

THE FEEDING RANGE OF CERTAIN BIRDS.

BY WILBUR K. BUTTS.¹

INTRODUCTION.

DURING recent years a vast amount of information has been collected regarding the range, migration, breeding habits, and nature of the food of nearly all our common birds. There is, however, very little known concerning problems connected with the life of individual birds. How long a bird lives, how fast it travels in migrating, whether the individuals of a resident species present in the winter are the same as those present in the breeding season, are questions about which we still know very little. Likewise we know little about the feeding range of individual birds. Bird banding has just begun to throw some light on these questions. Many observers have spent hours near the nests of birds determining the kind and amount of food brought to the young, but few, if any, have noted where the food has been procured. As F. C. Lincoln, in an article on "The History of Bird Banding,"² remarks, "The distance that birds range from their nests foraging for food has never been determined."

Some information concerning the winter feeding range has been gained by Mr. S. Prentiss Baldwin in his bird banding operations near Thomasville, Ga.³ This investigator found that with traps set about one hundred yards apart "repeaters" (birds returning again and again to the traps) were rarely taken more than one trap away from their usual station, showing that their range was surprisingly restricted.

Bird banding operations were conducted at Thomasville in 1923 by T. E. Musselman.⁴ In order to determine how local was the distribution of the birds he was catching, Mr. Musselman took one

¹ A contribution from the Ornithology Laboratory at Cornell University.

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² 'Auk,' 1921, pp. 217-228.

³ 'Proc. Linn. Soc.' N. Y., 31, 1919, pp. 23-26.

⁴ 'Auk,' 1923, pp. 448-450.

trap from its usual position and placed it half a mile beyond the last of his line of traps. Here daily catches were large, but scarcely any new birds were taken. Nearly all were Chipping Sparrows which had been banded during the first week of his operations, and which had moved, either because of a desire for different food, or because of the flocking instinct preparatory to leaving for the north. But few of these birds returned to the principal string of traps. The trap was later taken two miles away. Here only one haul was made, catching 15 or 20 birds. These were all new.

One particularly interesting case showing restriction of winter feeding area, is told by Dr. J. B. May who carried on bird banding work near Thomasville in 1924.¹ A Brown Thrasher, which was named "Peg Leg" because of a missing left foot, was caught several times during the winter in one of two traps. Finally the bird was taken to Thomasville, about two miles away, to be photographed. At the door of the studio "Peg Leg" escaped, and disappeared in the tops of the trees. Eight days later it appeared again at its old haunts. Thereafter it repeated at frequent intervals in one of two nearby traps, never going to others a hundred yards or so from its favorite roosting place in an old wisteria vine.

W. L. McAtee of the Biological Survey also expressed the opinion that birds do not travel far while on their winter feeding grounds. In a note on 'The Search for Food by Birds'² he remarks, Birds go over the same places. Various birds have more or less regular beats which they cover approximately on schedule. Their system of food-finding is to look everywhere in their domain, searching all day every day in the comparatively restricted area to which they appear to confine themselves.

By far the most important work on the local movements of birds has been done in England by H. E. Howard. He says in the preface to his book 'Territory in Bird Life'³ "When studying the Warblers some twenty years ago, I became aware of the fact that each male isolates itself at the commencement of the breeding season and exercises dominion over a restricted area of ground. Further investigation, pursued with a view to ascertaining the re-

¹ 'Auk,' 1924, p. 459.

² 'Auk,' 1920, pp. 341-344.

³ London, 1920, John Murray Publisher.

lation of this particular mode of behavior to the system of reproduction led to my studying various species, not only those of close affinity but those widely remote in the tree of avian life."

Since Howard's work has an important bearing on the present investigation, a brief summary of the more important of his findings is herewith given.

(1) At the beginning of the breeding season each male seeks out a favorable locality for the attainment of reproduction, and, occupying a limited area, isolates itself from its companions. This area, over which it exercises dominion, is known as its territory.

(2) The boundaries of such territories are in some cases remarkably definite, but they should not be thought of as lines definitely delimiting an area of which the bird is cognizant. The territory is established on the principle of habit formation. After seeking out a suitable environment each male, in response to its inherited nature, finds a place unoccupied by any other male, and settles in it. The bird then soon wanders away from the position in search of food, and returns. Presently it wanders away again, perhaps in another direction, but as before, works its way back again to headquarters. It repeats these journeys, and thus gradually forms a habit which compels it to remain within more or less well defined boundaries. The actual distance it travels must be determined to some extent by the abundance of food it is seeking.

(3) Each male keeps all other individuals of the same species, and, in some cases other species, away from its territory by fighting.

(4) Having thus established a territory the male proceeds to sing, usually from certain conspicuous posts, almost always within the territory, thus warning other individuals away, and advertising the fact that he is ready for a mate. If the males sing during migration or before establishing a territory, they are not then in full song.

(5) The females arrive on the scene later and seek out the singing males.

(6) The advantages to the species of such a system are many. Among the more important are these. It insures that the species will be evenly distributed over all the breeding grounds. It provides that the females can easily find the males at the proper moment. Finally, it insures an adequate supply of food in close

proximity to the nest for which the pair will not have to compete with other individuals.

(7) Each pair however does not necessarily obtain all its food within its territory. In case of the Guillemot, for example, which nests in colonies on cliffs, and has but a few square feet of territory, the principal object in establishing a territory is to secure a suitable nesting site, rather than to exercise dominion over a certain feeding area. At the other extreme there are certain Warblers which find plenty of room for their nests, but which must have an abundance of food close at hand. Since the young at birth are so delicate and susceptible to changes in temperature, the parents cannot afford to be absent from them long. Such birds obtain all their food within their territory. There are other species which obtain part of their food within the territory, and at times resort to common feeding grounds.

METHODS.

The method used for determining the feeding range of the birds in the present investigation was to trap and mark them so that the different individuals could be identified at any time. A record was kept of the places where these individuals were seen, and in some cases their movements were followed in order to determine just how much ground they covered.

Eighty one birds of the following species were marked:—Downy Woodpecker 3, White-breasted Nuthatch 7, Chickadee 14, Junco 15, White-throated Sparrow 1, Song Sparrow 14, Tree Sparrow 26, Robin 1. A few unmarked birds which could be identified by their nests were also studied.

The trap used at the winter feeding stations was of the inverted tray type which drops when released by a pull string. Later on small automatic cage traps, which operate by the bird stepping on a platform thus releasing the door, were used. These proved much more satisfactory, as several traps could be operated at the same time, and they did not have to be closely watched by the operator.

The location of the trapping and feeding stations where the birds were watched for, is shown on the map, p. 338.

Permanently marking the birds so that they could easily be identified at any time proved to be the most difficult part of the

problem. Bird bands as supplied by the Biological Surveys are of value for identification only when the bird is recaptured. For this reason, in addition to placing aluminum bands on their legs, an attempt was made to paint or dye the feathers. The idea of painting birds is not a new one. It was, in fact, used before bird banding was undertaken. F. C. Lincoln, in an article on "The History of Bird Banding."¹ remarks, "The earlier investigators marked their birds in a variety of ways, such as dyeing or staining the flight or tail feathers, attaching memoranda written on parchment, or mutilating feathers, feet, or bill."

Ernest Thompson Seton, in a note in 'The Auk' for October 1921,² also mentions marking some Snowflakes with printer's ink.

A number of experiments in coloring have been carried on by the Department of Ornithology at Cornell University for several years. Various organic dyes and colored India inks were tried but none proved to be sufficiently permanent when applied to living birds. A paint with turpentine as a base was used on one occasion, but this became gummy or sticky on drying, so that the feathers were matted together, leaving a bare spot on the breast of the bird. Consequently in the present investigation no paints of this nature were used for fear of causing injury to the bird. For the same reason mutilating the feet, bill, or feathers was not tried.

In order to test the permanence of the various stains, feathers of the domestic fowl were colored, allowed to dry, then soaked in water over night, and thoroughly washed. Those which still showed a fairly good color after this treatment, were then exposed to sunlight, wind, and rain until they faded. The more permanent colors were then tried on living birds. As a general rule the colors faded somewhat more quickly on living birds than they did on the test feathers exposed to the weather.

The following substances were tested:—silver nitrate, iodine, picric acid, indigo, carmine, congo red, methyl blue, methyl green, Hoffman's green, orange G, saffranin, gentian violet, indanthrene blue B, anthraflavone GC, thio indigo red B, indanthrene golden orange G, pontamine yellow, pontamine red, acid fuchsin, basic fuchsin, and artists' oil colors mixed with carbon-tetrachloride.

¹ 'Auk,' 1921, pp. 217-228.

² 'Auk,' 1921, p. 611.

Alcohol was used as a solvent for all dyes which would dissolve in it. If insoluble in alcohol, water was used, and the feathers were first washed with ether, alcohol, or carbon-tetrachloride to remove the grease.

In addition to being stained the bird was recorded by banding with the standard aluminum leg bands furnished by the Biological Survey.

Of all the stains tested, basic fuchsin and artists' oil colors mixed with carbon-tetrachloride proved the most satisfactory, and these were the only ones used to any extent on live birds. The length of time which the colors remained bright varied considerably with different individuals and different species. The following table indicates the length of time the colors lasted on some of the birds marked.

Species	Stain used	Length of period in days	Condition of color at end of period
Tree Sparrow	Artists' Oil Color	9	Bright
" "	Fuchsin	15	"
" "	"	16	Faint
" "	"	22	Bright
" "	"	23	Very faint
Chickadee	"	18	Faint
"	Artists' Oil Color	52	"
Junco	" " "	14	"
1 Downy Woodpecker	Fuchsin	11	Bright
1 " "	"	34	Very faint
1 " "	"	54	Practically gone
2 Nuthatch	"	10	Bright
2 "	"	26	"
2 "	"	42	Very faint
3 "	Artists' Oil Color	32	Bright
3 "	" " "	61	Very faint
3 "	" " "	90	Gone

Those with the same numbers are observations at different periods on the same individual. The length of the period is the time which elapsed between staining and recapture. In some cases

where the individuals were easily recognized, recapture was unnecessary to determine the condition of the color. "Bright" indicates that the color was almost as distinct as when applied, so that the bird was conspicuous and would immediately attract one's attention. "Faint" indicates that the color had faded considerably, but was still distinct enough to easily identify the bird. "Very faint" indicates that the color had so far faded that it could not be seen except under favorable conditions. Birds with the color very faint could still be identified if watched closely, but the color would not be noticed unless the observer were looking especially for it.

From the above table it may be seen that the color could not be depended upon to be bright enough to attract one's attention for more than ten days or two weeks after application. It is very desirable to have the color conspicuous enough to attract the attention of other observers so that more data may be collected. The color, however, was sufficient for the purpose of identification for at least three weeks in every case.

In order to obtain a more permanent method of marking, some colored leg bands were devised. Mr. C. L. Whittle in a note in 'The Auk' for 1925, p. 136, mentions the coloring of the standard aluminum bands by means of Diamond Dyes. After staining, the bands were varnished. The color, however, wore off within thirty days. Acting on this suggestion, some colored bands were made by cutting pieces of celluloid out of a small tray, purchased at the ten cent store, boiling them in some dyes for a few moments, and then bending them into the proper shape while still hot. The bands thus made were a little wider than the standard aluminum bands, in order to be more easily observed, but were used in the same manner. As they would not bend as easily as aluminum bands, they were harder to adjust on the leg of the bird, but after a little experience in preparing them, satisfactory results were obtained. Birds thus banded were also stained. After two weeks on a Song Sparrow, the colored band served as a much better means of identification than the color on the feathers. After a month the color near the lower edge of the band was somewhat worn off. The band served as a satisfactory means of identification throughout the nesting season. Doubtless bands could be manu-

factured of colored celluloid which would serve for the entire life of the bird.¹

It might be well to state here that in most cases the birds did not appear to be in the least injured by the application of the colors. A Tree Sparrow painted at one station was the first bird to be caught at another station about fifty yards distant, twenty minutes after he had been stained. Whenever a bird was watched after being colored and banded, it was observed to sit quietly for fifteen or twenty minutes, drying and preening its feathers, and attempting to remove the band. It usually appeared to be more worried about the band than about its brilliant plumage. It would soon begin to feed about with other individuals, which took no notice of the strange appearance of the colored bird. In two instances the birds appeared to be somewhat overcome either by fright or by the fumes of the carbon-tetrachloride in the stain. They remained on the ground for several minutes after being released before flying slowly away. Subsequent captures of both of these birds, however, proved that this condition was only temporary. Only one case of possible permanent injury occurred. A female Song Sparrow, which had been incubating for several days, did not return to the nest after being stained, and entirely disappeared from the neighborhood. Inasmuch as it had been handled in exactly the same manner as the other eighty birds which suffered no injury, it may well be that its disappearance was due to some other cause.

Since completing this work a paper has been received from Dr. Rudolph Drost telling of some bird coloring experiments in Germany.² This author was able to produce a stain with which he colored birds so that at the end of seven weeks the color was still as bright as on the day it was applied. Unfortunately he does not state what substance was used. He merely states that the mixture contained certain organic solvents which dissolved the oil and enabled the color to penetrate the horny substance of the feathers. Letters of inquiry to Dr. Drost were not answered.

¹ cf. also Burkett, 'Brit. Birds,' xvii, 295.

² 'Ornith. Monatsber.' March, 1925.

OBSERVATIONS ON THE WHITE-BREASTED NUTHATCH
(*Sitta carolinensis carolinensis*).

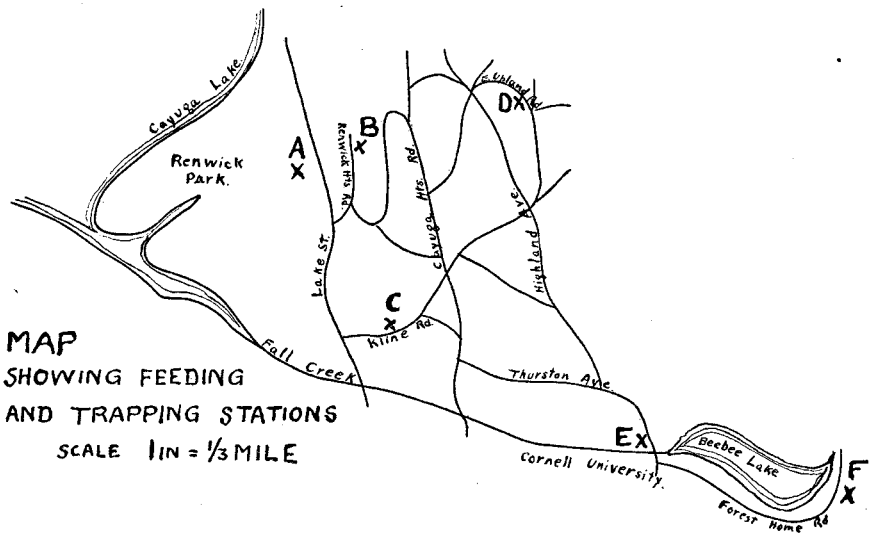
The first point noticed in the investigation of this species was that the birds are almost always found in pairs. This habit has been noticed by other observers. E. D. Sanderson, writing of the Nuthatch in Michigan,¹ says, "The birds are invariably found in pairs. In only one instance did I find half a dozen together on a river bank which doubtless were several pairs. The timber in this neighborhood consists of small lots of a few acres, and each of these will ordinarily be occupied by only one pair of Nuthatches."

In the present study nine pairs in the area under observation, about two square miles, were found. There may have been others. The first week in April a flock of about eight Nuthatches was reported. This was very likely a group of migrating birds, as they were not seen again in the neighborhood. Occasionally single birds were seen. In most cases these were birds which had temporarily become separated from their mates, and were calling loudly. It was frequently noticed that when a pair became separated the male would call loudly. The female would usually take her time before flying in the direction of the male, but would eventually seek him out. It did not appear, however, that the female followed the male any more than the male followed the female. In starting on a flight across an open field sometimes one would go first, sometimes the other. While searching about for food during the winter they kept up a continual chatter of low notes, presumably in order not to get separated. This made them easy to follow. During the nesting season, however, they were more quiet, but at the same time much more active, so that it became extremely difficult to keep up with them.

In the course of the study it soon became apparent that each pair did not wander freely about, but had a definite, restricted, though fairly large feeding range. No Nuthatch was reported at a feeding station other than the one at which it was trapped, with the exception of a pair which went freely between stations A and B. These, however, were only 300 yards apart. (See maps, pp. 338, 339.) As a rule only one pair fed regularly at each station, although others paid occasional visits.

¹ 'Auk,' 1898, p. 145-148.

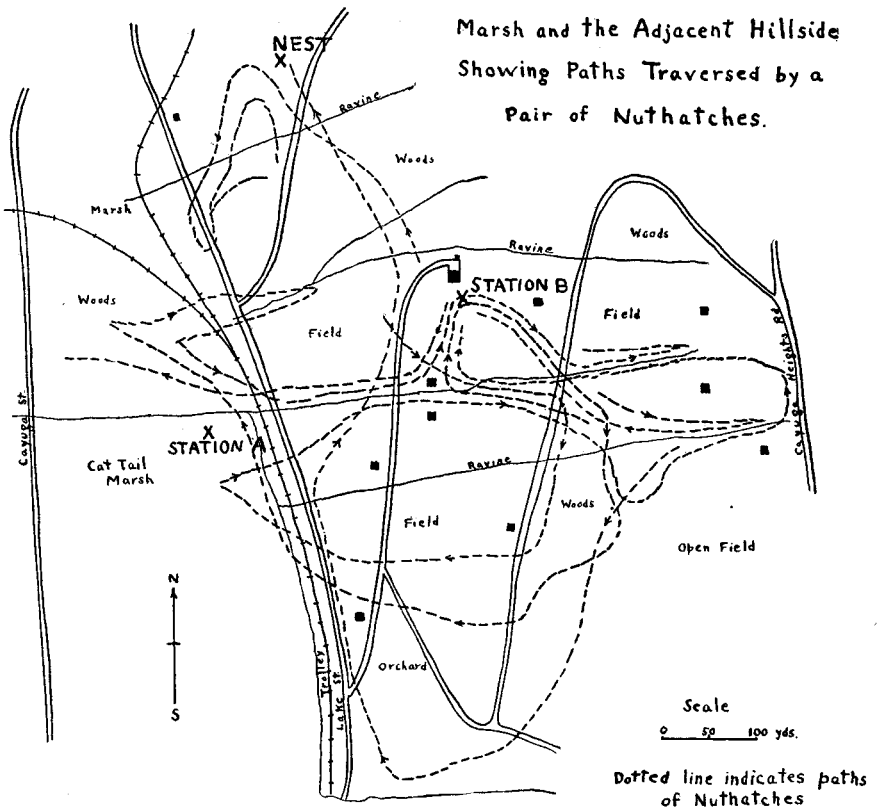
The map (p. 339) shows the principal paths travelled by a pair which were trapped in January, 1925, and stained red on the breast. They were recaptured several times, and restrained each time, so that the colors served for identification throughout the period in which they were under observation. The total time spent on their trail was seventeen hours on different occasions between February 1 and April 15. The longest period of continuous observation was for six hours on February 24. It was not



possible to plot on the map all the paths traversed during the entire seventeen hours without greatly confusing it, and so, in the main, only those which indicate the amount of ground covered are shown, the remaining paths being largely within the region south-east of station B. This area was evidently their headquarters, as it served as a starting point for their journeys, and was a place to which they returned again and again. It may be that the nest of the previous year was located here. In addition to the time spent in actually following the birds, they were seen many times at the feeding stations A and B, and at various points within their range as indicated on the map. Apparently the birds kept more

to the southern part of the range at first but increased the area covered to the northward on the approach of spring. The total area to which the birds confined themselves was about 48 acres, about half of which is covered with a growth of mixed hardwoods,

Map of a Portion of Renwick Marsh and the Adjacent Hillside Showing Paths Traversed by a Pair of Nuthatches.



the remainder being open fields with rather thickly scattered oaks, elms, and locusts. The ground slopes steeply to the west, and is crossed by several small ravines.

It may be noticed that the birds were not observed in the area shown in the northeast corner of the map, although this was suitable feeding ground. It may be that, by chance, they did

not wander in that direction when under observation, but more likely it was because that section was the territory of another pair which was seen there once, and which occasionally fed at station B. Still another pair of Nuthatches occupied the wooded region to the west of the map. This pair never fed at station A so far as known.

That the birds were active in the defense of their territory, at least after the approach of spring, was shown by the fact that on April 4 a strange Nuthatch approached their territory from the east. It was immediately chased by the pair along the eastern edge of their territory to a point somewhat beyond where they had ever been observed to go before. Here the chase was abandoned, and they returned to more accustomed paths.

Their nest was built in a knot hole in a white oak on the extreme northern limit of their previously observed range. During the nesting season it was extremely difficult to follow their movements, as they seldom uttered their call notes, and would frequently fly some distance from the nest before starting to search for food. Accordingly one could seldom follow them far, and it was not possible to determine accurately the maximum distance travelled from the nest. They were once seen 800 ft. from the nest and twice were followed a distance of 600 ft. as well as shorter distances a number of times.

Another pair of Nuthatches which was studied inhabited a strip of woodland about half a mile long and from 100 to 200 yards wide, along the south shore of Beebee Lake. They were trapped and stained orange on the breast at station F. They were not reported from station E, although they were observed to feed just across the street from it. Station E was used for photography, and if these birds fed there, they doubtless would have been noticed.

On March 6, while near the extreme eastern limit of their territory, another pair of Nuthatches approached from the east. They finally flew into the same tree where the female of the orange-stained pair was feeding. The male was a short distance away, too far to be able to see the other birds, although he must have been able to hear them. There was no fighting. After a few moments the unmarked pair flew off in the direction from which they had come. The observer followed them and found that they occupied an area to the east of the orange-stained pair.

On March 24 the orange-stained pair, when somewhat outside of their usual feeding range, again encountered two unmarked Nuthatches. Both pairs fed together peaceably for several minutes in the same grove of trees.

These two instances would seem to indicate that Nuthatches are not active in the defense of their territory during the winter, but it may very well have been that, since in both cases they were at the extreme limit of their observed range, the birds did not consider that their territory was being invaded.

On April 13, after several days of warm weather, the orange-stained pair chased another Nuthatch along almost the entire southern edge of their territory as far as the western end. Here they turned back and started feeding as usual.

The orange pair nested near the center of their winter feeding range. Another pair stained green at station C in January also nested in the vicinity of the feeding station. Three pairs of Nuthatches, then, banded between January 9 and February 13, nested not far from the station where they were captured. Six other pairs observed during the winter, but which were not banded, were still present, with possibly one exception, at the beginning of the nesting season, the last of April; or at least birds occupying the same territory were present. No Nuthatches were seen in the spring which were not accounted for by the winter records, with the exception of the flock of eight previously mentioned. Therefore it seems probable that all individuals of this species which winter in this locality are permanent residents, and therefore that the birds which are only summer residents farther north spend the winter south of Ithaca.

Dr. W. M. Tyler¹ also tells of a Nuthatch which was apparently permanently resident at Lexington, Mass. The same bird, or one which he supposed to be the same bird, came to his feeding shelf practically every day for over a year with the exception of an interval between June 6 and 16, 1914.

OBSERVATIONS ON THE CHICKADEE
(*Penthestes atricapillus atricapillus*).

Evidence regarding the feeding range of this species is somewhat conflicting. While following the Nuthatches in the vicinity of

¹ Wilson Bulletin, 1916.

stations A and B during February and the early part of March, a flock of about six Chickadees, most of which had been banded at stations A and B, were frequently in evidence. For perhaps one fifth or one sixth of the time when under observation the Nuthatches and Chickadees were together. This flock, or a portion of it, could nearly always be found in the neighborhood. When attempts were made to follow them, they were found to keep to the same general range that the Nuthatches did. They were more difficult to follow, however, and long continued observations were not made. In April the flock broke up. At least one banded pair, probably stained early in March, nested in the neighborhood.

On the other hand, there are some records of Chickadees being reported at stations at some distance from the one at which they were stained. A bird stained December 19 at station A was seen December 25 and several times during January at Station D, having travelled a distance three-fourths of a mile of semi-wooded country. Another Chickadee, or possibly the same one, stained at station A December 19 was seen about a week later at station C a distance of half a mile in almost the opposite direction.

One banded pair, probably captured during January at station C, nested in a hole in a telegraph pole about one fourth of a mile from this feeding station.

Four Chickadees stained at station F were frequently seen in the vicinity during February and March and two of them were still present in the breeding season.

The fading of the colors which distinguished the birds hampered getting more complete and reliable data on this species.

Inasmuch as at least three pairs nested within or near their winter feeding range, while others were apparently only winter residents, it seems reasonable to suppose that the permanently resident individuals had a restricted feeding area, while those which came to this region in the fall or early winter wandered about for a time before settling down in an area near a feeding station. On the other hand, the flocks may have been family groups, each consisting of a pair with the young of the previous season, the young ones leaving during April to nest elsewhere.

One of the marked Chickadees was first banded by Dr. A. A. Allen on March 7, 1921, and was recaptured at the same station

six times on the following dates:—March 7, 1921; April 29, 1921; December 21, 1922; December 2, 1923; February 18, 1924; January 25, 1925.

OBSERVATIONS ON THE DOWNY WOODPECKER
(*Dryobates pubescens medianus*).

The case of the Downy Woodpecker is similar to that of the Chickadee. A flock of five or six were frequently associated with the Chickadees and Nuthatches. One of these was banded November 8, 1924 at station B but was not painted until January 17, 1925. It was seen about a dozen times between January 17 and April 17, and was followed for five or six hours. It apparently stayed within the same area occupied by the Nuthatches and Chickadees and possibly nested there.

OBSERVATIONS ON THE TREE SPARROW
(*Spizella monticola monticola*).

It was not found practical to follow individuals of this species for any length of time. They were wary and would usually soon disappear in a tangle of weeds or cat-tails. Twenty-two individuals were stained at stations A and B during December, January and February. Between these two stations 300 yards apart they appeared to travel freely. All but eight were recaptured at least once, some of them five or six times, at station A or B. One of them, banded January 10, was recaptured January 27 at station C half a mile away. With this exception no stained birds were ever seen except in the immediate vicinity of the station where captured. Tree Sparrows were abundant in the marshes to the west. Numbers of stained birds could always be found in the immediate vicinity of station A. How much their apparent restriction to one locality may be due to the presence of the feeding stations we may only surmise, but it is not thought that the presence of the feeding station had very much influence, because the food was not kept at the stations continuously. Marked birds were still around when food had not been put out for a week.

OBSERVATIONS ON THE JUNCO
(*Junco hyemalis hyemalis*).

Like the Tree Sparrows these birds could not be followed long. Twelve individuals were stained during January and Feb-

ruary at station F where they inhabited a thick growth of young pine trees. During February and most of March, marked birds could always be found in the immediate vicinity, and were never seen farther than 100 yards from the feeding station, thus indicating that their winter feeding area was quite restricted.

Mr. C. L. Whittle and L. B. Fletcher¹ report that out of fifty-seven Juncos banded, many repeated frequently at the same station, but only one was ever taken at another station, although there were three other stations within two miles. Fourteen of the banded birds returned the next year to the same station.

These same investigators also report that the Goldfinch wanders freely about from place to place. Recoveries at one station of birds banded at another are matters of nearly every day occurrence.

OBSERVATIONS ON THE SONG SPARROW (*Melospiza melodia melodia*).

There are not sufficient data to draw any conclusions regarding the winter feeding area of this species. One individual, however, stayed in the vicinity of station A from December 19 until March.

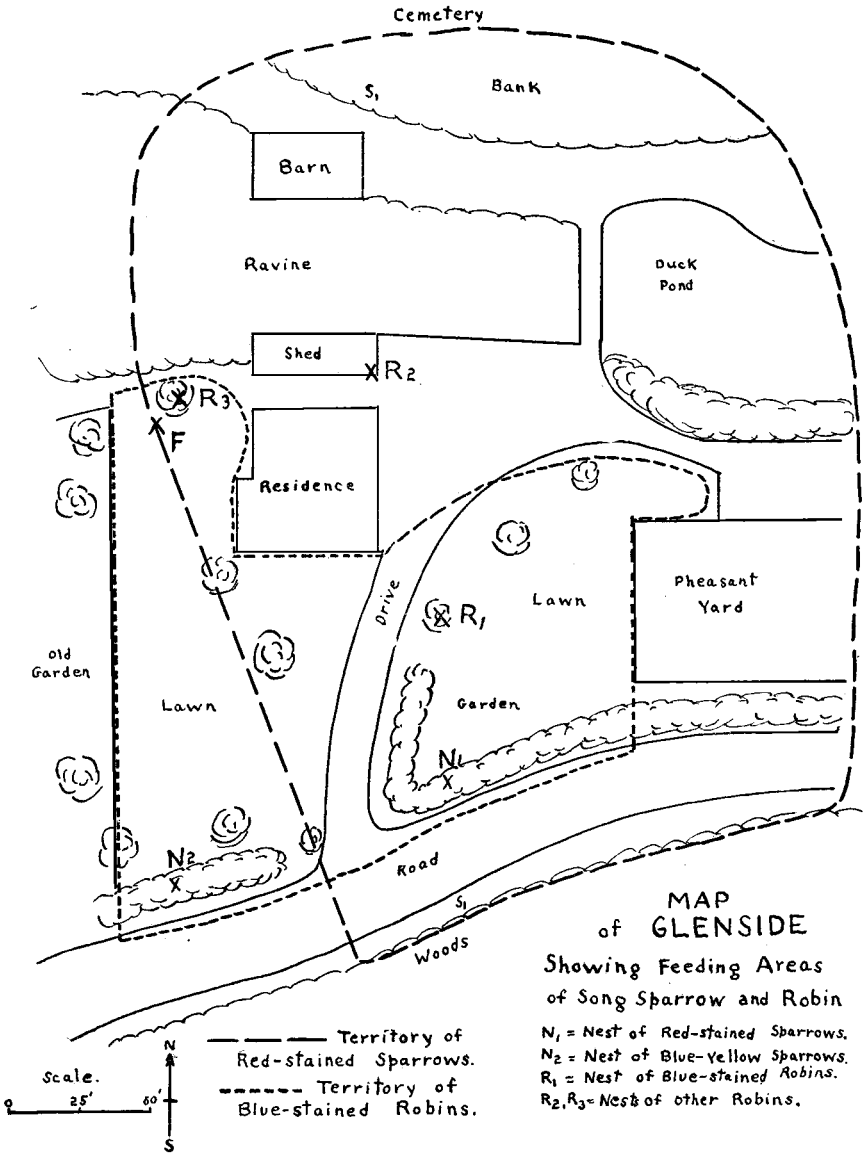
During the nesting season two pairs offered an interesting problem in the study of bird territories. Their nests were built in a low hedge of spruce one hundred feet apart. Each pair had a definite feeding area which was not encroached upon by the other pair. Unfortunately the behavior of the birds while establishing their territories was not observed, as the study was not begun until the nests had been built and the eggs laid.

The male of one pair was stained red on the right side, and provided with a red celluloid band on the right leg to serve for identification in case the color on the feathers faded too quickly. The female of this pair was stained red on the left side, and provided with a white celluloid band on the left leg. For convenience we will call this the red pair.

The male of the other pair was stained blue on the breast, and provided with a standard aluminum band. The female was stained orange on the breast, and provided with a yellow band. For convenience we will call this the blue-yellow pair.

As shown by the map (p. 345) the boundary line between the

¹ 'Auk,' 1924, pp. 327-333.



territories of the two pairs was just half way between the nests. The behavior of the birds while feeding on the lawn close to this line was carefully observed. This boundary must not be thought of as a distinct line which was never crossed by the birds, but none of the birds was seen to go over into the territory of the other pair for a distance greater than four or five feet, until after the blue-yellow pair deserted their territory. They fed a great deal on this portion of the lawn, and were under observation for several hours on different occasions. Occasionally the two males hopped about within a foot or two of each other beneath a shrub midway between the two nests: Each always stayed between his own nest and the other bird. Once while thus feeding beneath the shrub the red male apparently transgressed a little too far, and he was attacked by the blue male. As the red male stood his ground the fight ceased almost as soon as it had begun. On another occasion the red female was driven away by the blue male from a feeding station (marked F on the map) on the boundary line between their territories, but usually they fed there peaceably.

After the female of the blue-yellow pair was caught and stained, she did not reappear at the nest to finish incubating her eggs, although she had been in the trap not more than five minutes. This bird, as explained in the discussion of the effects of staining, was not seen again in the neighborhood. Her mate kept to his territory, and sang as usual for about three weeks. It was expected that he would obtain another mate, but none came. One day he flew over near the nest of the red female, while she was feeding her young, perhaps to try to entice her away. He stayed near her for several minutes but she paid no attention to him, and he finally flew away. The red male was not present at this time. After about two weeks without his mate he began to desert the portion of his territory nearest the red pair, and soon he was singing and spending most of his time in the old garden which constituted the lower part of his territory. At the end of three weeks he too disappeared, and was seen no more.

For a few days after the blue-yellow male had deserted the upper part of his territory, the red pair kept to their accustomed feeding grounds. Soon, however, they increased their area until it included all that of the blue-stained male. Soon after the blue-

stained male had entirely disappeared, the three young of the red pair left the nest. Two of them made their way into the old garden which had formerly been the territory of the blue-stained male, while the third went in the opposite direction. Thereupon the red male ceased singing in the vicinity of his nest and began to sing in two places, one in the old garden where two of his fledglings were hidden, and one in the upper part of his former territory where his other fledgling had wandered. Thereafter the old birds searched for food not far from the young instead of in their old territory.

It would thus seem that after the young had left the nest the territory was in the vicinity of the young.

As shown on the map, the territory of the red pair was bounded on the south by the edge of the woods, and on the north by the territory of still another pair which inhabited the cemetery. To the east it was not sharply delimited. Once the female wandered a distance of 100 yards up the ravine in this direction. The total area of the territory of the red pair was about 7000 square yards, a part of which was taken up by buildings and a small duck pond. The area available for feeding was about an acre. The extent of the territory of the blue-yellow pair was not ascertained before they disappeared.

OBSERVATIONS ON THE ROBIN (*Planesticus migratorius migratorius*).

Three pairs of Robins were under observation at station C. Only one pair, however, fed on the lawn. The nest of this pair was in a small spruce tree near the southeast corner of the house, as shown on the map (p. 345). The female was stained blue, and although the male was not captured and stained, for convenience we will call them the blue pair. The other two pairs fed in the ravine or in the cemetery to the northward. Once the blue female was observed to chase an unmarked female from the lawn near the tree in which the unmarked one was nesting.

The blue pair obtained most of their food from the lawn and the adjacent roadside, an area of 2,500 square yards or a little more than half an acre. They also fed at times across the road in an old field which had recently been burned over. This field, how-

ever, was not a part of their territory, since at least two other pairs also frequented it.

When the young left their nest they made their way into the woods across the road. Thereafter the parents searched for food to some extent in this woods, but for the most part still came back to the lawn. One of the young wandered a short distance down the road to the edge of a lawn in front of a neighbor's house. On this lawn its parents could easily have obtained food, but instead they always flew back to their old haunts to find a tender morsel for the youngster. The neighbor's lawn was doubtless the haunts of another pair on whose territory they did not attempt to trespass.

When able to begin to take care of themselves, the young birds fed partly in the woods and partly on the lawn frequented by their parents.

This lawn was also the feeding grounds of the two pairs of Song Sparrows already mentioned, several House Sparrows, and a Bantam hen with three chicks.

The nest for the second brood was placed in a tree overhanging the road. Time did not permit the carrying of the study further.

That Robins may on occasion travel some distance, is shown by the report of a Robin which was seen by A. H. Norton¹ crossing a passage of water between an island and a point, a distance of half a mile, carrying nesting material. Mr. Norton also says that on another occasion a Robin was under observation for nine hours one day and again nine hours the next day, during which time it occupied a section of the yard not exceeding 50 x 100 feet. During these eighteen hours, the bird was not out of sight for more than two minutes at a time, thus indicating the narrow limits within which it remained.

SUMMARY.

1. White-breasted Nuthatches travel in pairs throughout the winter.
2. Each pair has a definite winter feeding territory.
3. The winter feeding range of one pair of Nuthatches under observation was 48 acres, about half of which was wooded. The

¹ Bull. Essex Co. Ornith. Club, 1923.

range of another pair was about 25 acres, nearly all of which was wooded.

4. Three pairs of Nuthatches under observation nested within their winter feeding territory.

5. Nuthatches range at least 800 ft. from the nest in search of food.

6. Most, if not all, the individuals of the White-breasted Nuthatch wintering near Ithaca, N. Y., are permanent residents.

7. The data regarding the winter feeding ranges of the Chickadee and Downy Woodpecker are not conclusive, but apparently their ranges are similar to that of the Nuthatch.

8. Some of the individuals of the Chickadee present in winter are permanent residents.

9. The daily feeding ranges of Tree Sparrows and Juncos in winter are quite restricted.

10. The territory occupied by one pair of Song Sparrows under observation during the nesting season was 7,000 square yards, of which about one acre was available for feeding. They obtained practically all their food within this area until the young left the nest, when they followed the young.

11. The territory of this pair was restricted by the presence of another pair of Song Sparrows occupying an adjacent territory, and was enlarged when the neighboring pair disappeared.

12. The territory occupied by the pair of Robins under observation consisted of a lawn and roadside with an area of 2,500 square yards. They obtained most of their food within this area, but at times resorted to common feeding grounds. They continued to hunt most of the food for the young within this territory even after one of the young had moved 150 yards from the nest into another equally good feeding area. In this respect they were quite different from the pair of Song Sparrows.

CONCLUSION.

Since this study occupied a period of only six months, and was confined to a few individuals, any comprehensive statements, other than those given in the foregoing summary, cannot be made. We may say, however, that the results are in accord with Howard's theories concerning the part territories play in bird life. It is

evident also, that the method of study by marking individuals with stains or with colored bands opens up promising fields for future investigation.

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