

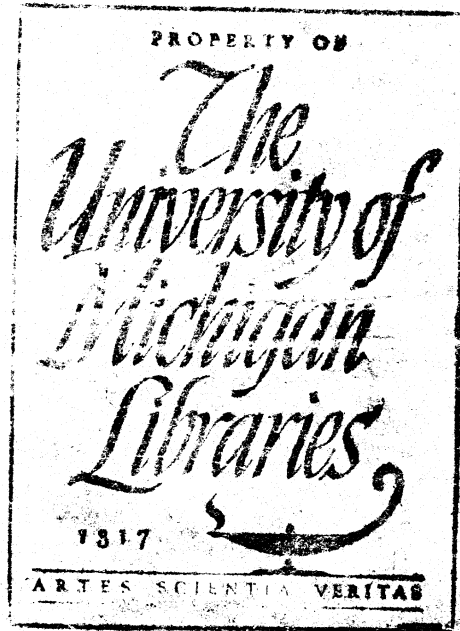
University of Michigan
A Midsummer Study

of

The Eastern Flying Squirrel

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of
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COMMON FLYING-SQUIRREL

'During the half hour before sunset nature seemed to be in a state of silence and repose. The birds had retired to the shelter of the forest. The night-hawk had already commenced his low evening flight, and here and there the common red bat was on the wing; still for some time not a Flying-Squirrel made its appearance. Suddenly, however, one emerged from its hole and ran up to the top of a tree; another soon followed, and ere long dozens came forth, and commenced their graceful flights from some upper branch to a lower bough. At times one would be seen darting from the topmost branches of a tall oak, and with wide-extended membranes and outspread tail gliding diagonally through the air, till it reached the foot of a tree about fifty yards off, when at the moment we expected to see it strike the earth, it suddenly turned upwards and alighted on the body of the tree. It would then run to the top and once more precipitate itself from the upper branches, and sail back again to the tree it had just left. Crowds of these little creatures joined in these sportive gambols; there could not have been less than two hundred. Scores of them would leave each tree at the same moment, and cross each other, gliding like spirits through the air, seeming to have no other object in view than to indulge a playful propensity. We watched and mused till the last shadows of day had disappeared, and darkness admonished us to leave the little triflers to their nocturnal enjoyments.' — *The Quadrupeds*, vol. 1, p. 218.



Drawn from Nature by J. Audubon, F.R.S.E.L.S.

PTEROMYS VOLUCELLA, GMEL.
COMMON FLYING SQUIRREL.

L. S. JACOBI, S. A. ZIMMERMAN, A. TOWN.

Engraved & Col'd by J. T. Bowen, Philad. 1843.

Introduction

At the outset of this study I had no way of knowing that the area I had chosen would produce the desired information. It was the general appearance of the woodlot and its proximity to Ann Arbor that favored my decision, for the lack of transportation was the limiting factor in any choice. I knew that it would be necessary to visit the study area twice daily; once in the evening to set traps, and again in the morning to examine them. The Campbell woodlot solved the transportation problem.

The reader may wonder why the flying squirrel was elected for purposes of study. A wildlife manager is usually concerned with game species, fur-bearers, or those animals which may have a predacious effect upon either. The flying squirrel is certainly not a game species, nor is there likelihood of its ever becoming one. Its small size and nocturnal habits are, in this case, its shield of protection. The choice was motivated by plain curiosity, plus a more mature desire to secure, if possible, information of the most general sort that was not obtainable from the literature.

The literature is not extensive on the life history of this squirrel. More has been written on the life history of the migratory Song Sparrow than on this common resident of our backyard woodlots. To my knowledge, there is but one paper that deals with sex ratios and home range. When does the flying squirrel breed? Do the young of the year produce both a spring and summer litter as yearlings? Is there a fall shuffle of populations? What is the turnover in any population of flying squirrels? Is this squirrel active throughout the winter, or does it remain inactive during periods of severe weather? These and many other questions are, as yet, inadequately answered.

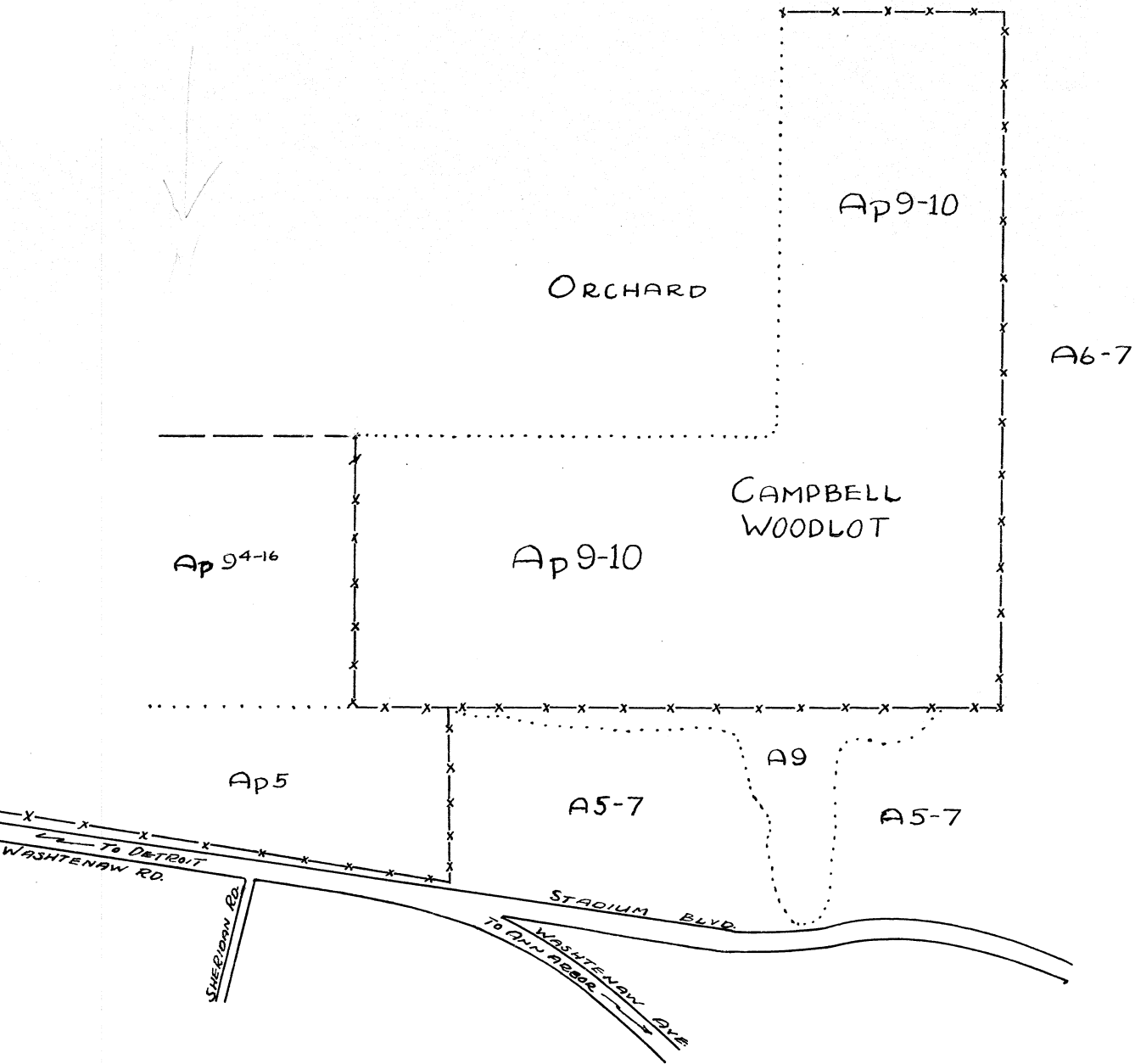
I did not expect to solve any of the above "mysteries" in

a midsummer study. However, from the few observations I have made, I believe that it is possible to project one's thoughts into the space of time which precedes and follows midsummer, and thereby deduce that which must occur in the lives of these squirrels.

STUDY AREA

CAMPBELL WOODLOT & LOWER SPUR

PITTSFIELD TWP., WASHTENAW CO.
AUGUST 1946



SCALE 1" = 5 Chns.

LEGEND

— HIGHWAY
-x- FENCE

..... WOODS B'DRY

TYPE SYMBOLS FROM S.A. GRAHAM'S "ECOLOGICAL CLASSIFICATION OF COVER TYPES"

The Area Studied

The Campbell woodlot is located just outside the city of Ann Arbor, its north border lying a few hundred feet south of the junction of Washtenaw Avenue with Stadium Boulevard. It is admirably situated to meet the needs of wildlife students interested in the study of small mammals. A contiguous woodlot of about 12 acres lies to the east. It has been heavily overgrazed and no oak-hickory reproduction is permitted to survive. Though the Campbell woods are grazed, they show less of this abuse than the above. There are portions of the central and west sections where reproduction has been replaced by a heavy growth of grass cover, and a comparison of grass with underbrush as it influences flying squirrel habitat is made in the following pages.

The Campbell woods comprise about 28 acres, as determined by pacing the boundaries with the aid of a compass. All distances were determined by pacing alone. The lower spur of oak-hickory woods lying outside the fence was included in the area since it is of the nature of a shelterbelt, and I was interested in its possible use by flying squirrels.

The woods are in the period of succession that approaches a beech, hard maple and basswood climax. As it exists today, it is predominantly of oaks and hickories. My estimates show red oaks to be greatest in number, followed by hickories, white oak, black oak, white ash, elm (both americana and fulva), hop-hornbeam, and basswood. Black walnut, red maple, and bur oak are common admixtures. Black ash, black cherry, and sassafras occur with less frequency.

In the spring, and probably during heavy rains, water flows through natural drainages in the lower and upper sections of the woods. At present, there are no active streams or springs within its boundaries. Free water is evidently not a requirement of flying squirrels.

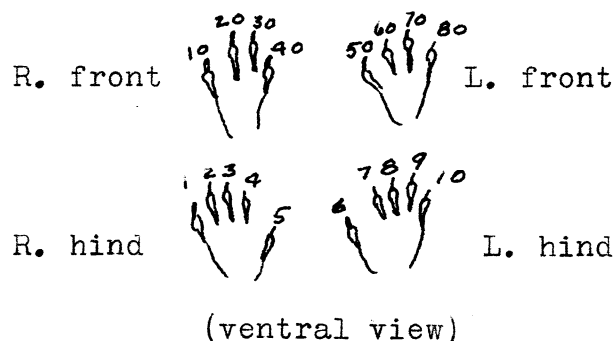
The topography is varied between upland and lowland, and there is little monotony in any one type.

The Mechanics of Securing Information

The methods or techniques used in the study were based upon those proved successful with small mammals. Three types of live traps were used. Those capturing the largest number of individuals were of the self-locking type, though the supply of these was greatest. The easiest to set were of the Sherman type but offered an avenue of escape to the captives since they did not lock upon closing. The woods were trapped in four sections and in the following order: The east end, central and west section, the southern block, and finally, the lower spur and its extensions along the fence. Originally, I attempted to place the traps in rows, one chain apart and with two chains between rows, but I modified this method in favor of placing traps in the most favorable spots, or what I considered so.

The period of field work extended through 30 consecutive days, from July 12 to August 10. Ninety-nine hours were spent in the field and 21 hours consumed in travel to and from the area. Traps were set 23 nights during the period for a total of 901 trap nights.

A method for handling squirrels was devised after an idea used by Stuewer (1943:207) in handling raccoons. A cone of $1\frac{1}{2}$ " mesh hardware cloth was constructed with the open end $3\frac{1}{4}$ " in diameter. Squirrels readily entered the cone from the trap and moved toward the small end, becoming securely held after a handkerchief was stuffed in behind them. The foot was then easily led through the mesh and the distal phalanx clipped according to a predetermined formula. The formula used is illustrated as follows:



Following the marking, the squirrel was maneuvered into a small bag placed over the open end of the cone and then picked out with the gloved hand. Such data as breeding condition, pelage color, apparent health, parasites, and actions were noted

at this time. They were then released and their further activities observed. It was seldom possible to locate home dens, for these animals are difficult to follow as they move through the maze of leaves and branches high in the oaks and hickories. Glides were rather easily observed, but at times a squirrel would forsake an attempt to reach home in favor of observing my activities which, in turn, were bent upon discovering his whereabouts. I might add that it is difficult to beat a squirrel at his own game. Whether or not a den is used merely for refuge is easily determined. If later attempts to rouse the occupant are unsuccessful, one may conclude that the squirrel was only enroute to the home site. Two home dens were located in snag trees and the occupants were flushed out on several different days. However, there were also days when the squirrels were absent from these nests, which may lead one to ponder the possibility of more than one home den. The data gathered is too meager for a positive statement. Dens of both types high in the oaks were left for later investigation when time and equipment are available.

Flying Squirrel Numbers

No flying squirrels were captured until the second night of trapping when one female was secured. In all, 32 individuals were captured over 23 nights. Ten of these 32 were captured but once; the remaining 22 were retaken 51 times. The east end of the woods proved most productive, but the arrangement of traps was such that they drew upon surrounding, untrapped areas. The first night or two in a new area resulted in the heaviest catch of wood mice (Peromyscus leucopus noveboracensis). Being a nocturnal associate of the flying squirrel these mice ruined large numbers of trap sets, but I found it possible to reduce the disturbance of traps by removing the mice as they were captured. My notes show approximately 180 wood mice taken. Only four shrews (Blarina brevicauda talpoides) were captured, all of them dead by morning. Two red squirrels (Sciurus hudsonicus loquax) were caught, both males, and may actually have been the same individual.

I have reason to believe that I succeeded in capturing very close to the total adult population of flying squirrels in these woods. A graphic curve of the catch in each area would show a high point during the middle of the trapping period, with low points at the beginning and end of the same period.

Each of the 11 squirrels taken in the upper block of the woods was recaptured at least once. Also, I determined the range of these squirrels to be consistently large enough to include ~~an~~ an area covered by no fewer than 8 traps.

With one exception, population figures by areas do not seem to exist in the literature. Burt (1940:48) captured 45 flying squirrels on the Edwin S. George Reserve, near Pinkney, Michigan. From a single plot of woods 3.72 acres in size, he took 6 individuals over the period June 29 to August 14.

There are many scattered accounts of the abundance of flying squirrels. Kennicott, Bachman, and Smith (all quoted by Seton, 1929:372) attest to the large numbers occupying the same den. Bachman, (1847:218) from a single observation point, witnessed upwards of 200 of these animals cavorting through the trees. Dr. J. Schenck (quoted by Howell, 1918:8) ran 50 of them out of one den. Their gregariousness must reach a zenith in winter when the desire for warmth brings them together in large numbers. But such heavy concentrations as are mentioned here were not noted in the Campbell woodlot. The pattern of captures indicates an overlapping of ranges but indicates, as well, that the centers of range for most flying squirrels are far enough removed from one another to question the possibility of 10 or 15 individuals utilizing the same home den.

Habitat

A clear conception of flying squirrel habitat may be gathered from the foregoing section on composition. However, an effort was made to localize preference within the 28 acres. Fifty-nine trap locations were successful in making 83 captures. The description of habitat immediately surrounding all trap locations was recorded, but to simplify the analysis and show positive preference, only the types of habitat surrounding successful traps are presented. All but six of the fifty-nine were placed on the ground. None of the six was placed higher than 5½' above ground. Heretofore, the general belief was that traps must be placed above ground to capture any more than an occasional squirrel.

Traps Successful---59

By location:

Ground-----53

Stump or Fork-- 6

By species of the trap trees:

Red oak-----32
 White oak----- 9
 Black oak----- 8
 White ash----- 4
 Snag trees----- 2
 Elm----- 1
 Basswood----- 1.
 Hickory----- 1
 Red maple----- 1

By average DBH of trap trees:

Red oak-----15"
 White oak-----12
 Black oak-----13
 White ash-----13
 Snag trees----- 9
 Elm-----14
 Basswood-----10
 Hickory-----18
 Red maple-----22

By average DBH of all trap trees---14"

By density of immediate Stand:

Heavy----3
 Medium---41
 Light----10

By density of immediate underbrush:

Heavy---- 9
 Medium---21
 Light----13
 Zero-----16

By species occurring in immediate habitat of trap location.

Times Present:

Oaks-----52
 Hickories----46
 Ash-----16
 Elm-----8
 Hop hornbeam-6
 Basswood-----3
 Maple-----3

A few facts may be safely drawn from the above tables, but only a few. There are too many variables in the habitat to attempt to "feed" observations into a comptometer and come out with nice, clear-cut answers. The data does suggest that flying

squirrels frequently make foraging trips to the ground, though it is well known that they cannot match red, gray, or fox squirrels in speed of travel on the ground. Another fact apparent is that they prefer large trees. My direct observations confirm this. They repeatedly choose to glide to large trees. The corrugated bark and height of these trees enables them to move quickly and glide far. Oaks are preferable, but perhaps only because they are most abundant.

The species of trees in the immediate area of capture may give us a further insight to habitat preference. Density of stand may indicate that with medium spacing a good mast crop is produced. If we refer only to the tables, the density of the underbrush seems to have little effect upon activity. However, the ground cover at the west end of the woods is primarily of grass, and though it covers over four acres, only two squirrels were captured throughout. It appears that a continuous lack of underbrush discourages occupancy by flying squirrels. Fox squirrels are not so limited. It may also be of interest to note that fewer captures of wood mice were made in this area devoid of underbrush.

Sex Ratios and Breeding Condition

Again, with but one exception, I find no mention of sex ratios in the literature. Burt (1940:48) secured 27 males and 18 females on the George Reserve, a ratio of 3:2. He doubted that this represented the true ratio. The Campbell woods yielded 32 squirrels; 17 were females and 15 males. I believe that this is closer to the true ratio among adults. Mayr (quoted by Hochbaum, 1944:50) has classified sex ratios as follows:

Primary---The proportion of sexes at fertilization.

Secondary--The proportion of sexes at time of birth.

Tertiary--The proportion of sexes during adult life.

On the basis of genetics, a 50:50 sex ratio is expected at fertilization (Hochbaum, loc. cit.:50).

If the ratio is even at fertilization, the factors of mortality that follow are almost equally effective against both sexes of flying squirrels. The upper block of woods yielded 11 squirrels: 7 females, 4 males. The remainder of the area produced 10 females and 11 males. The population of the upper block, on the basis of captures, did not visit the remainder of the woodlot, nor was their range (with one exception) utilized by the other 21 squirrels. The exception was an

individual which was captured on the edge of the upper block, and whose home den was located close by.

A still further breakdown of the sexes may offer somewhat more support to my contention that a 50:50 ratio is more normal. I separated adults into two classes: Young Adults, and Adults. It was easier to separate females into these two classes. If the teats were small, difficult to find, or impossible to find, it was taken to mean that the female had not yet bred and was therefore a young adult. Those whose teats were long and rough were classified as adults which had bred at least once. Pelage color sometimes assisted in deciding the classes in both sexes. The older the squirrel the more red is the back pelage. Young Adult males were those whose scrotum was small, the fur covering it dense and white, or the scrotum was not found by manual examination. Adult males had a scrotum which was obvious upon visual examination and the fur covering it thin, slightly black, or largely black. The combination of all these factors permitted a fairly rapid classification. The results are as follows:

Young Adults	
Females--7	Males--6
Adults	
Females--10	Males--9

Such a classification does not consider adult females that have failed to breed, although physically capable of doing so. Such females would appear as Young Adults.

I have not admitted the possibility of having captured ^{important} young of the year. There are several reasons for this; the most is based upon the assumption of a somewhat arbitrary date for the birth of the spring litter. Many scattered accounts indicate a wide period of time covers the breeding phase and also the birth of litters. Seton (1929:378) states that the mating season of volans is mid-March. Hamilton (1943:240) says it is from late February to mid-March; and again in June or July. Howell (1918: 8) implies that it is late February or March and a second in June or July. Kelker(1931:166-167) observed amplexus in a pair of flying squirrels on March 12, at Saginaw Forest, near Ann Arbor. Evermann and Clark (quoted by Seton, op.cit.:378) in Indiana, say it occurs in spring, "...about sugar making time".

The birth of litters appears to last from April to June, and a second from July to September. J. W. Stack (1925:128-129) at East Lansing, observed 4 young no more than a third grown on May 20. In New York, Merriam (1884:201) found 3 half-grown young on April 30. On the Edwin S. George Reserve, Landwer (1935:67) found 3 or 4 young on August 11. The work of Burt

(1940:48) on the George Reserve, leads him to believe that the young are born in May and June.

Ruth D. Svihla (1930:211-213) had a captive female that gave birth to a litter of 4 on October 8. On November 7, the eyes opened on all four. It was November 26 before all were out of the nest box, and on December 8, they were still nursing. It was eight months before they were scarcely distinguishable from the parent. Admittedly, this is a captive litter. But the fact remains that it was a month before the eyes opened and 7 weeks before the young ventured outside the nest.

I believe that the young of the year may be recognized when three months old. If this is true, then any squirrels born at the Campbell woodlot after April 15 would have been recognized as young of the year. None were so recognized.

Allen(1943:118) writes that it is about 3 months before young fox squirrels venture to the ground, at that time weighing from 10 to 14 ounces, about half the weight of the average adult.

None of the adult females taken at the Campbell woods were lactating.

General Observations

No concerted attempt was made to determine home ranges but those squirrels that were captured several times covered distances which may contribute some information on their usual cruising radius. Of 22 squirrels repeating, the diameter of range extended from about 45 yards up to a little less than 160 yards, most of them covering the latter distance. One male traveled 175 yards between traps. In this particular woodlot the range is not large, nor does there seem to be necessity for extensive range.

The flying squirrel is a very gentle animal under ordinary circumstances. Not always did they attempt to hide after being released. Some seemed not at all alarmed, and upon release, 3 or 4 began digging around in the leaf litter for food. Following release, I have approached to within 5 feet of these small creatures without exciting in them the least apprehension of danger. At times they appeared oblivious to my presence. When handled gently they do not attempt to bite, but may "chatter" or "chirr" their displeasure over such strange confinement. They do not fight the traps and none ever received injuries

while confined.

When released against a small sapling they appear undecided about accepting such a means of escape. A few have jumped to the ground rather than waste a glide from the top of a sapling. On the ground they are not very adept, and Sollberger (1940:282-293), who made a study of the Eastern Flying Squirrel, writes that they are quite helpless if trees are not nearby for escape. He describes their voice as a "tssep" of varying volumes. To me, it sounds like a little "chip" or "chirr". Like Sollberger, I have observed abrupt changes in direction of glide. They appear well able to avoid obstacles while in the air.

The distance of their glides depends upon the height from which they start. About 50 yards was the longest glide witnessed, but it was across a slope. I believe they can glide farther than this if given a high enough point from which to begin. Most glides are under 100 feet. In the air, the petagium is spread further apart between the front feet than between the hind feet. There is a tremulous motion of the tail in all glides.

I have two captives at home, a male and female. The male was nearly dead when found in the trap but by judicious care it recovered in three days time. It is infected with several pea-size growths commonly found in cottontail rabbits and transmitted by flea bites. This male squirrel is the only one not appearing in good health, though all had fleas. They are not hardy animals. Three were lost as a result of overexposure to cool summer nights. Cotton batting was supplied in all traps after the first mortality but was not wholly effective when temperatures dropped. The wood mice suffered no mortalities from exposure at any time. The reported gregariousness of flying squirrels may be partially explained as a means of merely keeping warm.

A most fitting description of this small creature is offered by Merriam (1884:198). "A more gentle, docile, and graceful animal than the Flying Squirrel does not exist."

Summary

There are scattered accounts of both the time of breeding and the production of litters in Glaucomys volans volans. Nearly all are based upon one or two observations, or are merely estimates without observations. The same accounts place the average size of a litter at 3 young. General agreement indicates the birth of two litters per year but the months of greatest production are unknown for the spring and late summer litters.

Whether or not late summer young breed the following spring is unknown. From observations at the Campbell woodlot it appears that they do not.

A sex ratio that approaches 50:50 in adults has been demonstrated in a single study only, and within a small area.

These squirrels commonly come to the ground in search of food. In reaching the ground and in moving from place to place they prefer to use large, rough-barked trees.

An oak-hickory stand devoid of underbrush for several acres may, and in this case does, limit flying squirrel activity. A parallel case is shown for the wood mouse, a terrestrial mammal. This poses a problem for those who regard the flying squirrel as wholly arboreal. The lack of adequate ground cover has effected limitations upon (1) a terrestrial species; and (2) an arboreal species.

The distance that a squirrel may glide depends upon the height at which the glide begins, the higher the point of departure the longer will be the glide. Change of direction has been adequately demonstrated in mid-glide.

The usual range of an individual squirrel is not large, being less than 160 yards in diameter in a 28 acre woods.

The great sociability and gregariousness attributed to this animal may be reasonably explained as a means of conserving body heat in cool and cold weather. They are not immune to 12 hours exposure during cool nights in midsummer.

The management of the flying squirrel as a necessary member of the fauna of oak-hickory woodlots will be largely determined by the treatment accorded to fox and gray squirrel habitat. Any improvement of the latter will favor conditions for flying squirrels.

The use of small snags for refuge and home dens is recognized,

and a slight additional burden could be placed on woodlot owners in allowing such snags to remain standing. Their size is small and they prevent no light from reaching the leaf litter.

A continuation of the foregoing study would be highly profitable. The groundwork has been laid for a more complete understanding of the biology and ecology of the flying squirrel.

Literature Cited

- Allen, D. L.
1943 Michigan fox squirrel management.
Michigan Dept. Cons., Game Div. Pub. 100, 404 pp.
Lansing, Michigan.
- Audubon, John James, and Rev. John Bachman
1847 The viviparous quadrupeds of North America.
Vol. I: 216-222. Wiley and Putnam, London.
- Burt, W. H.
1940 Territorial behavior and populations of some small
mammals in southern Michigan.
Univ. of Mich., Mus. Zool. Misc. Pub. 45; 58 pp.
Univ. of Mich. Press, Ann Arbor.
- Hamilton, W. H.
1943 The mammals of eastern United States.
Comstock Pub. Co., Ithaca, New York.
- Hochbaum, H. A.
1944 The canvasback on a prairie marsh. 201 pp.
American Wildlife Institute, Washington, D. C.
- Howell, A. B.
1918 Revision of the American flying squirrels.
North American Fauna No. 44, 64 pp.
U.S.D.A. Bur. Biol. Sur., Washington, D. C.
- Kelker, G.
1931 The breeding time of the flying squirrel.
Jour. Mamm. 12:166-167.
- Landwer, M. F.
1935 An outside nest of a flying squirrel.
Jour. Mamm. 16:67
- Merriam, C. H.
1884 Mammals of the Adirondack region. pp. 197-206
Press of L. S. Foster, New York.
- Seton, E. T.
1929 Lives of game animals. Vol. 4, Part 1:368-384
Doubleday, Doran & Co., Inc., Garden City, New York

- Stack, J. W.
1925 Courage shown by flying squirrel, *Glaucomys volans*.
 Jour. Mamm. 6:128-129
- Stuewer, F. W.
1943 Raccoons: their habits and management in Michigan.
 Ecol. Mon. 13:203-258.
- Svihla, R. D.
1930 A family of flying squirrels.
 Jour. Mamm. 11:211-213.

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