WINTER STUDIES ON THE TREE SPARROW, *SPIZELLA ARBOREA*[1]*

By THEODORE DAVID SARGENT[2]

INTRODUCTION

Two general factors operate to produce and maintain an aggregation of birds. These are: (1) the attraction of individuals to a locality, such as a source of food or protection, and (2) the social attraction of individuals to each other. This investigation is an attempt to shed some light on the relative importance of these two factors in the maintenance of winter flocks of Tree Sparrows. By means of a color-banding project during the winter 1957-58, answers to the following questions were sought: How stable, in time and space, are winter flocks of Tree Sparrows? How much wandering do these birds exhibit? What pattern of dispersal occurs upon withdrawal of a food supply of these birds? To what extent can "homing instinct" be demonstrated in the Tree Sparrow?

Relatively permanent winter flocks with restricted ranges have been reported in the Slate-colored Junco (Whittle and Fletcher, 1924), crowned sparrows (Price, 1931), and Black-capped Chickadee (Butts, 1930-31; Wallace, 1941). For the Oregon Junco the suggestion has been put forward that individual birds become integrated into a stable flock by frequenting a common feeding circuit (Sabine, 1955).

On the other hand, Wallace (1942) characterized wintering groups of Tree Sparrows as loose associations. Likewise, Heydweiller (1935) concluded that wintering Tree Sparrows exhibit too much wandering to permit uniform flock structure. In a continuation of her study (Baumgartner, 1938) she concluded that most individual Tree Sparrows have a winter range of from 500-1,700 feet. She correlated longer wanderings (up to her observed maximum of 6,800 feet) with three factors: fall settling, spring excitement, and mid-winter storms. However, a social organization, described as a straight-line pecking order modified by reverse pecks, has been observed in Tree Sparrow winter flocks (Sabine, 1949).

In reviewing some of the work on wintering groups of various species, some difficulty in adequately defining the term "flock" becomes apparent. For the purposes of the present study, "flock" will refer to an aggregation of individuals of the same species forming a separate unit within the population at any given time. It seems preferable to me to apply adjectives to this general term, rather than to change the use of the term to fit different observations on various species or to introduce many new terms.

*Published with the aid of a grant from The Guy Chester Crampton Research Fund of the University of Massachusetts.

[1]This paper represents the major part of a Senior Thesis submitted for Departmental Honors in Zoology at the University of Massachusetts, May, 1958.

[2]Present address: University of Wisconsin, Department of Zoology, Madison, Wisconsin.

MATERIALS AND METHODS

Three banding stations were established around the center of Amherst (Fig. 1, A, B, C). Three Mason traps, baited with a 2:1 mixture of chick-scratch and Hungarian millet, were in operation at each station. Each of the trapping areas was within 25 feet of a window for observa-

Fig. 1. A map of the area of study. A = station A; B = station B; C = station C; N = mist-netting site; E = Arcadia Wildlife Sanctuary; O = systematic observer; ● = "chance" observer.

(Taken from U.S.G.S. maps)

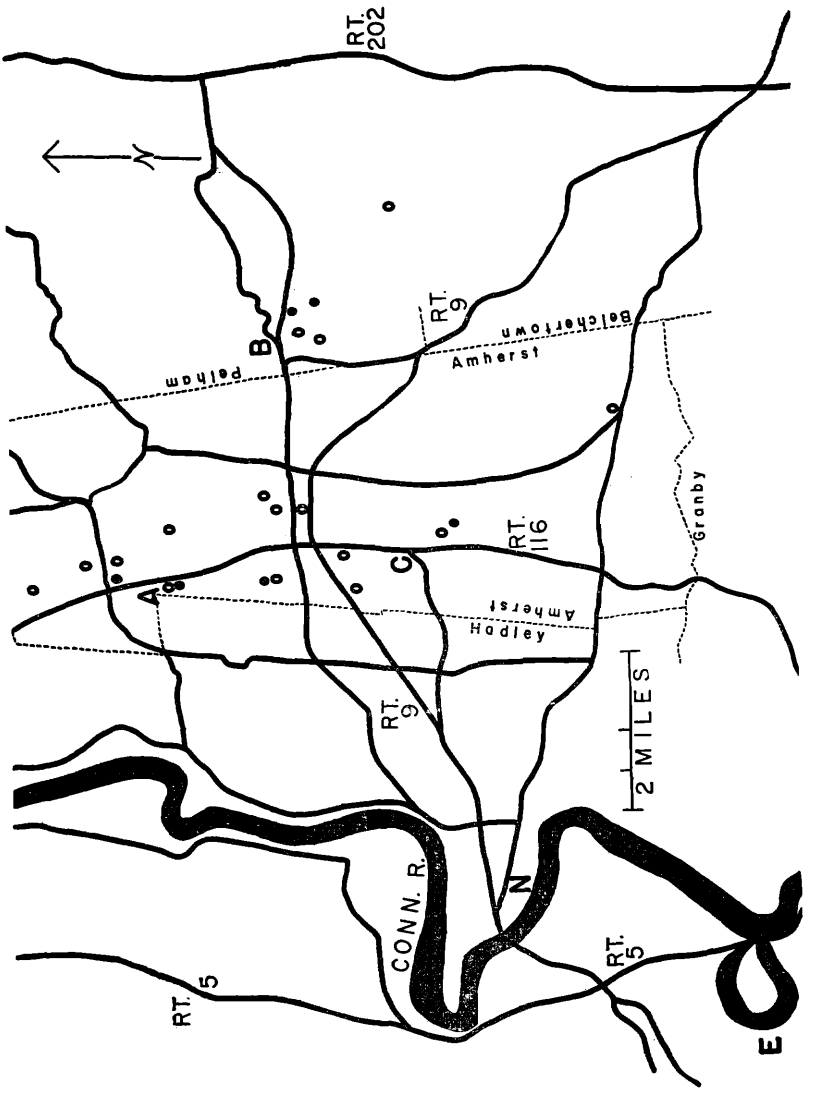

Table 1

Summary of Bandings

Location	Band Color	Type of Color Band	Leg of Color Band	Number Banded
Station A	red	aluminum	left	72
Station B	blue	aluminum	left	72
Station C	green	aluminum	left	102
Hadley	white	aluminum	left	10
Arcadia	pink	plastic	right	6
	yellow	aluminum	left	20

tion and occupied about 100 square feet of ground. A few birds were mist-netted in Hadley (Fig. 1, N) and two groups were banded at Arcadia Wildlife Sanctuary in Easthampton (Fig. 1, E). These latter two groups were transported to station C in "homing" experiments.

Table 1 summarizes the information on the birds color-banded at each location.

In addition to observers at each of the stations, 16 people having feeding stations in the area (Fig. 1, O) were enlisted to make observations of their Tree Sparrows on data sheets which had been supplied. Some of these observers were extremely systematic in taking notes on the numbers, band colors, and behavior of their Tree Sparrows; others could be much less so. Wherever this variance seems important in interpreting the results, it will be discussed. Occasionally I received reports of color-banded Tree Sparrows from people other than the systematic observers (Fig. 1, ●). In judging the accuracy of all observations I could use only such criteria as the observer's previous experience, answers to questions, and occasionally my own subsequent observation. By using a single one-color band per bird, questions of confusing color combinations were avoided.

In taking data, three facts were obtained for each bird trapped: (1) the time of day to the nearest hour, (2) the specific trap in which the bird was caught, and (3) what other individuals, if any, were caught in the same trap at the same time.

Tree Sparrows did not appear regularly at the stations until January 8. Extensive trapping was carried on from that date until February 8. After this latter date, the pressure of other studies allowed less time to be spent at the stations.

RESULTS AND DISCUSSION

Trapping Data

At station C, 102 individuals were trapped; they were retrapped a total of 233 times. At station A, 72 individuals repeated a total of 89 times. However, at station B, only 19 individuals were trapped and none of these repeated. Therefore, under each of the headings below, the data from station C will be considered in detail, comparable data from station A will be presented, and the data from station B will not be considered.

As Borror (1948) has pointed out, any analysis of numbers from trapping data is based on the assumption that all of the birds attracted to the area of the traps have equal chances of being caught. Although trap-shyness or the trap-habit in certain individuals might tend to

invalidate this assumption, probably in terms of the total number of birds in an area it is not too unsound. However, it should be kept in mind throughout the following discussion.

Another point must also be kept in mind. Some of the statistical checks used in the interpretation of the trapping data in the present study are based on the data from fewer individuals than would be desired.

Instability of the Tree Sparrow Flocks about the Stations. Figure 2 shows the banding and repeat data for one month of midwinter trapping at station. It is apparent that the number of new birds trapped was high for the first several days of the month, dropped off for about two weeks, and then markedly increased during the last week. If the month is divided into four periods of approximately equal banding time, this increase of new birds in the last week, as well as the extent to which birds repeated throughout the month, is clearly shown (Table 2).

To estimate the total number of Tree Sparrows in the area around station C at the end of each period (Table 2), the following ratio was used:

$$\frac{\text{Number of individuals banded in previous periods}}{\text{Total number of individuals in the area}} = \frac{\text{Number of banded individuals trapped in a period}}{\text{Total number of individuals trapped in a period}}$$

This ratio is a modification of the "Lincoln Index" (Lincoln, 1930).

The estimates based on this index should have tended to remain constant, if a uniform group of birds was attracted to the area of the traps throughout the periods. However, as is obvious in Table 2, the estimates did not remain constant. The estimate for the last period is far higher than the ratios of new birds to repeats in the two preceding periods would warrant, on the basis of chance sampling (chi-square values of 55.13 and 14.12 respectively). Therefore, it seems likely that changeable groups of birds were being attracted to the area of the traps throughout the month.

Table 2

New Birds and Repeats During Four Periods of Banding at Station C

	Periods			
	I Jan. 8-12	II Jan. 15-21	III Jan. 23-28	IV Feb. 1-8
Number of New Individuals	27	18	9	43
Repeating Individuals from Period I	—	18	6	6
Repeating Individuals from Period II	—	—	5	5
Repeating Individuals from Period III	—	—	—	2
Estimated Number of Individuals in the Area*	—	54	82	233

*See text for method of estimation.

Fig. 2. A chart of the banding and repeat data for one month of trapping at station C. Dates of banding across the top, hours of banding per day across the bottom, and individual band numbers down the left column.

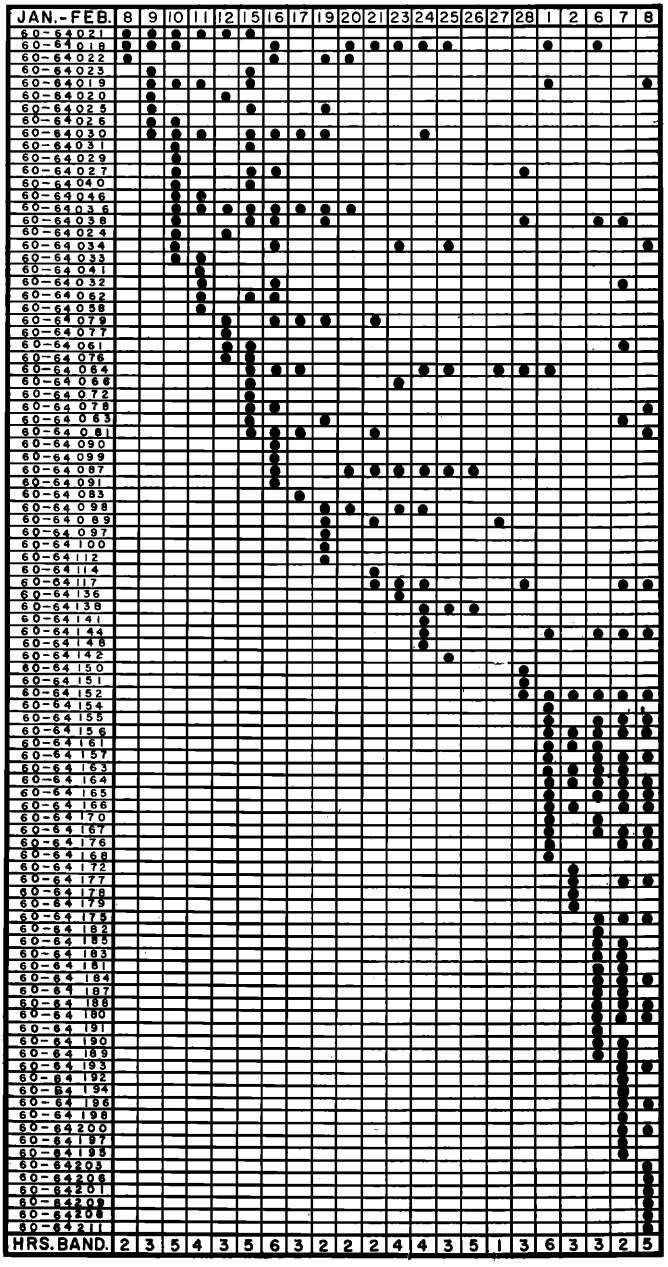

Table 3

New Birds and Repeats During Four Periods of Banding at Station A

	Periods			
	I	II	III	IV
	Jan. 8-12	Jan. 15-17	Jan. 19-25	Jan. 26-Feb. 2
Number of New Individuals	25	22	15	10
Repeating Individuals from Period I	—	15	6	7
Repeating Individuals from Period II	—	—	4	2
Repeating Individuals from Period III	—	—	—	3
Estimated Number of Individuals in the Area*	—	62	118	114

*See text for method of estimation.

The data from station A were analyzed similarly. Table 3 shows the number of new birds and repeats occurring in four periods, again divided on the basis of approximately equal banding time. The estimated numbers were almost constant in periods III and IV, but the ratio of new birds to repeats in period II was far lower than would be expected from random sampling of 114-118 individuals in the area (chi-square value at least 8.82). Thus, it again appears that the traps were attracting changeable groups of Tree Sparrows throughout the periods.

This evidence for changeable groups of Tree Sparrows appearing at the traps at both stations implies that the flocks making up these groups were unstable, since no new groups were noted without a number of repeating individuals and no old groups ever entirely disappeared. This evidence for flock instability in Tree Sparrows supports the observations of Heydweiller (1935) and Wallace (1942) of flocks which were changeable in composition and numbers.

An alternative explanation of the variability in the "Lincoln Index" estimates might be that the samples were not of adequate size. However, it seems to me that the samples were not so small as to invalidate the highly significant chi-square values obtained.

The Occurrence of Tree Sparrows in Relation to Snowfall. Although no definite correlation between snowfall and the total rate of capture of Tree Sparrows was found, influxes of new individuals often occurred following snowfalls. Figure 3 shows the rate of capture of new birds and repeats in relation to snowfall at station C. From the figure it can be seen that the rate of capture of new birds per hour only once markedly exceeded repeats per hour. This was three days after the snowfall of January 28-29, during the period, previously noted (Fig. 2; Table 2), of a marked influx of new birds.

On a number of other occasions, a similar influx of new birds occurred following a snowfall. No Tree Sparrows were trapped at any of the stations until after the four-inch snowfall of December 10 or the seven-inch snowfall of January 7-8. On January 23 a large group of new birds appeared at station A; it had snowed a total of about three inches during six of the previous eight days (cold weather kept the snow

Fig. 3. Fluctuations in the daily rate of capture of new birds and repeats at station C. Snowfall amounts are shown by the rectangles.

on the ground). An influx of new birds at Arcadia occurred one day after the five-inch snowstorm of February 7-8.

Since ground-feeding birds may be forced to wander considerably during periods of snow in order to find food (Wallace, 1955), some of the influxes noted in the present study probably represent wandering groups or individuals from areas where the food supply had been covered. If this was the case, it would explain some of the changing composition of the flocks about the stations. It is to be noted that Baumgartner (1938) correlated wanderings of Tree Sparrows with midwinter storms.

Tree Sparrows Occurring Together. On 74 occasions at station C, two or more birds were caught together in the same trap. Of the 292 pair combinations represented, 19 were noted twice. Of 65 similar pair combinations at station A, one was noted twice. No two individuals were trapped with each other more than twice. No correlation between the birds occurring together twice and their original banding dates could be found. It would appear that two birds never occurred together in the same trap more often than would be expected by chance or as a result of severe weather conditions driving large numbers of birds into the traps frequently.

Likewise, birds originally banded together on the same day showed no tendency to repeat together on succeeding days. On 17 days, two or more Tree Sparrows were initially banded at station C. However, when these birds repeated, they did so 72% of the time on a day when no other birds with which they were originally banded repeated. Birds initially banded together at station A repeated alone 56% of the time thereafter. This tendency for birds initially banded together to repeat singly on succeeding days became more noticeable as the number of days following the initial bandings increased. This suggests that if new

individuals represented groups of wandering birds on some occasions, they seemed eventually to amalgamate with the birds already present at the stations and to become individual members of the population, rather than to retain distinct subgroup affiliation. This, again, would better explain flock instability about the stations.

The Time of Day and the Occurrence of Tree Sparrows. There was no significant difference in the number of birds trapped per hour at each of the ten hours of the day during which trapping took place at both stations. When the observed number of birds trapped per hour at each of the ten hours was compared to the numbers expected if the birds occurred at random at all hours at station C, a chi-square value of 4.00 was obtained. A similar comparison gave a chi-square value of 6.43 for the birds occurring at station A. In addition, 90% of the birds occurring six or more times at both stations were caught during at least five different hours of the day.

These data suggest that the Tree Sparrow populations were not composed of flocks which had feeding circuits with fixed timetables. The occurrence of the Tree Sparrows with equal frequency at all hours of the day does not support the usual contention that Tree Sparrows are more likely to appear at feeding stations during certain times of day and not during others.

Wanderings of the Tree Sparrows

Figure 4 shows the direction taken and distance covered by Tree Sparrows which wandered one-half mile or more during January and February (not including birds released away from the station where

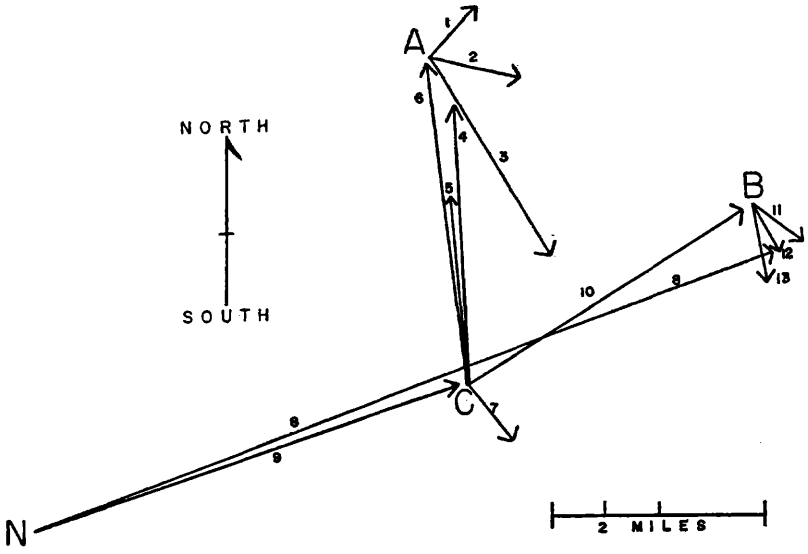

Fig. 4. Wanderings of the Tree Sparrows. The base of an arrow represents an initial point of banding; the tip represents a point of subsequent observation.

trapped). Table 4 gives additional data for these wanderings. Seven of the 15 individuals wandered over two miles. The longest distance a bird was known to have wandered was seven and one-half miles. These distances are to be compared to the maximum wandering of 6800 feet observed in Tree Sparrows by Baumgartner (1938).

Although the wanderings of the individuals considered in this paper were based on very reliable reports or on retrapped birds, some difficulties in observing the color-bands did arise in some other cases. The aluminum color-bands were very dark and a number of reports of black-banded birds were received. These reports were necessarily discarded. The pink plastic bands which were larger and brighter proved superior to the darker-colored aluminum bands. Occasionally reports were received of white bands on the right leg; these were, of course, regular Fish and Wildlife aluminum bands.

Since the chance of the observers spotting any one of the color-banded birds seems small (especially when it is realized that some of the observers could not be as systematic in making observations as would have been desired), it seems likely that considerably more wandering occurs in this species in the winter than was actually observed. It might also be noted that there were no observers in the directions west of stations A and C.

Snowcover forcing birds to wander in order to find food might explain influxes into the stations, as suggested previously, but wanderings from the stations are not so easy to explain. Feed was available throughout the entirety of each storm at each of the stations. Since Sabine (1949) has shown that a social hierarchy exists in Tree Sparrow flocks, it is interesting to speculate that overcrowding at the stations, with consequent social intolerance, forced individuals near the bottom of the social hierarchy to leave the area.

Of the birds wandering from station A, only those noted prior to the withdrawal of feed are considered here. The wanderings of birds from station A following the withdrawal of feed are briefly considered in the next section.

Table 4

Data on the wanderings of the Tree Sparrows

Number*	Number of Times Color-Banded Birds Seen	Maximum Number of Individuals at One Time
1	4	1
2	5	1
3	1	1
4	1	1
5	1	1
6	1	1 (retrapped)
7	23	2
8	1	1
9	3	1 (2 retrapped)
10	1	1
11	2	1
12	2	1
13	1	1

*coincides with number on Figure 4.

The Effect of Withdrawal of Feed

On February 6 all feed was covered at station A and feeding was not resumed until March 2. Although the red-banded birds no longer appeared at station A, the results were inconclusive. Actually, fewer observations of birds from station A were reported by the observers after February 6 than had been reported prior to that date. The area west of station A is largely open agricultural land, and it may be that the birds dispersed in that direction, where there were no observers.

"Homing" Data

On January 22, six birds were trapped at Arcadia Wildlife Sanctuary, banded with pink bands, transported the seven and one-half mile distance to station C, and released at 4:35 P.M. All of these birds had been originally banded at Arcadia, three of them during the previous winter. On January 24, one of these birds was observed back at Arcadia. Three of these birds were retrapped at Arcadia on February 9, and the same three were retrapped again on February 13 and 15. Pink-banded birds were observed at station C until January 26. On February 5 and 10 a pink-banded bird was observed at a feeder three and one-half miles from station C in almost the exact opposite direction from station C as Arcadia. I observed this bird on February 10.

On February 9, twenty birds were trapped at Arcadia, banded with yellow bands, and released at station C at 3:30 P.M. Nineteen of these twenty birds had not been trapped at Arcadia previously. Since fairly extensive trapping was carried on at Arcadia prior to February 9, these nineteen new birds seemed to be individuals which were driven to the trapping areas by the heavy snowfall of February 7-8. Yellow-banded birds were observed at station C until March 5, but none of these birds were observed or retrapped back at Arcadia, despite extensive banding activity.

Thus, although three of the first group of six returned to Arcadia, none of the second group of twenty returned. One difference between the two groups was the length of time that the members were known to have been in the Arcadia area. All three of the birds which "homed" had been trapped at Arcadia previously during the winter, and two of the three were originally banded there during the previous winter.

The explanation of "homing" based on the assumption that birds recognize familiar landmarks after exploration of an unknown area (Griffin, 1955), seems applicable to the results obtained. It has been shown that Tree Sparrows may wander considerable distances during the winter and certainly many landmarks could be learned. Thus, if a bird received a stimulus which could be satisfied by returning to a familiar area, learned landmarks might orient it. Since abundant food was available at the point of release, it seems possible that unfamiliarity itself was a significant factor in initiating "homing."

SUMMARY

1. Winter studies utilizing banding techniques were made on the Tree Sparrow in the Amherst area during the winter 1957-58.

2 The flock structure of the Tree Sparrow seemed unstable.

3. Snowfalls appeared to cause wanderings of the Tree Sparrows with consequent influxes of new birds into the banding stations.

4. No subgroup affiliations among the Tree Sparrows occurring at the stations could be found.

5. Tree Sparrows occurred with equal frequency at all hours of the day at the stations over a one month period.

6. Tree Sparrows wander considerably during the winter. Seven of fifteen wanderings exceeded two miles, the longest being seven and one-half miles.

7. Success in "homing" seems related to familiarity with an area. Unfamiliarity itself may be important in initiating homing.

ACKNOWLEDGMENTS

I wish to express my appreciation to Mr. and Mrs. Sargent Russell, Mr. and Mrs. Ralph Seitz, and Mr. and Mrs. Reginald French for making stations A, B, and C such enjoyable places at which to work. I also wish to thank the many observers for their cooperation.

I am indebted to Mr. Edwin A. Mason for the use of the traps and the banding laboratory at Arcadia Wildlife Sanctuary, and for his suggestions concerning the problem. I am also indebted to Dr. Robert W. Kleis for making available the unpublished monthly weather summaries from the University of Massachusetts weather station.

I especially wish to express my appreciation to Dr. Lawrence M. Bartlett for his generous help and guidance through every step of the problem.

LITERATURE CITED

BAUMGARTNER, A. MARGUERITE. 1938. Experiments in feather marking eastern Tree Sparrows for territory studies. *Bird-Banding*, **9**: 124-135.

BORROR, DONALD J. 1948. Analysis of repeat records of banded White-throated Sparrows. *Ecol. Monogr.*, **18**: 411-430.

BUTTS, W. K. 1930-31. A study of the chickadee and White-breasted Nuthatch by means of marked individuals. *Bird-banding*, **1**: 149-168. **2**: 1-26, 59-76.

GRIFFIN, DONALD R. 1955. Bird navigation; in: Recent Studies in Avian Biology, edited by Albert Wolfson. Univ. Illinois Press. Pages 154-197.

HEYDWEILLER, A. MARGUERITE. 1935. A comparison of winter and summer territories and seasonal variations of the Tree Sparrow. *Bird-Banding*, **6**: 1-11.

LINCOLN, FREDERICK C. 1930. Calculating waterfowl abundance on the basis of banding returns. U.S.D.A. Circ. 118, pp. 1-4.

PRICE, JOHN B. 1931. Some flocking habits of the crowned sparrows. *The Condor*, **33**: 238-242.

SABINE, WINIFRED S. 1949. Dominance in winter flocks of juncos and Tree Sparrows. *Physiol. Zool.*, **22**: 68-85.

————, 1955. The winter society of the Oregon Junco: the flock. *The Condor*, **57**: 88-111.

WALLACE, GEORGE J. 1941. Winter studies of color-banded chickadees. *Bird-Banding*, **12**: 49-67.

————, 1942. Returns and survival rate of wintering Tree Sparrows. *Bird-Banding*, **13**: 81-83.

————, 1955. An Introduction to Ornithology. Macmillan Co., N. Y. p. 210.

WHITTLE, C. H. and L. B. FLETCHER. 1924. Group habit among birds. *Auk*, **41**: 327-333.