

EXPERIMENTS IN FEATHER MARKING EASTERN
TREE SPARROWS FOR TERRITORY STUDIES

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A FEW years ago I published¹ a brief account of a new method of marking birds for individual identification and preliminary studies on territory using this system. Since that time so many inquiries have come in for further information that at the risk of some repetition I should like to set forth at this time a more complete description of the method and the conclusions obtained thereby in a three-year study of the Tree Sparrow (*Spizella a. arborea*.)

1. METHOD

Studies of the feeding-range of birds have been made by various banders operating more than one sub-station. About ten years ago at Cornell University Wilbur Butts experimented with various methods of marking individuals for field identification, such as staining areas of the birds' plumage or adding colored celluloid bands to the standard Biological Survey band. These methods have since been employed by numerous banders for studies of winter areas as well as nesting habits.

In the present study it was hoped to find a new method of marking individual birds which would be more conspicuous than the tiny celluloid bands and more satisfactory for man and birds than staining. For the benefit of those unfamiliar with this method of decorating birds the procedure will be described. Clean, white chicken feathers of a size comparable to the bird's own tail feathers were thoroughly boiled in Diamond dyes, using a shallow pan so that they were not bent while wet. After drying they were readily fluffed back into their normal shape. To apply the feather to the bird the end was dabbed with Duco Household Cement, then simply inserted under the upper tail coverts and held against the base of the tail a few moments until dry. It was soon observed that the feathers curled upwards and were more conspicuous if glued on upside down.

In 1933 only two colors were used, differentiating only between the birds of the two stations. In 1934 the four stations were represented by different colors, besides which each bird was marked by an additional individual feather. Since the variety of colors available by boiling in dyes was not sufficient for the number of banded birds, artists' oil colors were employed to paint portions of feathers. In this way a gorgeous assemblage of colors and combinations was devised, but, while the colors did not fade, the paint made the feathers brittle so, on the whole, this method was not found to be as durable.

¹ See Bibliography 1 and 2.



Tree Sparrow with added white plume. Republished from *Bird-Banding*, Vol. V. p. 45.

In the following table are listed the few colors of a large assortment of experiments which were considered satisfactory throughout the season:

TABLE I.—SUCCESSFUL COLOR PATTERNS FOR MARKING BIRDS INDIVIDUALLY

<i>Entire Feather Dyed</i>	<i>Part Painted (Artists' Oils)</i>	
Bright red	Red tip	Red tip, green center
Bright yellow (orange)	Red center	Red tip, dark center
Bright blue	Yellow tip	Red tip, yellow center
Bright green	Green tip	Green tip, dark center
White (untouched)	Green center	Yellow tip, dark center
	Dark center	

With these sixteen colors a large number of birds could be marked individually by using a single feather, doubles (*i.e.* two of the same color) or a combination. Combinations of dyed or a dyed with a painted feather were most readily identified; two painted feathers were confusing.

The reasons for discarding other shades and patterns were numerous and only too well founded, but there is space to mention only a few of the objections. Regarding the dyed feathers, only sharply contrasting colors remained permanently distinguishable, hence violet, orange (unless substituted for yellow), pink and other shades were eliminated. In the use of oil paints it was soon learned that the more complicated the color pattern, the more difficult

was the identification, so that best results were obtained by using a single color, either as a broad tip or band across the middle of the feather. Painting right and left sides of the feather a different color gave the false impression on side view of one of the dyed uni-colored plumes. Dark tips seemed to merge into the background and appear simply as a white feather. The reverse of some of the patterns mentioned here: *e.g.* green tip, red center, was found as clear as the one listed, *viz.* red tip, green center, but if both were used, the brief flash of color which frequently was all the bird allowed, was not sufficient for me to be sure which color was uppermost. Other workers may be keener of imagination and eye in designing and then distinguishing their patterns, and I should be glad to hear of other successful colors.

2. ADVANTAGES OF SYSTEM

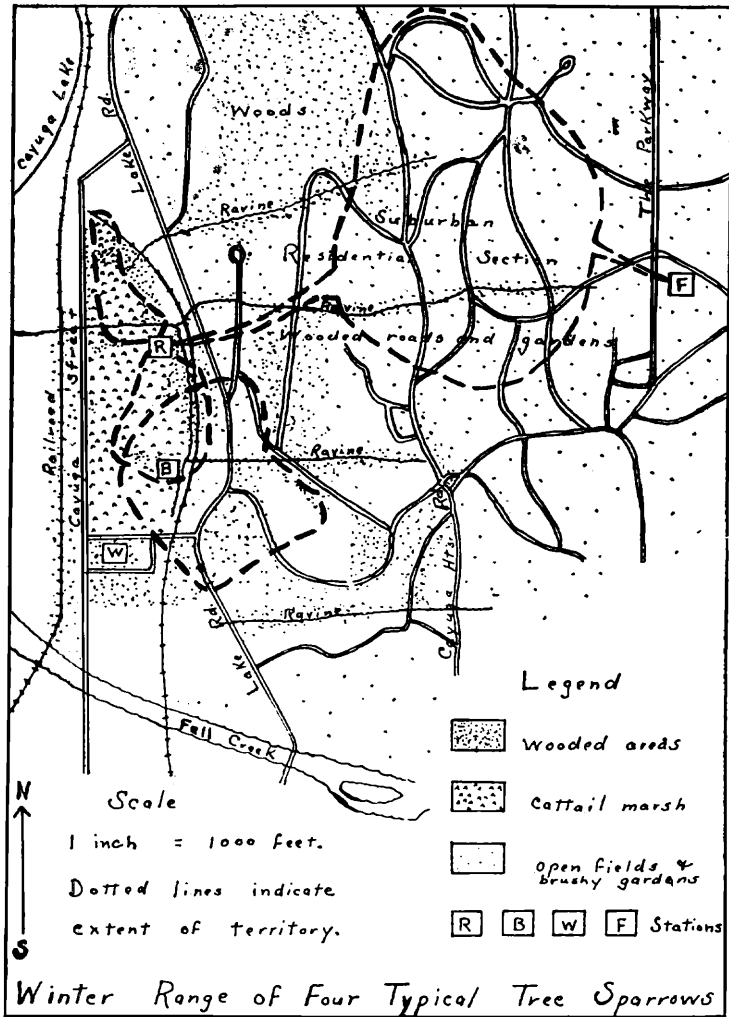
In comparing the advantages of this system of individual marking with previous methods, three factors must be considered: its permanence, its conspicuousness in the field, and its effect upon the bird itself. In regard to permanence, it can not, of course, compare with the celluloid bands, since the feathers disappear with the molt and the work must be done all over again the next year. On the other hand they were much more conspicuous. Not only were they more easily traced in the marshes and dense undergrowth, but they were noticed by townfolk and casual observers, thereby affording many valuable records of the wider ranging individuals. Staining some part of the bird's own plumage has been found unsatisfactory because it is messy when wet, mats down the feathers impairing the bird's normal activities and wears off in a few weeks and becomes indistinguishable.

The effect of these plumes upon Tree Sparrows was negligible. They sometimes resented the Biological Survey bands, but neither they nor their companions were ever observed to notice the feathers. That this extraneous baggage did not seriously affect their migration flight is evidenced by the large return ratio the following season (40.3 per cent) of the birds so decorated.

3. EXPERIMENTS WITH OTHER SPECIES

My own work was limited to Tree Sparrows, and proved highly satisfactory both on the wintering grounds at Ithaca, New York, and with breeding birds at Churchill, Manitoba. It was unsuccessful with nestlings because their tails were not yet grown when they left the nest and the body plumage was too soft to hold even a small piece of feather.

This method has since been employed by investigators on other species, and of those which have come to my attention the following results have obtained:



Republished from *Bird-Banding*, Vol. VI., page 3.

Game Birds (Pheasants, Grouse, Quail).—This method with variations appropriate for large birds is being used extensively and with apparent satisfaction by Aldo Leopold of the University of Wisconsin and his coöperators in Wisconsin, Michigan and Minnesota; by King and Bump in New York, and by Emlen in California. This work is fully described by Leopold (1938). Mr. Emlen writes me that he had almost one hundred per cent survival of feathers on California Quail by coating, drying, and recoating both surfaces and then gluing over most of its length. "My principal trouble was with fading, but my yellow (a wool dye) and red were generally distinguishable in September after marking in January. . . . I always clip the upper tail coverts so that the feathers will be more conspicuous."

Spotted Sandpiper.—A few were marked by Miss Theodora Nelson at Douglas Lake Biological Station, Michigan, and observed directly thereafter to preen and pluck out the extraneous feather. Thus it appears that birds with long necks and bills are not adapted to this type of decoration.

Kingfisher.—One bird trapped at the nest and decorated by Victor E. Gould near Ithaca, New York, appeared greatly distressed and later deserted the nest. Whether or not this is typical of the species is not known, as Mr. Gould did not repeat the experiment.

Downy Woodpecker.—Gustav Swanson of the University of Minnesota (correspondence) has recently marked Downy Woodpeckers and Nuthatches. Due to the mildness of the winter, there have been few recaptures, but one Downy was recorded "on January 9th still bearing his green tail plume after over six weeks."

Starlings.—Several hundred roosting birds were captured in the cupola of the Veterinary building at Cornell by John T. Emlen, Jr., and coöperators. He found that the feathers seldom showed, since the birds were seen chiefly in silhouette, especially around the roost. Furthermore many were lost and badly damaged because of the crowded roosting habits of this species. This suggests that gregarious birds and hole nesting species may not long retain plumes applied by mere man.

English Sparrow.—Richard Weaver of Cornell University writes that in the winter of 1937 he marked fifteen hundred birds to study flock distribution, using chiefly white feathers: "Many birds kept the feathers for long periods but often they were so worn toward spring that only a stub remained. There was about one-third loss according to the repeats that I recorded in my periodic catches."

Chipping Sparrow.—Mr. Weaver has also worked rather extensively with nesting and young Chipping Sparrows. His results with young correspond with mine on young Tree Sparrows. He reports that the most successful plumes were Wood Duck feathers, which curled upward and of course did not fade, but that he found difficulty in distinguishing individuals.

Wood Thrush.—Mrs. Weaver, working with nesting Wood Thrushes on the Cornell campus, was able to mark young, since their tails are longer than young sparrows, but none were retained longer than two weeks.

Mr. Weaver further reports the marking, but no observations, of a few Robins, Bluebirds, Baltimore Orioles, Red-eyed Vireos, Swallows, Cowbirds, and Blue Jays (the last by John Arnold at Cornell University). Mr. Emlen has likewise experimented with a number of species, including California Jays, Mockingbirds, Flickers, Meadowlarks, White-crowned Sparrows, and English Sparrows, and he expresses great enthusiasm for the method. With hawks and a few flickers he used the starling technique of trimming.

4. RECORDING OF DATA

The following method of keeping records, while it may not have been the best, was found convenient both in the field and in analyzing the data later, and may, therefore, be worth a brief explanation: In the field notebook was kept a list of the colors and combinations to be used at each station with columns for the band number, date, and observations to be included at the time of capture. All the birds from one station were given a dyed feather of the same color, besides a painted feather as their individual badge. In this way the station of a bird out of its normal flock could sometimes be determined where a glance was too brief to distinguish the smaller individual pattern. Repeats, returns, and miscellaneous observations were recorded daily on index cards for each individual. For sight records in the field, a map of the area was mimeographed and systematic surveys made two or three days a week to plot the location of each individual bird whenever seen.

5. EXTENT OF TERRITORY OF WINTERING TREE SPARROWS

Banding operations long ago established the fact that Tree Sparrows have a strong instinct to return to their wintering grounds from year to year, and to remain in a limited area throughout the season. Less is known about the precise extent of that area, or the nature and permanence of the flock inhabiting it. Nothing is known of those birds which wander once or twice into a bander's trap and are never seen again. Such records in spring and fall are classed as migrants, but are they all migrants? What becomes of the birds that never return? Have they all perished or have they shifted their feeding grounds? These questions were among the most intriguing problems considered in this study of the Tree Sparrow.

During 1933 the lack of individual markings made definite conclusions impossible, and the general observations serve only to corroborate more definite data the following year. In 1934 a total of eighty-one birds were marked individually and their ranges plotted on the mimeographed maps. Of these, seven reported only

once, and were never seen in the field, so that they may be ignored in the following discussion. The remaining seventy-four have been grouped into four classes according to the dimensions of their territories as determined by measuring the two farthest location points on their individual maps. The nine birds seen only at the traps may safely be assumed to have wandered at least a few hundred feet in the course of the winter, and so the minimum known range of five hundred feet has arbitrarily been attributed to them. This decision raises the average range somewhat above preceding estimates², but it is felt that it more nearly represents the truth.

TABLE II.—EXTENT OF WINTER TERRITORY OF SEVENTY-FOUR TREE SPARROWS AT ITHACA, N. Y.

Range.....	500-800 ft.	1000-1700 ft.	2000-3000 ft.	3000-6800 ft.
Average Range.....	650 ft.	1300 ft.	2200 ft.	3800 ft.
Number of Birds...	21	23	13	17
Per Cent of Total...	28.3	31.1	17.6	23.0
Number of Constant Repeaters.....	14	14	7	9

From this table it may be observed that the majority of the birds are limited to an area well below two thousand feet with an average of about one thousand feet. At the same time, the other forty per cent constitute a proportion that must be considered an essential part of the picture.

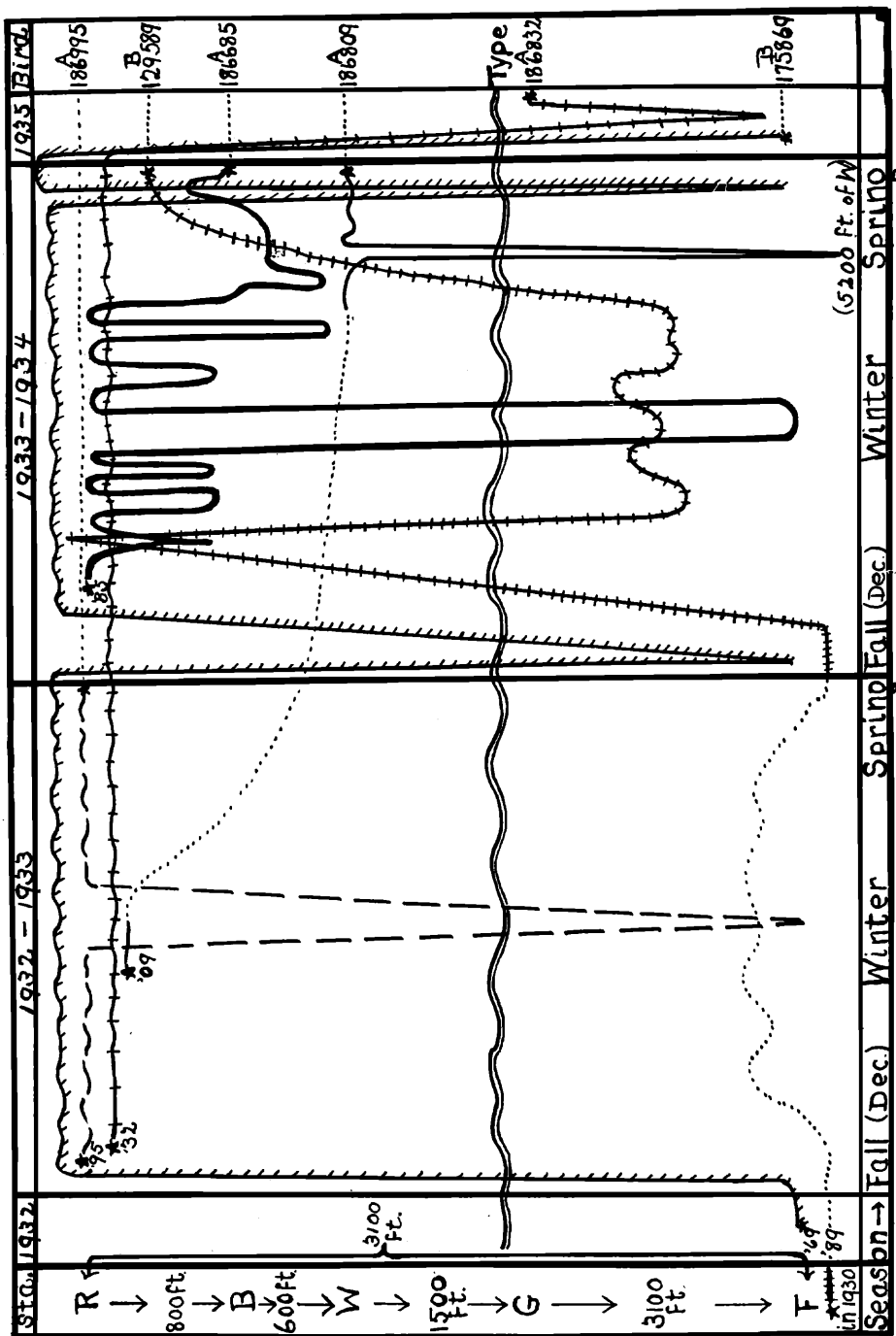
6. FACTORS INFLUENCING WIDE-RANGING TREE SPARROWS

An analysis of the movements of this forty per cent reveals some interesting correlations that may explain their wanderings. Of the thirteen individuals ranging between two thousand and three thousand feet, about half were steady repeaters and all but two were plotted well within the average until March. The extension of their range thereafter seems to be the result of spring excitement.

Birds recorded beyond three thousand feet, ranging up to sixty-eight hundred feet, are about equally divided between regular residents of one or another station which take occasional side trips to greater distances, and infrequent visitors which apparently have their headquarters elsewhere than around any station. Some may come several times and stay several days, others visit only once in a season and may or may not return another year. Of the seventeen individuals from 1934 and eight wide-ranging cases from other years, a few seem to be persistent roamers, but an overwhelming majority of the wanderings can be correlated with three factors: *fall settling*, *spring excitement*, and *midwinter storms*. In the last instance, snows rather than cold seem to be the deciding factor. On the accompanying graph an attempt has been made to trace pictorially the movements of typical examples, correlating

See Bibliography 2.

Winter Wanderings of Six Tree Sparrows at Ithaca, N.Y.



the extent of their wanderings with the season and motivating forces. Below are outlined the case histories of the birds graphed. For distances between stations, refer to the left-hand column of the graph. A detail map of the area, showing the actual relationships of the stations and ecological factors of the region is reprinted from *Bird-Banding*, 1935.³ Station G, established since the map was made, is located just below the "e" of the southernmost "ravine."

<i>Taken at R</i>		<i>Taken at F</i>		
A186995—Banded Jan. 21, 1933 (range 3100 ft.)	Repeats fairly regularly throughout season	Feb. 12, 1933 (last day of a snowy week)		
<i>Summary.</i> —Regular resident; extension of range due to storm.				
<i>Taken at R</i>		<i>At B</i>	<i>At W</i>	<i>At F</i>
A186685—Banded Jan. 16, 1934 (range 3800 ft.)	Repeats Jan. 17, 19 " 20 (a.m.) " 21 " 26, 29 Feb. 2 (5 p.m.) " 11, 12, 14 " 18, 19, 20 " 21, 22, 23 " 28, Mar. 1, 2 Mar. 12, 14	Jan. 20 (p.m.) " 22, 24 " 31 Feb. 2 (2 p.m.) " 15, 17		Feb. 6, 7, 8, 9 (snowy week)
Sight records throughout marshes all season, near <i>R</i> and <i>B</i> .				
<i>Summary.</i> —Regular resident of the area, vacillating between two stations 800 feet apart; extensions of range during a snowy week and in spring.				
<i>Taken at F</i>		<i>Taken at R</i>		
B175869—Banded Mar. 20, 1932 (range 3500 ft.)	Repeats April 13, 14, 16, 20	Return Jan. 29, 1933 Repeats Feb. 5, 6 (snowy week)		
	Return Dec. 12, 1933	Jan. 26, 31, 1934 Feb. —daily, sometimes twice, sight records a few 100 feet from R		
	Mar. 22	Mar. 1 " 10, 11, 12, 13, 14 " 18, 19		
	Return Jan. 12, 1935 (no station in marshes)	" 25, 27, 28, 29 April 14, 17, 20, 21, 22, 23		
<i>Summary.</i> —From point of view of Station F would be considered a migrant, though a resident only half a mile away.				

³ See Bibliography 2.

<p style="text-align: center;"><i>Taken at R</i></p> <p>A186809—Banded Jan. 27, 1933 (range Repeat Jan. 31 5300 ft.)</p>	<p style="text-align: center;"><i>Taken at W</i> (Station opened in March)</p> <p>Return Mar. 9, 1934 (probably resident, caught the 2d day after trap was opened) Sight records constantly at s. end of marsh near B and W Sight record in town, 5200 ft. away, Mar. 10, 11</p> <p><i>Summary.</i>—Occasional visitor to traps, though sight records prove it a resident in the region; ranging widely in spring.</p>
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<p style="text-align: center;"><i>Taken at F</i></p> <p>B129589—Banded Dec. 31, 1930 (range Return Dec. 14, 1932 3500 ft.)</p> <p>Return Dec. 29, 1933</p>	<p style="text-align: center;"><i>Taken at R</i></p> <p>Repeat Jan. 17, 1934</p>										
<p><i>Sight Records Between Stations</i></p> <table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: left;"><i>Date</i></th> <th style="text-align: left;"><i>Distance from F</i></th> </tr> </thead> <tbody> <tr> <td>Jan. 28, 1934</td> <td>(Regularly with other F birds) 800 ft.</td> </tr> <tr> <td>Feb. 25, 1934</td> <td>1200 ft.</td> </tr> <tr> <td>Feb. 27, 1934</td> <td>2400 ft.</td> </tr> <tr> <td>Mar. 15, 1934</td> <td>(Roosting in Renwick marshes) 3500 ft.</td> </tr> </tbody> </table> <p><i>Summary.</i>—Regular resident between two stations, extending its range to one or another trap during fall settling and winter storms.</p>		<i>Date</i>	<i>Distance from F</i>	Jan. 28, 1934	(Regularly with other F birds) 800 ft.	Feb. 25, 1934	1200 ft.	Feb. 27, 1934	2400 ft.	Mar. 15, 1934	(Roosting in Renwick marshes) 3500 ft.
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A number of these birds, it may be observed, never returned to their original station, yet they had neither died, as might have been assumed by examining only the station records, nor had they materially changed their winter quarters. While superficially it appears like a shift in territory, analysis of all the cases under observation indicates that they were only casual visitors in the area where banded. All things being equal, individuals of this species seem to return to the same headquarters year after year, though they may wander some during the season.

A true shift was observed in the 1934-1935 season, after the obliteration of the Renwick marshes by a "cleaning squad" of PWA workers. Both food and cover entirely removed, the flock at Stations R and B spread over the adjacent hillside and to the weedy lots at the south end of the marsh. In a few periods of irregular trapping, six R and two B returns were taken at Stations F (3100 feet away) and W (1500 feet away) and at a new station G in Dr. A. A. Allen's garden at Glenside (1500 feet southeast of W and 3000 feet southwest of F). Four of them were captured at two different stations, suggesting that the new territory was not

yet fully established. Such a case is A186832 of the graph, a regular repeater at R in 1934, with a range of twenty-three hundred feet in the lowlands and marshes.

8. COMPARISON OF RANGE IN SUBURBAN AND OPEN COUNTRY HABITATS

In a more open, exposed territory at Varna, a few miles from Ithaca, weekly observations were made as a check area where no trapping or feeding stations might influence the movements of the birds. Here whole flocks seemed to range over areas of a size recorded only for a few scattered individuals at Renwick. While no banding was done, flocks of fifty to two hundred birds were frequently followed along the hedgerows and brushy rivulets. During the fall and early winter they could usually be found in one or two definite places, from which they flitted nervously down the hedgerows ahead of the intruder, encompassing an area some fifteen hundred feet in a route which finally led them back to their starting point. By January this area was apparently exhausted, and smaller groups were occasionally located from six hundred to one thousand feet to the south and east. Another flock of fifty or more which was at first believed to be an entirely different unit was found three thousand or more feet to the southwest. On several occasions in late winter, however, this flock was seen to fly en masse toward the other area and, when followed, only that number of birds was found feeding quietly in the hedgerows, strongly suggesting that these birds were part of the early winter flock, with a flock territory of at least three thousand feet.

SUMMARY

The following statements are offered in summary:

1. Marking of small birds with extraneous plumes is a reliable and harmless method of distinguishing individuals for a season's study. Bright colors and simple patterns are most readily recognized in the field.

2. The majority of Tree Sparrows have a winter range of from five hundred to seventeen hundred feet, with an average of about a thousand feet.

3. The more extensive movements of the other forty per cent can be largely attributed to three factors: fall settling, spring excitement, and midwinter storms.

4. Storms seem to influence both the size and range of flocks. While snows brought in more distant birds and caused the frequent repeats of regular residents, it also seemed, contradictorily, to set some of the regular repeaters wandering widely to other stations.

5. Birds which are taken at banding stations only in spring and fall may not be migrants, but may have a winter range only a few thousand feet from the station.

6. The openness of the area appears to have a direct influence upon the freedom of movement of flocks: the size of the *flock territory* at Varna corresponding more nearly to that of wider-ranging individuals in the Renwick marshes, where birds as a flock covered only a very limited range.

LITERATURE CITED

1. HEYDWEILLER, A. M. 1934. Tail plumes as a means of marking individual birds. *Bird-Banding*, 5 : 1 : 45-47.
 2. HEYDWEILLER, A. M. 1935. A comparison of winter and summer territories of the Tree Sparrow. *Bird-Banding*, 6 : 1 : 1-11.
- LEOPOLD, A., LEE, O. S. and ANDERSON, H. G. 1938. Wisconsin pheasant movement study 1936-1938. *Journ. Wildlife Management*, 2 : 1 : 3-12.

ABSTRACT—EXPERIMENTS IN FEATHER MARKING TREE SPARROWS FOR TERRITORY STUDIES

This paper describes the method and gives the results obtained by marking small birds with extraneous feathers. It is a conspicuous, harmless and effective way of differentiating individuals for a season's study of group movements, though not permanent. A summary of the work done by other students with other species is included. The winter ranges of a flock of seventy-four Tree Sparrows are tabulated into four groups, ranging from 500 to 6800 feet, giving the number of birds, per cent of total and average range in each group. The more extensive wanderings of 40 per cent of the flock are correlated with three factors: fall settling, spring excitement, and midwinter storms. Typical examples are graphed and their cases outlined. The normal flock range of birds in an open country habitat are found to compare more closely with the range of the wider ranging individuals in a suburban situation.

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