

## AN ECOLOGICAL STUDY OF SOME MINNESOTA MARSH HAWKS

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WITH THREE ILLUSTRATIONS

Of that much discussed group, the hawks and owls, the Marsh Hawk has probably drawn more debate over its right to live than any other single species. With the hope of casting more light on this question, the writer, during the spring and summer of 1932 and 1933, made a special study of the Marsh Hawks (*Circus hudsonius*) which nested on a single square mile in east central Minnesota.

Considerable data regarding the prey taken by Marsh Hawks have been published but information concerning the environment from which this prey was taken is largely lacking. In this study the vertebrate life of the area in which the hawks were living was studied in detail at the same time that the data regarding their food were being gathered, in order to learn just what choice the hawks were exercising in securing their prey.

While collecting this material relative to their food, the writer recorded many observations regarding the life history of these hawks, and particularly he became interested in the social organization of the families. In fact his intimate observations of many of the peculiar and really remarkable habits of this bird have made it a real character for him. The knowledge of these habits has come to take rank in the writer's estimation, along with its positive economic value, as a strong argument favoring its protection. If only shooters could get to know in a similar way the birds they are condemning, how often it might swing the balance in the birds' favor!

## THE VERTEBRATE LIFE OF THE AREA

The square mile to which the present study was restricted lay in the center of an extensive area of very slightly rolling, sandy country just north of Minneapolis in Minnesota. A scattered stand of timber, composed largely of oaks, occupied the higher parts of the tract while the lower portions had been sedge swamps some years ago, but drainage had changed them into damp peat meadows of bluegrass. An irregular intervening belt was covered by willow and dogwood brush. About a quarter of the area was under a neglected type of cultivation.

A brief statement regarding the vertebrate life present on this area will give the reader a definite picture of that part of the biotic environment which was exposed to the predations of these particular hawks.

Amphibians and reptiles were not abundant. Of the following species recorded, only the common toad, leopard frog, and garter snake could be classed as common.

- Tiger Salamander. *Ambystoma tigrinum*.
- Common Toad. *Bufo americanus*.
- Swamp Tree Frog. *Pseudacris nigrita triseriata*.
- Wood Frog. *Rana cantabrigensis*.
- Leopard Frog. *Rana pipiens*.
- Black-banded Skink. *Eumeces septentrionalis*.
- Garter Snake. *Thamnophis sirtalis sirtalis*.
- Blue Racer Snake. *Coluber constrictor flaviventris*.
- Blanding Turtle. *Emys blandingi*.
- Bell Turtle. *Chrysemys belli belli*.

The Marsh Hawk has been accused of preying extensively on birds, so particularly thorough study of these was made. One hundred species were encountered

on the tract, and of these, sixty-seven were found to nest. A census method was devised (Wilson Bull., 47, 1935, pp. 195-197), by which a total avian population of about 2000 birds was arrived at, or three plus birds per acre. Naturally in these surroundings small passerine birds were predominant in numbers. The following fifteen species, given in the approximate order of their abundance, were found to be the most common:

Clay-colored Sparrow. *Spizella pallida*.  
 Song Sparrow. *Melospiza melodia melodia*.  
 Yellow Warbler. *Dendroica aestiva aestiva*.  
 Catbird. *Dumetella carolinensis*.  
 Northern Yellow-throat. *Geothlypis trichas brachidactyla*.  
 Cowbird. *Molothrus ater ater*.  
 Goldfinch. *Spinus tristis tristis*.  
 Red-winged Blackbird. *Agelaius phoeniceus arctolegus*.  
 Brewer Blackbird. *Euphagus cyanocephalus*.  
 Eastern Kingbird. *Tyrannus tyrannus*.  
 Alder Flycatcher. *Empidonax trailli trailli*.  
 Mourning Dove. *Zenaidura macroura marginella*.  
 Brown Thrasher. *Toxostoma rufum*.  
 Vesper Sparrow. *Pooecetes gramineus gramineus*.  
 Warbling Vireo. *Vireo gilvus gilvus*.

Those predacious birds that competed for food with the Marsh Hawk were:

American Bittern. *Botaurus lentiginosus*. One or two pairs.  
 Red-tailed Hawk. *Buteo borealis borealis*. Two pairs near the area.  
 Sparrow Hawk. *Falco sparverius sparverius*. Three or four pairs.  
 Screech Owl. *Otus asio naevius*. One or two pairs.  
 Great Horned Owl. *Bubo virginianus virginianus*. One pair.  
 Crow. *Corvus brachyrhynchos brachyrhynchos*. Two pairs.

The approximate numbers of game birds present were:

Ruffed Grouse. *Bonasa umbellus umbellus*. Ten to fifteen.  
 Prairie Chicken. *Tympanuchus cupido americanus*. Ten to fifteen.  
 Bob-white. *Colinus virginianus virginianus*. Fifteen to twenty.  
 Ring-necked Pheasant. *Phasianus colchicus torquatus*. Ten to twelve.  
 Killdeer. *Oxyechus vociferus vociferus*. Four to six.  
 Upland Plover. *Bartramia longicauda*. Six to eight.  
 Mourning Dove. *Zenaidura macroura marginella*. Forty to fifty.

Numerous farms within one mile of the area were supporting about 2000 domestic poultry.

Twenty-four species of mammals were found to occur on the tract. No population counts of these were attempted but all of the following could be classed as common to abundant:

Meadow Mouse. *Microtus pennsylvanicus pennsylvanicus*.  
 Northern White-footed Mouse. *Peromyscus leucopus noveboracensis*.  
 Loring Red-backed Mouse. *Clethrionomys gapperi loringi*.  
 Striped Ground Squirrel. *Citellus tridecemlineatus tridecemlineatus*.  
 Cottontail Rabbit. *Sylvilagus floridanus mearnsi*.

Several mammals present which were food competitors of the Marsh Hawk were:

Mink. *Mustela vison letifera*. Occasional.  
 Short-tailed Weasel. *Mustela cicognani cicognani*. Occasional.  
 Long-tailed Shrew. *Sorex cinereus cinereus*. Common.

Short-tailed Shrew. *Blarina brevicauda brevicauda*. Common.  
Striped Skunk. *Mephitis mephitis*. Occasional.

#### NOTES ON THE LIFE HISTORY OF THE MARSH HAWK

Soon after the arrival of the Marsh Hawks in March, certain of these birds were often seen performing their spectacular courting dives. In doing this the bird, in a very evident state of excitement, dived from a height of perhaps a hundred feet at a very steep angle for about fifty feet, when it "zoomed" up again to about its original height where it turned over *sidewise*, like the wings of a wingnut being turned onto a bolt. The aviator refers to this as a "barrel roll." This is often incorrectly described as a somersault. In this inverted position the bird beat its wings two or three times, then righted itself by the same sidewise turn, and again dived into the great dip to repeat the performance again and again. Brown birds have been seen performing in the above manner and these have usually been considered as second year males. The writer feels fairly sure, however, that females also engage in these actions although less frequently than do the males. The females of the closely related Hen Harrier of Europe have been recorded as performing like the males but with much less spirit.

Nest building activities usually began late in April and early May. During the first year's work on this tract, six nests of this hawk were built on or very near it, while the second year, four nests were built within its limits. Two families were successfully reared in 1932 and three in 1933. Nests were usually situated a quarter of a mile or more apart, but in 1933 two families were reared within two hundred yards of each other with apparently very little antagonism.

Evidence was found to indicate that these ground nesting hawks, like many of the tree and ledge nesting species, tend to nest in the same general locations, if not on identical nest sites, on successive years. Ground cover is subject to more rapid change due to fires and cultivation than are trees and ledges, so probably this tendency is fully as strong in the Marsh Hawk as in the other species; but changes in the environmental conditions often prevent repeated nestings on the same site.

The incubation period for the eggs of this hawk has been variously stated as being from twenty-one to thirty-one days. The writer in two instances had the opportunity to determine this period. It proved to be thirty-two days in one case and thirty to thirty-one in the other.

During this study brooding females were flushed from nests with eggs more than seventy-five times, while not once was a male found brooding eggs. This strongly indicated that the males took no part in the incubation of the eggs.

The smaller nestling hawks often fail to survive due to their inability to secure food in competition with the larger nestlings. This variation in size and the resulting mortality is usually explained by the fact that the young hatch on succeeding days. Early in life, female hawks exhibit larger size and heavier bones, especially in the legs and feet, than do the males. This difference in growth rate as well as the difference in age probably has an important bearing on whether or not all of the young will have opportunity to develop. For instance in a case where, of six young, the first four to hatch are males and the last two, females, these last two will have an inherent vigor and ability to grow faster than the older males and will have a fair chance of survival. Whereas, if the first hatched are females and the last, males, the difference will only be accentuated by the females' tendency toward greater growth and the males will have little chance of survival.

The female was never seen to favor the smaller nestlings in feeding and this

treatment resulted in the death of several of them. The female was observed on one occasion to actually pick up a dead nestling, dismember it, and feed it to the remaining young.

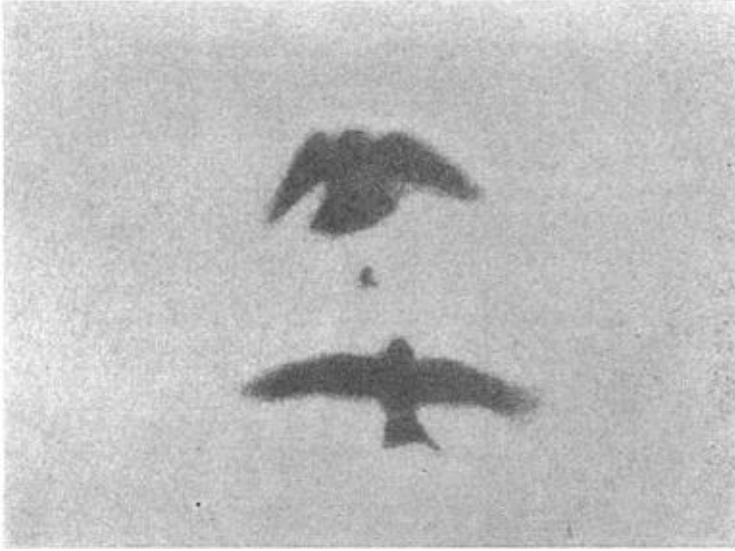


Fig. 51. Male Marsh Hawk dropping prey to female.

From motion picture film.

The spectacular transfer of prey from the male Marsh Hawk to the female in mid-air (fig. 51) has been described by a number of writers. This was found to be a not unusual occurrence and was, in fact, the normal method of passing prey captured by the male to the female. This exchange took place sometimes as frequently as fifteen to twenty times a day between the birds of a single pair. It is not surprising that this exchange should occur so often when it is known that the male captures about eighty per cent of the prey for the young during their period of greatest growth. During twenty-eight and one-half hours spent observing at least two different nests, the writer found that the females captured prey eight times, while during the same period the males brought in prey forty-three times. Forty-two of the catches made by the males were transferred to the females near the nests.

Not only were the males never found to brood the eggs but also they were never observed to brood or feed the young. One hundred and sixty hours were spent by the writer in careful observations at three different nests and during that time the males appeared at the nests but eight times while the females came in one hundred and forty-six times. The visits of the males were found to be really "forced landings" wherein they alighted with prey when the females were not present to receive it. This situation was apparent from the fact that the male birds regularly circled the nests, calling for the females for some minutes before alighting, then when they did appear at the nests, they dropped in, released their talons from the prey, and literally bounced back out of the nests with the very evident attitude of an intruder. And as to attending the young, the males appeared not even to be aware of their presence, not to mention feeding them.

From well over one hundred and eighty hours of close observation during these two seasons, the writer concluded that the function of the male Marsh Hawks

during that period when the young were being fed was that of hunting for food and that they guarded the nests only at those times when the females were feeding the young or during the few short periods when the females were away hunting. The duties of the females consisted largely of guarding the nests and feeding to the nestlings the food brought in by the males.

These duties seemed to be well recognized by the birds themselves. The male on returning from a hunt normally dropped his prey to the female and sailed over to a favorite lookout perch from which he watched until the female had finished feeding the young. He then went hunting again while she went on guard on certain chosen perches in the vicinity of the nest. Occasionally the male appeared to linger too long, whereupon the female, becoming impatient, swooped threateningly at him driving him off to his hunting again.

Considerable information regarding the hunting ranges of two pairs of hawks was secured. In both cases the birds leaving the nests seemed to follow one of three fairly definite loops out over the surrounding country. The extent of the loops was determined approximately and plotted on a map. In each case the territory covered by the hunting birds amounted to about one square mile. At several points the ranges of these two pairs overlapped slightly and a bird from one pair was observed on several occasions hunting side by side with one from the neighboring pair with no signs of antagonism. Evidently their territorial rights were not very firmly established at the periphery of their ranges. Undoubtedly weather conditions, abundance of food animals, and other factors would cause considerable daily and seasonal fluctuations in the extent of these hunting ranges.

The fledgling hawks learned to fly during their fifth week. Little hunting, even for insects, was attempted at first, but greatly reduced rations from the adults soon forced them to look for beetles and grasshoppers in the tall grass. They developed skill at flying very rapidly and when between seven and eight weeks of age they were observed catching prey from their parents in mid-air after the manner of the adults. The young birds spent the nights in the vicinity of the nests until about eight weeks old, when the families seemed to break up and the young started out for themselves.

#### FOOD OF THE MARSH HAWK

Data regarding the prey taken by the Marsh Hawks on this particular section during the two seasons were secured chiefly from three families and by three methods, namely: direct observation from blinds; examination of pellet contents; and examination of gullet contents of nestlings. Pellet determinations were made by the United States Biological Survey. The following is a complete list of the identified prey taken:

##### Mammals

- Cottontail Rabbit. *Sylvilagus floridanus mearnsi*. Juvenile.
- Striped Ground Squirrel. *Citellus tridecemlineatus tridecemlineatus*.
- Meadow Mouse. *Microtus pennsylvanicus pennsylvanicus*.
- Red-backed Mouse. *Clethrionomys g. loringi*.
- Jumping Mouse. *Zapus h. campestris*.
- White-footed Mouse. *Peromyscus l. noveboracensis*.
- Eastern Chipmunk. *Tamias s. griseus*.
- Pocket Gopher. *Geomys bursarius*.

##### Birds

- Ring-necked Pheasant. *Phasianus c. torquatus*. Juvenile.
- Domestic poultry. *Gallus domesticus*. Juvenile.
- Bob-white. *Colinus v. virginianus*.

- Marsh Hawk. *Circus hudsonius*. Juvenile.  
 Northern Flicker. *Colaptes a. luteus*.  
 Mourning Dove. *Zenaidura m. marginella*.  
 Red-winged Blackbird. *Agelaius p. arctolegus*.  
 Meadowlark. *Sturnella m. magna* or *S. neglecta*.  
 Red-eyed Towhee. *Pipilo e. erythrophthalmus*.  
 Savannah Sparrow. *Passerculus s. savanna*.  
 Catbird. *Dumetella carolinensis*.  
 Willow Thrush. *Hylocichla f. salicicola*.  
 Bluebird. *Sialia sialis sialis*.
- Reptiles  
 Blue Racer Snake. *Coluber constrictor flaviventris*.
- Amphibians  
 Leopard Frog. *Rana pipiens*.
- Insects  
 Grasshoppers. Acrididae.  
 Ground beetles. Carabidae.  
 Stink bugs. Pentatomidae.  
 Carrion beetles. Silphidae.  
 Gold bugs. Scarabidae.
- Plants  
 Dogwood fruits. *Cornus*.  
 Blueberries. *Vaccinium*.  
 Raspberries. *Rubus*.

Many of the above items appeared only occasionally or very rarely. Young cottontail rabbits and striped ground squirrels bore the brunt of the predations of these hawks, constituting about 50 per cent of the bulk of the food. The chart in figure 52 shows the food of the family from which the most data were gathered. This represents the food both as to numbers and bulk.

The striped ground squirrel constituted the main source of food for these particular hawks. It was common on the area and its diurnal habits made it particularly vulnerable to the Marsh Hawk. Both adults and young were taken.

Cottontail rabbits of nearly adult size were recorded in the prey and ranked a close second to the ground squirrel as a staple food of the hawks. Both of these mammals have great reproductive potentialities and in a favorable environment must have many destructive forces at work against them to keep their populations within reasonable bounds. The Marsh Hawks, in preying upon these so extensively, are therefore playing an important role as a balancing factor for these highly unstable populations.

Passerine nestlings and fledglings took first rank numerically in the recorded foods but in bulk were much less important than were the two forms mentioned above. This area, having such a heavy passerine population, could, and very evidently did, withstand considerable predatory pressure from both the avian and mammalian predators listed previously. Little concern is registered by ornithologists over the ability of these forms to hold their own in anything like a favorable environment.

Mice of four species entered into the diet of these hawks but ranked below those species noted above as a food source. Population data for four consecutive years indicate that the meadow mouse, the most available mouse for this bird, was fairly abundant but was declining in numbers during these two seasons and continued to decline for two more years to a very low point in 1935. This gradual decrease instead of a rapid drop suggests that this was a direct result of drought conditions and not a part of their population cycle.

Data secured on the pheasants and poultry taken by these hawks support statements made by a number of ornithologists to the effect that individual hawks develop a chicken killing habit. In the food data gathered, five young pheasants

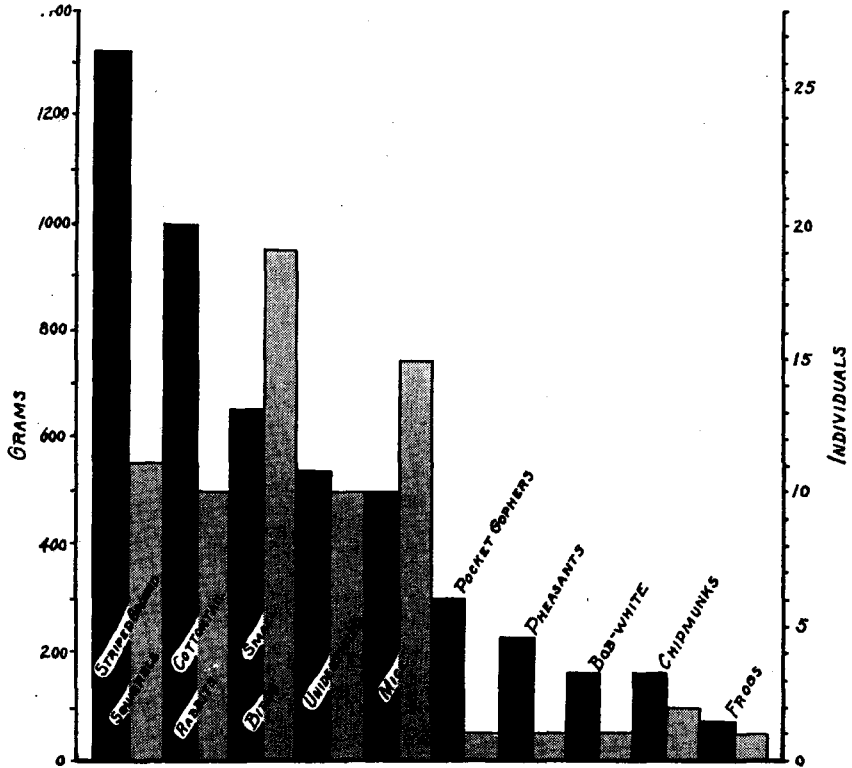


Fig. 52. Classification of prey of family no. 2, 1932, taken during five day period. Black bars represent weight in grams; shaded bars, numbers of individuals.

and several young chickens appeared. Three of the pheasants and all of the chickens were the prey of one pair. The other two pairs studied had each taken one very young pheasant and no poultry, although poultry was more accessible to them than to the first pair mentioned. It is noteworthy that all of the farmers in the vicinity seemed to recognize the effectiveness of guinea fowls and Purple Martins in protecting their poultry from hawks and that the only farmer reporting hawk damage had neither of these about his premises, while one or the other was present on all of the other farms.

One Bob-white was present in the diet of each of the three families studied most carefully. On this area the ground cover had been repeatedly burned and was too sparse to furnish proper protection for this bird from just such predators as the Marsh Hawk. In such marginal cover a few of these birds, both young and adults, could be expected to be taken. Protection from fires would, in a few years, greatly improve this cover and allow a much denser Bob-white population to exist safely.

Most of the remaining vertebrate prey listed was taken only rarely. These species, at the population levels existing at the time of this study, probably had little

to fear from the predations of the Marsh Hawk.

Insects, principally the larger Orthoptera and Coleoptera appeared occasionally in the pellets of the adults. None of these was ever recorded as brought to the nestlings, yet many appeared in the pellets of the young just learning to fly, indicating that the young took these themselves as their first prey.

Much plant material was swallowed accidentally by both adults and young. The appearance of the fleshy fruits of dogwood, blueberries and raspberries in the pellets of the young just learning to fly, strongly suggested, however, that these were taken intentionally by the birds during that period of scanty rations, perhaps being mistaken for animal food.

From the data presented, it appeared that the Marsh Hawks living under the conditions herein described, preyed upon nothing more formidable than three-fourths

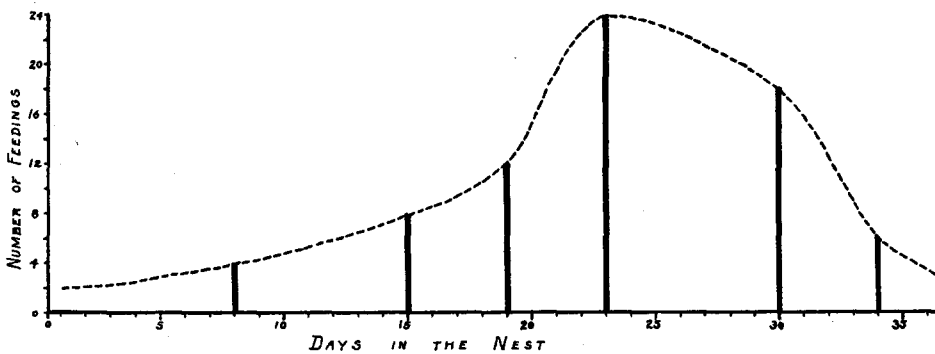


Fig. 53. Curve showing numbers of feedings for entire nest period. Dark vertical lines indicate observed feedings.

grown cottontail rabbits and adult pocket gophers. Adult cottontail rabbits, pheasants, prairie chickens, and domestic poultry were all available but were not recorded as taken while smaller prey was abundant. The Marsh Hawk may attack these forms at other seasons of the year while under pressure of hunger, but during its period of greatest consumption, the nesting period, it appears to limit its diet to the smaller, more prolific forms and to the young of the larger species.

In this study it was found that the daily rations of the young in the nest increased gradually up to about the twenty-fifth day of their lives when a marked reduction in these rations occurred, several days before the young began to fly (fig. 53). This curve of the reduced food consumed by the young corresponds well with the curve for the decrease in weight of young raptors near the end of the nest period recorded by Sumner (Condor, 31, 1929, pp. 85-111). This decrease in weight thus appears to result not only from possible physiological changes taking place in preparation for flight but also from an actual decrease in the amount of food consumed.

From this same chart (fig. 53), the total amount of food consumed by this particular family of young hawks (five hatching and three maturing) during their nest life may be roughly determined. Assuming the curve to represent their daily feeding throughout this period, the daily totals would amount to three hundred and eighty-eight feedings. The average of the sixty-three articles of prey brought to this family is about seventy-four grams. The total for the period then would be 28,712 grams, or about sixty-three pounds of food consumed by this family of nestling Marsh Hawks up to the time of their taking wing.



## CONCLUSIONS

The following conclusions were derived from this study of the Marsh Hawks which nested on a single square mile in eastern Minnesota in 1932 and 1933.

1. The area on which these hawks lived was supporting an avian population of about three birds per acre. These were mainly small passerine birds, but Ring-necked Pheasants, Ruffed Grouse, Prairie Chickens, and Bob-whites were present with many domestic chickens available on near-by farms. Several species of mice, striped ground squirrels, and cottontail rabbits were the dominant mammals. Reptiles and amphibians were not abundant.

2. The male hawks did not assist the females in brooding the eggs.

3. Pairs of hawks were found nesting as near together as two hundred yards, with little evidence of friction, although they were normally separated by at least a quarter of a mile.

4. The hawks showed a strong tendency to nest on successive years in the same locations.

5. The period of incubation for the eggs of these hawks was from thirty to thirty-two days.

6. Female nestling hawks at an early age become larger and heavier than the males. It therefore seems probable that the distribution of the sexes among the young, as well as the variation in hatching time, is an important factor in determining whether or not the smaller young will survive.

7. The female hawks spent nearly all of their time either guarding the nest or feeding the nestlings. This latter duty was performed exclusively by the female.

8. The male hawks captured about eighty per cent of the food consumed by the nestlings during the greater part of their nest life. The males transferred nearly all of the prey they secured to the females in mid-air. On rare occasions males brought food to the nest, but left immediately without apparently noticing the young.

9. Each of the pairs of hawks studied hunted over an area of about one square mile. These hunting ranges overlapped in places, at which points the birds showed no resentment over the presence of the others.

10. The young began to fly at about five to six weeks of age and were sufficiently agile when only seven to eight weeks old to catch prey in mid-air which had been dropped to them by the adults. The young remained in the vicinity of the nest for about three weeks after learning to fly.

11. Thirty-one different forms of food including mammals, birds, reptiles, amphibians, insects, and fruits were recorded as taken for food by these hawks. Mammals comprised about three-fourths of the bulk of the food taken. Striped ground squirrels were the largest single item in their diet while young cottontail rabbits were almost equally as important. Small birds ranked highest in their diet in number of individuals, but constituted only a small portion of the bulk.

12. Two of the three families studied most closely gave no evidence of molesting poultry. The third pair was found to have taken a number of domestic chickens.

13. The one pair which preyed to some extent on poultry took at least three young pheasants while the other two pairs took one each.

14. One Bob-white was found in the food of each of these three families of hawks. One was an adult bird.

15. The daily amounts of food brought to the young decreased markedly toward the end of the nest life of the nestlings.

16. One family of young hawks was calculated to have consumed approximately sixty-three pounds of food up to the time of their taking wing.

*Museum of Natural History and Department of Zoology, University of Minnesota, Minneapolis, Minnesota, August 3, 1935.*