to that described by Goertz *et al.* (1975), except that the base layer usually consisted of moss in addition to leaves. In this study the base layer ranged from 1-5 cm in depth and was covered by shredded bark, often extending to within 2-5 cm of the top of the box. Nesting material included grasses, pine needles, hair, and chips of outer bark in addition to the basic leaves, moss, and shredded bark.

In those boxes where the nest extended to the top, squirrels usually were buried in the nesting material. In a shallow nest they usually were huddled in a cup-like depression in the center of the nest. In nests containing young, the nesting material became matted down as the young grew larger, an observation which agrees with Goertz *et al.* (1975) and Muul (1968).

Female squirrels in this study were observed to come into estrus and mate in late January and early February. Young were born during the first half of March. During the study, a total of 5 litters were observed containing 1-3 young/litter with an average of 2.0. These data confirm earlier observations that litter sizes are larger in the northern part of the range (four or five [Howell, 1918], two to five with an average of 3 [Sollberger, 1943], two to five [Muul, 1970]) than in the southern part (1 to 4 with an average of 2.1 [Goertz *et al.*, 1975], and a maximum of 4 [Moore, 1947]).

As has been reported previously (Sollberger, 1943; Goertz, 1965; Muul, 1969; Goertz *et al.*, 1975) there is also a late summer breeding period, although of lower intensity than that in the spring. I found a few immature squirrels in October and November, having measurements and weight expected of individuals born in August or early September. Nest boxes were not used during this late summer breeding period.

Food Habits and Feeding Stations

Table 1 summarizes the use of boxes as feeding stations by the flying squirrels. Box use varied from light (a few middens) to extremely heavy (midden depth 10-13 cm). Midden remains included acorns, seedless sweetgum balls, immature pine cone cores and bracts, and insect remains. Acorns were most heavily utilized. These major food items are correlated with those found by Goertz *et al.* (1975).

In keeping with the findings of Goertz *et al.* (1975) and Avenoso (1968), no food caches were observed, while in the northern parts of the flying squirrel's range food caches have been found (Sollberger, 1940; Muul, 1965, 1968). These findings seem to confirm Goertz *et al.* (1975), Weigl (*pers. comm.*), Avenoso (*pers. comm.*) and my conclusion that the milder winters, the alternate foods, and a greater ease of obtaining mast in the southern part of the range do not necessitate any sort of food caching.

Utilization of Boxes by Other Species

Numerous other species utilized the boxes over the study period (Table 2). In two boxes gray squirrels were able to enlarge the box opening to the point that they could occupy the box, at which point no further evidence of flying squirrel utilization was found. During the spring when birds nested in several of the boxes, flying squirrels were possibly excluded. The black rat snakes probably served as predators on the flying squirrels; however, they were only found in late spring through early fall when the flying squirrels usage of the boxes was decreased.

SUMMARY

This study has provided additional information on the biology of the flying squirrel in the southwestern part of its range. The data illustrate differences between populations living under different climatic conditions and reveal the importance of studies covering all portions of a species range.

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Table 2. Organisms Other Than Flying Squirrels Utilizing Nest Boxes

Phylum Mollusca	
Class Gastropoda	
Slugs	
Phylum Arthropoda	
Class Insecta	
Order Hymenoptera	
Mud-daupers - <i>Vespula</i> sp.	
Yellow-jackets - <i>Vespula</i> sp.	
Red-wasps - <i>Polistes</i> sp.	
Ants	
Order Siphonaptera	
Fleas	
Order Orthoptera	
Camel crickets - <i>Ceuthophilus</i> sp.	
Wood cockroach - <i>Paroblatta</i> sp.	
Phylum Chordata	
Class Amphibia	
Gray tree frog - <i>Hyla versicolor</i>	
Class Reptilia	
Broad-headed skink - <i>Eumeces laticeps</i>	
Six-lined racerunner - <i>Cnemidophorus sexlineatus</i>	
Black rat snake - <i>Elaphe obsoleta</i>	
Class Aves	
Wren - <i>Troglodytes aedon</i>	
Class Mammalia	
Gray squirrel - <i>Sciurus carolinensis</i>	
Small rodents - <i>Peromyscus</i> sp.	

Table 1. Nest Box Utilization By Flying Squirrels, *Glaucomys volans*

Type of Utilization	Number and Percent of Boxes Used				
	sp. 1972	1972-73	1973-74	1974-75	Mean
No Use	13 (37%)	13 (37)	12 (35.3)	8 (24.2)	11.9 (34.6)
Feeding Stations	10 (28.6)	12 (34.3)	16 (47.0)	15 (45.5)	13.2 (38.5)
Nesting	7 (20.0)	7 (20.0)	7 (17.7)	7 (21.2)	6.7 (19.5)
Changing Use	4 (11.4)	2 (5.7)	0 (0)	3 (9.1)	2.2 (6.4)
Total Boxes in Use	35	35	34	33	34.5

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