FOOD OF YOUNG RAPTORS ON THE EDWIN S. GEORGE RESERVE

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DURING the nesting seasons of 1941, 1942, and 1946 we studied the food of several young Cooper's Hawks (*Accipiter cooperii*) following Errington's (1932) method of squeezing stored food from the gullet. Our work began while the birds were still in the nest. We continued it by tethering the hawks on the ground during a period in which they would normally have been flying. We attached a jess to each tarsus, fastening the two jesses with swivels to one short chain, thus obviating trouble with broken legs. In 1946 we studied also the food of two young Red-tailed Hawks (*Buteo jamaicensis*) and one young Barred Owl (*Strix varia*), again tethering the birds on the ground.

We did this work on the Edwin S. George Reserve, a tract of about 1300 acres of former farm land in southwestern Livingston County, Michigan. It is owned by the University of Michigan and administered by the Museum of Zoology as a field study area. The terrain is rough and morainic. Present cover types are about as follows: "26 per cent mixed hardwoods (mainly *Quercus-Carya*), 11 per cent tamarack (*Larix laricina*) swamp, 6 per cent brush, largely around the margins of swamps and bogs, 4 per cent bog, 7 per cent marsh, and 46 per cent grassland" (O'Roke and Hamerstrom, 1948).

The area ordinarily supports from three to six breeding pairs of raptors including, in varying combinations, the following: Turkey Vulture (*Cathartes aura*), Cooper's Hawk, Red-tailed Hawk, Marsh Hawk (*Circus cyaneus*), Great Horned Owl (*Bubo virginianus*), Barred Owl, and Long-eared Owl (*Asio otus*). Some of these—notably the Turkey Vulture and Long-eared Owl—have nested much less often than the others. The Cooper's Hawk is one of the most regular nesters. Our data concerning this species we obtained from four broods—two in 1941, one in 1942, and one in 1946. Two of the nests (Nos. 1 and 3) were found by Dr. Arthur E. Staebler.

The general plan was to visit the nests or tethered young once or twice daily. When we could identify the gullet contents on the spot, we returned the food at once. In most cases, however, we had to take diagnostic portions to the Museum of Zoology for comparison with reference collections there. Several members of the staff helped with the more difficult identifications, especially Drs. Pierce Brodkorb, George M. Sutton, Josselyn Van Tyne, William H. Burt, and Emmet T. Hooper. We found additional evidence of what the hawks were eating in such debris as bones and feathers, and in items of prey which had not been eaten. Most of the nest-trees were easy to climb, but one (Nest 2) required a little engineering since we did not want to scuff the bark by daily use of climb-

FIG. 1. Young Cooper's Hawk tethered on ground near nest. Photographed at the Edwin S. George Reserve, near Pinckney, Michigan, on July 15, 1946, by Alfred E. Brandt and George M. Sutton.

ing irons. When the four nestlings were about two weeks old we fastened a shallow basket, about 18 inches in diameter, to a rope which passed through a pulley high in the tree. The pulley was hung from a coil spring to keep the rope

from breaking when the trees swayed in the wind, and to keep enough tension on the rope to prevent the basket from swinging. We transferred the nestlings to the basket, which was suspended about 10 feet below the nest, and knocked the nest from the tree. The adults accepted the new "nest" immediately and even decorated it with a few juniper twigs. With this apparatus we could bring the young to the ground whenever we wished.

When the young were about ready to become "branchers"—i.e., to climb about the nest-tree—we tethered them on the ground until the adults began to lose interest in feeding them. When the young received so little from the parents that further study was not worth-while, we turned them loose. One free-flying brood we helped to feed for several days while they became accustomed to their new way of life.

We were unable to identify most of the food items which we took from the gullets of the nestlings during the first 10 days or so of their lives, as the material consisted for the most part of small scraps of meat with little or no fur, feathers, or bone attached. After they began to eat larger pieces of prey it became progressively easier to identify the food. Over the three seasons we examined the broods of young hawks a total of 189 times. We found no newly-brought-in items of prey on 25 of these visits. The food recovered from the young (gullet contents, debris, and uneaten prey) was as follows:

Nest 1, *June 10–July 24, 1941.* Birds: Ruffed Grouse (*Bonasa umbellus*), 1 ad.; Bob-white (*Colinus virginianus*) (?), 1 imm.; Ring-necked Pheasant (*Phasianus colchicus*), 8 imm.; Killdeer (*Charadrius vociferus*), 1 age ?; Mourning Dove (*Zenaidura macroura*), 3 ad., 2 imm., 3 nestl.; Yellow-billed Cuckoo (*Coccyzus americanus*), 1 ad.; Flicker (*Colaptes auratus*), 2 imm., 1 age ?; Hairy Woodpecker (*Dendrocopos villosus*), 1 ad.; Downy Woodpecker (*Dendrocopos pubescens*), 2 imm.; Phoebe (*Sayornis phoebe*) (?), 1 age ?; Bank Swallow (*Riparia riparia*), 1 imm.; Blue Jay (*Cyanocitta cristata*), 2 ad., 3 imm., 2 nestl., 1 age ?; White-breasted Nuthatch (*Sitta carolinensis*), 1 age ?; White-breasted Nuthatch (?), 1 age ?; Robin (*Turdus migratorius*), 8 imm.; Cedar Waxwing (*Bombycilla cedrorum*), 1 imm., 1 age ?; Starling (*Sturnus vulgaris*), 1 ad., 6 imm., 1 age ?; Starling (?), 2 age ?; English Sparrow (*Passer domesticus*), 4 ad., 4 imm., 4 age ?; English Sparrow (?), 1 imm., 1 age ?; Red-wing (*Agelaius phoeniceus*), 1 ad., 2 imm., 3 age ?; Baltimore Oriole (*Icterus galbula*), 2 ad., 1 age ?; Grackle (*Quiscalus quiscula*), 1 imm.; Cowbird (*Molothrus ater*), 2 imm.; Vesper Sparrow (*Pooecetes gramineus*), 2 age ?; Vesper Sparrow (?), 1 age ?; unidentified birds, 3 imm., 2 nestl., 4 age ?. Total Birds: 16 ad., 47 imm., 7 nestl., 26 age ?.

Mammals: Eastern Chipmunk (*Tamias striatus*), 2 ad., 2 imm., 4 age ?; Red Squirrel (*Tamiasciurus hudsonicus*), 1 age ?; Gray Squirrel (*Sciurus carolinensis*), 1 imm., 1 age ?. Total Mammals: 2 ad., 3 imm., 6 age ?.

Nest 2, *June 8–24, 1941.* Birds: Ruffed Grouse, 2 imm.; Ring-necked Pheasant, 3 imm.; Mourning Dove (?), 1 nestl.; Yellow-billed Cuckoo, 1 ad.; Screech Owl (*Otus asio*), 1 ad.; Flicker, 3 ad., 2 imm., 2 age ?; Purple Martin (*Progne subis*), 1 ad.; Blue Jay, 1 ad., 2 imm., 3 nestl., 1 age ?; Catbird (*Dumetella carolinensis*), 1 imm., 1 age ?; Robin, 1 imm.; Robin (?), 1 age ?; Cedar Waxwing, 1 imm.; Cedar Waxwing (?), 1 imm., 1 nestl.; Starling, 2 imm.; English Sparrow, 1 ad., 3 imm., 4 age ?; Red-wing, 2 ad., 2 imm., 1 age ?; Baltimore Oriole, 1 imm., 1 age ?; Cowbird, 1 imm.; Scarlet Tanager (*Piranga olivacea*), 2 age ?; Cardinal

(*Richmondena cardinalis*), 1 imm.; Towhee (*Pipilo erythrophthalmus*), 1 ad.; unidentified birds, 2 ad., 2 imm., 6 age ?. Total Birds: 13 ad., 25 imm., 5 nestl., 19 age ?.

Mammals: Striped Ground Squirrel (*Citellus tridecemlineatus*), 1 imm.; Eastern Chipmunk, 9 age ?; Red Squirrel, 1 imm.; Fox Squirrel (*Sciurus niger*), 1 imm.; Southern Flying Squirrel (*Glaucomys volans*), 1 imm.; Cottontail (*Sylvilagus floridanus*), 1 imm.; unidentified sciurid, 1 imm. Total Mammals: 6 imm., 9 age ?.

Nest 3, *June 23–July 2, 1942.* Birds: Ruffed Grouse, 1 ad.; Ring-necked Pheasant, 1 ad.; Mourning Dove, 1 ad., 2 imm.; Flicker, 1 imm.; Hairy Woodpecker, 1 ad.; Eastern Kingbird (*Tyrannus tyrannus*), 1 imm.; Cedar Waxwing, 1 imm.; Starling, 1 ad., 1 imm.; English Sparrow, 1 imm., 3 age ?; Red-wing, 2 imm., 1 age ?; Baltimore Oriole, 2 age ?; unidentified birds, 2 age ?. Total Birds: 5 ad., 9 imm., 8 age ?.

Mammals: Striped Ground Squirrel, 1 age ?; Eastern Chipmunk, 2 age ?; Bog Lemming (*Synaptomys cooperi*), 1 age ?; Meadow Jumping Mouse (*Zapus hudsonius*), 1 age ?. Total Mammals: 5 age ?.

Nest 4, *June 14–July 19, 1946.* Birds: Flicker, 3 imm., 1 age ?; Hairy Woodpecker, 1 age ?; Blue Jay, 1 imm.; Catbird, 1 imm.; Robin, 1 age ?; Robin (?), 1 imm.; Wood Thrush (*Hylocichla mustelina*) (?), 1 nestl.; Cedar Waxwing, 1 age ?; Starling, 4 imm.; Yellow-throated Vireo (*Vireo flavifrons*), 1 ad.; English Sparrow, 1 ad.; English Sparrow (?), 1 age ?; Meadowlark (*Sturnella magna*), 1 ad., 2 imm., 1 age ?; Red-wing, 1 ad., 2 imm., 2 age ?; Red-wing (?), 1 imm.; Baltimore Oriole, 2 imm.; Cowbird, 1 imm.; Scarlet Tanager, 1 ad.; Cardinal, 1 imm.; Vesper Sparrow (?), 1 imm.; Song Sparrow (*Melospiza melodia*), 1 imm.; unidentified birds, 1 imm., 5 age ?. Total Birds: 5 ad., 22 imm., 1 nestl., 13 age ?.

Mammals: Prairie Mole (*Scalopus aquaticus*), 1 age ?; Eastern Chipmunk, 1 ad., 2 imm., 2 age ?; unidentified sciurids, 3 age ?; unidentified mouse, 1 age ?. Total Mammals: 1 ad., 2 imm., 7 age ?.

Near three of the nests there were one or two "plucking trees" in which the adult hawks repeatedly dressed out their kills. Since we do not know how much of this prey they ate themselves and how much they fed to the young, we have not included any of it in the food list above. Many prey species occurred both in the food recovered from the young hawks and in the debris under plucking trees. In some cases we could be sure that these represented different individuals because they appeared at different times. There were three bird species that we found only among the plucking tree debris, never among the foods of the young hawks. Altogether, there were at least 21 plucking tree items representing kills not listed above. These items were (where age is not stated, it is not known): Ruffed Grouse, 1; Mourning Dove, 2 ad.; Flicker, 1 ad.; Purple Martin, 1; Tufted Titmouse (*Parus bicolor*), 1; Catbird, 1; Brown Thrasher (*Toxostoma rufum*), 1; Starling, 2 imm.; English Sparrow, 1 imm. and 1 age ?; Baltimore Oriole, 1; Cowbird, 2 ad.; Scarlet Tanager, 1 ad. male; Rose-breasted Grosbeak (*Pheucticus ludovicianus*), 2 imm.; Towhee, 1 ad. male; and Cottontail, 2 imm.

Of the 262 individual prey items among the foods of the young hawks, 84.4 per cent were small to medium-sized birds, and 15.6 per cent were small mammals. The largest items of prey were these: Ring-necked Pheasant, 1 ad. female; Ruffed Grouse, 2 ad.; Fox Squirrel, 1 imm.; and Cottontail, 1 imm. (and 2 more among the plucking tree debris).

In general, the food list is much the same as that which has been found in other studies elsewhere (see, for example, Fisher, 1893; Hausman, 1928; Snyder, 1932; Errington, 1933; McAtee, 1935; May, 1935; Edge and Lumley, 1940; and McDowell, 1941). A conspicuous difference between our study and those of others is that we found no domestic poultry or pigeons. Insects, amphibians, and reptiles in small numbers have been reported in other studies, and in one unusual instance (Fitch *et al.*, 1946) lizards formed the greater part of the diet. We found only birds and mammals. It is possible that certain kinds of prey, or certain size classes, were not brought to the nestlings. This is another reason for listing the plucking tree material separately. Segregating the data in this way should make possible a more precise comparison of different studies.

Although predation often falls heavily upon the immature, our food list does not show such a trend. Of 155 birds whose age we could determine, 25.1 per cent were adults, while 74.9 per cent were immatures. At least 8.4 per cent were nestlings. On the basis of 14 of the mammals, a similar age ratio occurred: adults, 21.4 per cent; immatures, 78.6 per cent. These immature:adult ratios are about what one would expect to find in prey populations at this time of year.

Nine bird species and one mammal species make up 73.7 per cent of the 213 completely identified items in the food list, although the total list is composed of 30 to 33 species of birds and 10 of mammals. In order of their occurrence as prey, the 10 species fed most often to the young hawks were: English Sparrow, Chipmunk, Red-wing, Starling, Blue Jay, Flicker, Ring-necked Pheasant, Mourning Dove, Robin, and Baltimore Oriole. Six of these were found at all four nests: English Sparrow, Chipmunk, Red-wing, Starling, Flicker, and oriole. Probably others would have been added to these six if Nest 3 had been under observation for a longer time.

At the three nests with the longest span of data (1, 2, and 4), most of the 10 major prey species were taken essentially throughout the period of most intensive study, i.e., the last half of June through all but the last week of July. Up to July 1, the species which were taken in greatest numbers at these three nests were the Chipmunk (12), Red-wing (7 + 1?), English Sparrow (7), Starling (5), Blue Jay (5), and Flicker (5). These were the most abundant species in the totals for the whole period. All of them except the Chipmunk were taken in even greater numbers in July, although no Blue Jays were found after July 14, no Flickers after July 18, and only one Red-wing after July 15. Two species, however, were distinctly more characteristic of July than of the whole period: (a) the 11 immature Pheasants were all taken between July 7 and 22 (the one adult hen, at Nest 3, on June 26); and (b) all of the Mourning Doves except one (plus 1?) were taken in July. Robins were taken somewhat more often in July than in June (7 + 1? vs. 3 + 1?), but this difference is not necessarily significant. Orioles, at the bottom of the list of the 10 most commonly eaten species, were scattered about equally through June and July.

The order of abundance of the prey species poses something of a problem, especially in the case of the birds. With the exception of the Red-wing, not one of the nine bird species most heavily preyed upon was among the most common breeders on the Reserve proper. The English Sparrow, Starling, and Pheasant were actually among the least common, while the Blue Jay, Flicker, dove, Robin, and oriole were no more than moderately common.

Conversely, the most abundant breeding species were not represented among the food items in numbers at all proportional to their occurrence. Dr. George Miksch Sutton, who has been studying the nesting birds of the Reserve for many years, has been kind enough to list for us the ten breeding species which he found to be commonest in the 1941–46 period. The first four are arranged in descending order, with the most common listed first; the rest are, he believes, certainly among the first ten, although they may not be listed in precisely their order of abundance: Field Sparrow (*Spizella pusilla*), Wood Pewee (*Contopus virens*), Goldfinch (*Spinus tristis*), Song Sparrow (*Melospiza melodia*), Red-wing, Yellow-throat (*Geothlypis trichas*), Oven-bird (*Seiurus aurocapillus*), Yellow-throated Vireo, Indigo Bunting (*Passerina cyanea*), and Least Flycatcher (*Empidonax minimus*). Of these, only the Red-wing was among the first ten food-species of the young hawks, and although it held second place among birds on the food list, it ranked no higher than fifth in order of abundance in the summer bird population. Only one other of the commonest summer residents—a single Yellow-throated Vireo—occurs on the food list at all. Most of the commonest summer birds were rather small, perhaps too small to be worth while to a Cooper's Hawk at all, or too small to be worth taking back to the nest—but a few were at least as large as the English Sparrow. All of them occurred in the kinds of habitat in which one or another of the major prey items were found.

The very fact that English Sparrows and Starlings were so large a part of the food total is plain evidence that these hawks did not confine their hunting to the Reserve. Both species lived in numbers around the farm buildings and cultivated lands *outside the boundary fence.* The closest places at which English Sparrows could be found in numbers were: from Nests 1 and 3, slightly over a half mile—immediately outside the fence; from Nests 2 and 4, about three quarters of a mile—a half mile beyond the fence, across pasture and cultivated land. Starlings were abundant at the English Sparrow concentrations nearest to Nests 1 and 3. In the case of Nests 2 and 4, Starlings were closer than the English Sparrows by almost half a mile. Only at Nest 4, however, does the Starling figure more prominently than the English Sparrow as an item of prey. At this nest only one English Sparrow was recorded (2.4 per cent of all birds recovered).

Both Uttendörfer (1939) and Tinbergen (1946) have commented upon a similar disproportionate occurrence of certain kinds of prey in the food of the closely related European Sparrow Hawk (*Accipiter nisus*). Both of these authors

emphasize the fact that *Accipiter nisus* hunts certain types of habitat more often than others, rather than all types at random. Uttendörfer points out that in Germany the Sparrow Hawk seldom hunts in the vicinity of its nest, but flies out some little distance instead. Tinbergen says that it hunts especially often those places in which prey species are most abundant. In Holland these places are most often around villages and cultivated fields, but when—as seldom happens—a woodland has a high population of small birds, the Sparrow Hawk hunts there more often than is usual in that type. Both authors make clear that this habit of hunting certain habitats or localities plays a large part in determining what species are caught. Uttendörfer further believes that some Sparrow Hawks show a preference for certain species of prey. Tinbergen (1946: 194), however, says: "But it is not necessary that there is a preference for the species as such. On the contrary, it is probable that a comparison of the food with the faunae of those places that are hunted over (so not of the whole domain) would show that the different species are represented proportionally." He points out that captures are not *strictly* proportional to abundance, for some species are more easily caught than others. He cites the House Sparrow (*Passer domesticus*) as one of the more vulnerable species. It is not only especially abundant in the habitat in which the Sparrow Hawk does most of its hunting, but it is also especially liable to be caught "as it often leaves cover, as it is always busily moving about and probably as it lives socially throughout the year" (p. 203). Birds which are especially conspicuous (brightly colored, noisy, singing or feeding in exposed places), which are slow flying, which often leave cover, and which occur in groups rather than singly, are apt to be caught in disproportionately large numbers. Those whose habits are the opposite—secretive, quick, etc.—are apt to be caught in disproportionately small numbers.

Tinbergen's analysis would seem to explain the apparent contradiction in our data. Even though our Cooper's Hawks did not prey most extensively on the birds that were most abundant on the Reserve itself (with the exception of the Red-wing), there were concentrations of English Sparrows and Starlings within easy reach of all four nests. Blue Jays, Flickers, Mourning Doves, Robins, and orioles did not live in great concentrations anywhere in the neighborhood, but they were all moderately common. All of these species characteristically leave cover and fly out into open stretches for considerable distances; they are perhaps more vulnerable for that reason than some other species which out-rank them in abundance. It seems significant that all the Pheasants were taken in 1941 and 1942, a time of relative abundance in the country surrounding the Reserve. Southern Michigan experienced the almost nation-wide Pheasant decline of the mid-forties, and we found no Pheasants among the Cooper's Hawk's foods in 1946.

Red-tailed Hawk and Barred Owl

Six pairs of raptors attempted to nest on the Reserve in 1946—two pairs

of Cooper's Hawks, two of Red-tails, one of Great Horned Owls, and one of Barred Owls. We hoped to make a comparative study of the food habits of all four species. However, the eggs in one Cooper's Hawk nest were destroyed during incubation, and if there was a second nest we did not find it. The Horned Owl nest had but one young, not yet able to fly, when it was found by Drs. Samuel Graham and E. C. O'Roke on April 22. Two days later the young owl was gone from the nest, and the adults abandoned the nesting woods shortly thereafter. We think the nestling was killed. The two Red-tail nests had but one young each. We obtained some food habits data from each of these broods, but one of the young was killed by a Horned Owl about three weeks after we had tethered it on the ground. The Barred Owl nest held two small young when we found it June 3, but one was gone by the next day. The young owl which disappeared was far too small to have left the nest in a normal manner. We tethered the remaining one; it was killed in late August, presumably by a Red-tail.

It is worth emphasizing that in this year of high nesting density—six pairs of raptors on 1300 acres—the success ratio was very low, quite apart from the disturbance caused by our studies. Both Red-tail broods numbered only one young each, and we did not climb to these nests until after the eggs had hatched. The Horned Owls were apparently wholly unsuccessful, and we did not climb that tree at all. The Barred Owls had only two young, one of which disappeared just after we had visited the nest once. The successful Cooper's Hawk nest had three young and one egg which failed to hatch, while all the eggs in the other nest were destroyed before we climbed to it.

As a matter of fact, it was fighting between the Barred Owls and the successful Cooper's Hawks that led us to that particular hawk nest (Nest 4). On the afternoon of May 14 we heard two adult Barred Owls calling, in rapid cadence, at a spot in the woods about a quarter of a mile away. Their calls were followed at once by the chatter of a Cooper's Hawk, apparently at the same place. Within a matter of seconds another Cooper's Hawk appeared over the tree-tops, flying rapidly toward the commotion. The flying hawk dove vertically, and was lost to view behind the crest of a ridge. Following the bearing given us by the stooping hawk, we walked directly to the nest. The commotion had died away before we got there, and the owls were gone, but there was still a very much excited Cooper's Hawk scolding near the nest. The Barred Owl nest, which we found about two weeks later, was only 200 yards away.

We have very little comparative material. We got 59 pellets and one uneaten prey item from the tethered young Barred Owl, over the period June 4 through August 28. A few pellets were probably broken and scattered before we found them, but as we gathered the pellets generally every three to five days, we probably got most of them. One young Red-tail was tethered from May 17 to June 6, the other from June 4 to July 12. We visited these hawks much less regularly than we did the Cooper's Hawks, and got from them only 27 items of prey.

The Barred Owl had eaten mainly mice (110), but 15 insectivores, 13 small birds, and 12 amphibians were represented. There were 18 beetles in the pellets. As the two genera of bettles which we could identify are known to be attracted to carrion, it is possible that the young owl caught them rather than receiving them from the adults. There were no crayfish (*Cambarus* sp.), although Barred Owls commonly eat them. Among the foods of the Red-tails, members of the Sciuridae made up almost half (13) of the total number of items. It is of interest that of the four birds recovered, three (Red-wing, Blue Jay, and Flicker) were among the most important foods of the young Cooper's Hawks. There was one weasel (*Mustela* sp.).

The Barred Owl and Red-tail data are as follows:

Barred Owl Nest, *June 4–August 28, 1946.* Birds: Hairy Woodpecker (?), 1 imm.; Crested Flycatcher (*Myiarchus crinitus*), 1 ad.; White-breasted Nuthatch, 1 age ?; unidentified birds, 2 ad., 4 imm., 4 age ?. Mammals: Prairie Mole, 1; Star-nosed Mole (*Condylura cristata*), 2; Shrew (*Sorex*, probably *S. cinereus*), 2; Short-tailed Shrew (*Blarina brevicauda*), 10; Eastern Chipmunk, 1; Southern Flying Squirrel, 3; White-footed Mouse (*Peromyscus* sp.), 66; Bog Lemming, 33; Meadow Vole (*Microtus pennsylvanicus*), 10; Meadow Jumping Mouse, 1; unidentified mammals, 1. Amphibians: 12 unidentified frogs and/or toads. Snakes: 1 unidentified. Insects: *Geotrupes* sp., 10; *Necrophorus* sp., 2; unidentified beetles, 6.

Red-tail Nests, *May 17–June 6 and June 4–July 12, 1946.* Birds: Sora (*Porzana carolina*), 1 age ?; Flicker, 1 ad.; Blue Jay, 1 age ?; Red-wing, 1 imm. Mammals: Prairie Mole, 1; Weasel (*Mustela*, probably *M. frenata*), 1; Striped Ground Squirrel, 1; Eastern Chipmunk, 3; Gray Squirrel, 3; Fox Squirrel, 6; Meadow Vole, 2; Pine Vole (*Pitymys pinetorum*), 1. Toad (*Bufo americanus*), 2. Snakes: Blue Racer (*Coluber constrictor*), 2; unidentified snake (probably Blue Racer), 1.

Summary

During three nesting seasons we identified the food brought by the parent birds to four broods of young Cooper's Hawks, to two young Red-tailed Hawks (two broods of one each), and to one young Barred Owl on the Edwin S. George Reserve, in southeastern Michigan. We used Errington's (1932) tethering technique.

Of a total of 262 Cooper's Hawk food items recovered from the gullets of the young hawks, as not yet eaten prey, or as residual debris in the nests or at the tethered young, 84.4 per cent were small to medium-sized birds and 15.6 per cent were small mammals. Of 155 birds whose age we could determine, 25.1 per cent were adult and 74.9 per cent immature. At least 8.4 per cent were nestlings. Of 14 comparable mammals, 21.4 per cent were adult and 78.6 per cent immature.

Nine bird and one mammal species constituted 73.7 per cent of the 213 completely identified food items brought to the young Cooper's Hawks, although the total list included 30 to 33 species of birds and 10 of mammals. The Chipmunk was the second most abundant item of prey. Three of the nine birds

(English Sparrow, Starling, and Red-wing) occurred locally in concentrations, although the first two were decidedly scarce on the Reserve itself. Five characteristically leave cover and fly out across the open (Blue Jay, Flicker, Mourning Dove, Robin, and Baltimore Oriole). All of these eight species were moderately common in the neighborhood, although only one (Red-wing) was among the most abundant of the Reserve's nesting birds. The ninth (Ring-necked Pheasant) was represented only in 1941 and 1942, a time of relative abundance in the farmlands surrounding the Reserve, and not at all in 1946, a time of scarcity.

The food brought the two young Red-tailed Hawks and one young Barred Owl was largely small mammals plus a few birds, amphibians, snakes and insects.

Literature Cited

Edge, Rosalie, and Ellsworth D. Lumley

1940 Common hawks of North America. Emergency Conservation Committee, Publ. 81.

Errington, Paul L.

1932 Technique of raptor food habits study. *Condor*, 34: 75–86.

1933 Food habits of southern Wisconsin raptors. Part II. Hawks. *Condor*, 35: 19–29.

Fisher, Albert K.

1893 The hawks and owls of the United States in their relation to agriculture. *U. S. Dept. Agric., Div. Orn. and Mamm., Bull.* 3.

Fitch, Henry S., Ben Glading, and Verl House

1946 Observations on Cooper Hawk nesting and predation. *Calif. Fish and Game*, 32: 144–154.

Hausman, Leon A.

1928 The hawks of New Jersey and their relation to agriculture. *N. J. Agric. Exper. Sta., Bull.* 439.

1948 Birds of prey of northeastern North America. Rutgers Univ. Press, New Brunswick, N. J.

May, John B.

1935 The hawks of North America. Nat. Assoc. Audubon Societies, New York.

McAtee, W. L.

1935 Food habits of common hawks. *U. S. Dept. Agric., Circ.* 370.

McDowell, Robert D.

1941 The Cooper's Hawk in Pennsylvania. *Penna. Game News*, 12 (1): 4.

O'Roke, E. C., and F. N. Hamerstrom Jr.

1948 Productivity and yield of the George Reserve deer herd. *Jour. Wildl. Mgt.*, 12: 78–86.

Snyder, L. L.

1932 The hawks and owls of Ontario. Roy. Ont. Mus. Zool., Handbook 2.

Tinbergen, L.

1946 De Sperwer als roofvijand van zangvogels. *Ardea*, 34: 1–213.

Uttendörfer, O.

1939 Die Ernährung der deutschen Raubvögel und Eulen und ihre Bedeutung in der heimischen Natur. J. Neumann-Neudamm, Berlin.

Wisconsin Conservation Department, Plainfield