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A COMPARISON OF WINTER AND SUMMER TERRITORIES AND SEASONAL VARIATIONS OF THE TREE SPARROW (*Spizella a. arborea*)¹

By A. MARGUERITE HEYDWEILLER

IN a recent issue of *Bird-Banding* (Vol. V, No. 1, Jan., 1934) I sketched briefly the results of a winter's study of the Tree Sparrows about Ithaca, New York, tracing their meanderings by means of colored chicken feathers which were glued to the base of their tails with Duco household cement. During the past winter (1933-1934) this study was extended, with larger traps which could be kept in operation continuously, with more stations, and with a different-colored feather for each bird.

A word first on this method of marking birds. I experimented this year with two coloring-agents, Diamond dyes and artists' oil colors. With the oil paints I was able to create a glorious assemblage, marking the tips or centers of the feathers with various and sundry colors. The colors were permanent enough, but I discovered to my sorrow that in the course of a month or so the feathers themselves wore off. The stiffness of the paint made them brittle, and by the end of the season I was identifying these birds—if at all—by the characteristic shape of the plume. A few combinations remained entire and identifiable, but whether by chance or because of inherent superiority of colors I am not certain. The most successful plumes on the whole, I have decided, are those which are thoroughly boiled in Diamond dyes, insuring both permanence and distinctness of colors.

The method itself has its limitations. For a winter's study I found it admirable. The feather apparently does not disturb the bird; if carefully selected and applied it will stick as long as the tail does; and the feathers are certainly more conspicuous than the tiny celluloid bands in use at many banding stations. On the other hand, it is not permanent, since, of course, it disappears with the molt, and the study must consequently be limited to a single year. Caution must also be employed in marking nesting birds in this way. With nesting Tree Sparrows in Canada I had no trouble whatever;

¹Read at the 52d annual meeting of the American Ornithologists' Union at Chicago, Illinois, October, 1934.

they flirited their tails a few minutes and returned dutifully to their respective nests. Another student at Cornell, Mr. V. E. Gould, experimented with the Kingfisher with results which were not so happy, resulting in every case in desertion of the nest. With young birds I again found the method impossible. Since they left the nest before their tails appeared, I attempted to glue small pieces to the contour feathers of the back; to no avail, for these feathers, besides being extremely soft and loose, are the first to molt, even before the bird is full grown.

WINTER TERRITORIES

During the winter, however, I tramped my marshes and plotted my gay "birds of paradise" each on an individual map. And I discovered that Tree Sparrows are apt to wander more frequently and over a wider area than I had realized last year, when all the birds from one station were marked identically. In all I handled 77 birds, of which 21 were returns from last winter (a 34 per cent return ratio), and 13 had previously been banded by Dr. A. C. Fraser three fifths of a mile from my station. The accompanying Map I will illustrate the relationships of my various stations and the territories of typical individuals.

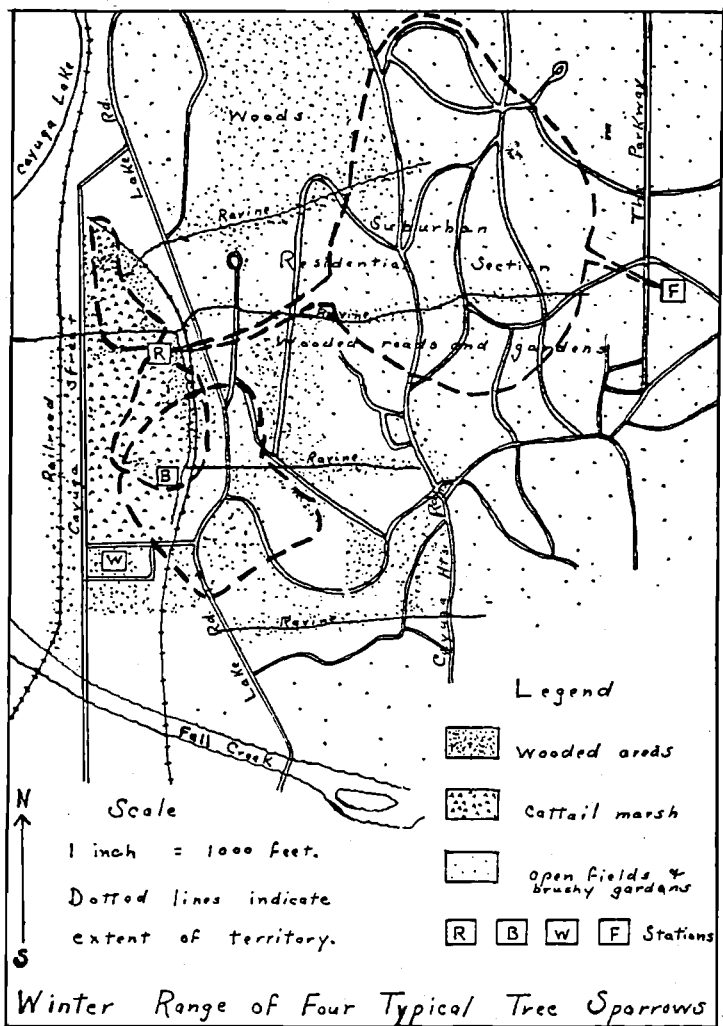
In determining the range of these birds I have measured the distance between the two farthest points on their individual maps—presumably the diameter of their territories. Within a 1,000-foot diameter were 38 birds, and within a 2,000-foot diameter there were 21 individuals. This includes the majority. Between 2,000 and 2,500 feet there were only four birds. But then comes an interesting list of 17 individuals, besides some 14 sight records from townfolk—which range from 3,000 to 6,800 feet, averaging 4,000 feet. Mr. Daniel Smiley of Lake Mohonk likewise writes me of two of his birds which he recaptured 6,800 feet from the original station. These cases are too many to rank as accidentals. Obviously the final statement of the extent of wintering territory of the Tree Sparrow must include these wanderers as a vital part of the whole.

The histories of some of these individuals may reveal why return ratios at banding stations are not higher. I have classified them under four general headings:

1. Timid individuals who, although they were plotted constantly within the normal range from the station (1,000 feet), never were taken in the traps after the initial banding.

2. Wanderers who cover so large an area that they happen only once or twice into a trap and may miss it entirely another year.

3. Regular residents of one locality who meandered once into a bander's trap out of the normal territory. B175874, for example, banded by Dr. Fraser in 1932, never returned, yet in 1934 I observed him constantly throughout the winter at one of my stations. Neither migration nor mortality can be blamed for that failure to return; he simply did not belong there. Another individual whose activities puzzled me at first was given band B129589 by Dr. Fraser in 1930.



Map I

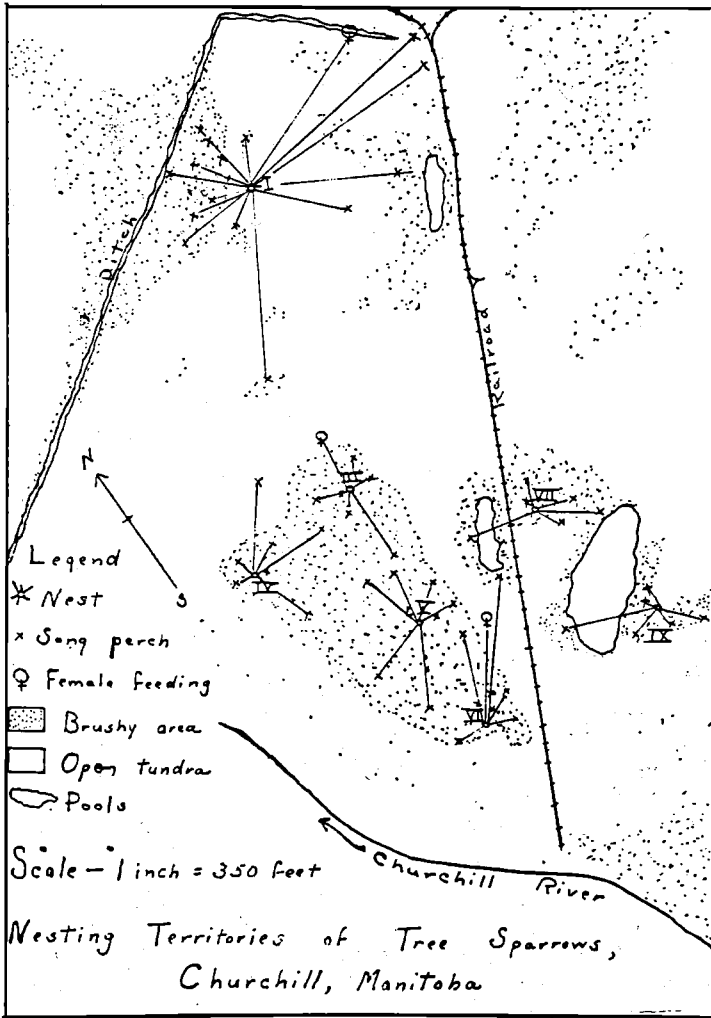
I took him once in 1934, and applied a red and a yellow feather to his tail. He never returned to either station, but in the following weeks the Department telephone rang steadily with reports of this bizarre creature who was wandering into every back yard between the two stations.

4. Emigrants who shift their territory from year to year. In no other way can I account for B175869, who repeated constantly at Dr. Fraser's station in 1932, apparently moved to Renwick in 1933, and returned there for the 1934 season. Another striking example of this type was C118623, banded in 1933. He repeated regularly until he was transported to a point fifty miles from Ithaca. He never returned, but in 1934 I chanced to collect him out of a flock of some two hundred birds three and one half miles from the banding station.

With the wanderlust so prevalent among the Tree Sparrows it is impossible to attribute to them a uniform group habit. The flocks which I observed were made up one day of one personnel, at another time of several additions and a few absentees, or split into several small groups. Frequently a bird whom I had established in one group appeared next day in an entirely new flock.

On the whole, however, there seemed to be two *sets* of flocks, inhabiting the territory around my two stations, one at either end of the marsh. While I commonly found single individuals out of their territory, I never recorded an entire flock, even of only three or four birds, beyond their area. There was a more or less definite line through the marsh at which the group invariably circled back. I tried to explain away this phenomenon, I tried to find exceptions and overlap and I searched the middle territory repeatedly for combinations, but the line remained. The food at the stations was not, I believe, a factor in determining their territory, for only one of the stations was kept in operation continuously; and, moreover, there were many days when the ground was bare and most of the birds ignored my tempting assortment of chick-feed and crumbs.

Their nocturnal behavior was equally distinct. With the assistance of several of my friends, I patrolled the marsh at dusk on several evenings, and determined the roosting-places of the groups. The birds were released from the Renwick and Bergholz stations simultaneously, while observers out in the marsh watched where they settled. The Renwick birds spread over the north end of the marsh, the Bergholz birds at the south end. The one or two Renwick birds that had been visiting their Bergholz cousins that day settled with them for the night. Through the middle of the marsh was an area untenanted. After dark we tramped assiduously, and flushed birds throughout the areas north and south, but none from the central strip. These birds always scuttled out singly almost under foot, from the clumps of dead grass and cat-tails. In areas where there are pine woods the birds apparently show a preference for such cover. Mr. Wendell P. Smith and Mr. C. L. Whittle inform me



Map II

that their Tree Sparrows fly toward the pines at dusk, and recently I flushed a bird from the center of a dense young white pine, about three feet from the ground. Although it was after dark, the size of the bird, the flash of light edgings of the tail feathers, and the characteristic chip of alarm made identification reasonably certain.

HOMING INSTINCT

In 1933 I attempted to determine the power of the homing instinct in these birds by transporting them to various distances from the station. Six birds carried from one to five miles from their station returned within a week. A five-mile bird was back in the traps the following morning. One individual transported ten miles covered the intervening fields in sixteen days. Beyond ten miles I had a hundred per cent loss. The eight birds released on March 3d from seventeen to one hundred and fifteen miles from Ithaca apparently began their spring migration from that point. Hoping that an earlier transportation would give them more time to return, I tried again in 1934. On February 2d six birds were dropped fifty and one hundred miles northwest of Ithaca. My record still stands at a hundred per cent loss. However, the return of two of the eight 1933 subjects is interesting in itself. A third was the stray C118623 collected three and one half miles from the station.

SUMMER TERRITORIES

With the melting of the snows in late March and April the little flocks of Tree Sparrows melted inconspicuously from their winter territories. Fewer and fewer of the familiar plumes appeared at the traps, nor could they be located in their accustomed haunts in the marshes. The spring migration was on, and for two summers it was my privilege to follow this species to its breeding grounds in the Far North. Churchill, Manitoba, eight hundred miles north of Winnipeg on Hudson Bay, was made accessible by rail in 1929, and there on the edge of timberline, where this is one of the most abundant species, I was able to trace the complete nesting cycle of the Tree Sparrow.

My first nest was found the first day in the field, June 5, 1933. Although completely lined with soft white ptarmigan feathers, it was apparently a premature attempt, for during the ensuing week of almost constant sleet and snow the birds had little to do with it. The first egg was not laid until June 11th, and even that was fully a week ahead of the majority of my nests. By the 21st, however, (which is considered the first day of spring in the north) incubation was well under way. My latest nest had its complement of five eggs on June 29th.

It was interesting to compare the territory of these nesting pairs with that of winter birds. The females were easily captured and marked with the gay chicken feathers by placing a wire box trap over the nest, from which the eggs had been removed to avoid breaking. Males could be taken after the young hatched, at which

time they took an active part in duties about the home. As would be expected, the territory was found to be considerably more limited than their winter ranging. In a crowded area like the 300-by-800-foot patch of brush that harbored four nests, the song perches of the males included a territory only 200-to-300 feet in diameter. A more isolated nest such as No. 1 of 1933, on the other hand, was surrounded by a territory some 600 to 700 feet in diameter. In Map II, I have diagrammed these areas, indicating a few of the outlying song perches.

During the twelve to thirteen days of incubation I never saw the female more than 450 feet from her eggs. While the young were in the nest, both parents gleaned food from the tiny birch and willow leaves and the thick tangle of low branches, frequently only ten to fifteen feet from their charges. Throughout the latter part of July and most of the month of August the gay plumes waved from the same little territory of 200 to 300 feet in diameter, and the young scuttled among the underbrush well out of sight.

It was not until the 19th of August that the birds emerged from the thick cover. Whereas they had previously been confined to the areas of brushy willows and birches, they flushed now wherever we walked. Across the grasses and moss of the river flats they rose at every step, little flocks of young and adults of whose affairs I know nothing except that they were strangers there. The familiar beplumed birds were gone—the plumes were probably lost in the molt, but the Biological Survey bands with which they were also labelled were likewise not to be found on the birds that now invaded the area studied.

DEVELOPMENT OF YOUNG COMPARED WITH SOUTHERN SPARROWS

By the 19th of August the young birds finally shift for themselves. Already it is autumn in this northern land and there is no time for a second brood. If the Tree Sparrow is to maintain its numbers it must lump its progeny into one family. Thus we find five the normal number of eggs in a nest and, frequently six, as compared with the three or four of their more southern relatives, the Chipping and Field Sparrows, as well as most of the other Fringillids. But if the season is short, is the length of day ample compensation? During June and early July there is no complete darkness. The light fades about 10:30, but there is a continuous glow on the northern horizon and the night is nearer dusk than midnight. By 2 A.M. it is broad daylight again, and activities commence about a quarter of three, continuing steadily until nearly 9 P.M. At every hour and at practically every age at which I have observed this species, I have found the intervals between feedings to average about three minutes—or twenty visits per hour, one or two young at a time being fed. Compare this seventeen-and-a-half hour day, with 350 feedings divided among five youngsters, with the figures on the Song Sparrow contained in the thesis of Miss Doris Haldeman at

Cornell University in 1929—a working day of fourteen and three quarters hours, with 261 feedings among three young. I have no data on the Field and Chipping Sparrows in this regard, and must assume that they are very similar. The age at which the young leave the nest reveals whether or not the longer day balances the demands of a larger family. Among the southern species, the Song Sparrow has been found ready to move at the age of seven days, the Field Sparrow at about seven and three quarters days. The young Tree Sparrows, though they will scatter at the age of eight days if molested, normally remain in the nest nine and one half days. At this age they are unable as yet to fly, simply hopping out of the little cavity in the tussock of moss which cradles their nest. I frequently wondered if an elevated nest would be emptied as soon, and was able to check this last summer, when I found a nest in a little spruce some miles back from Churchill. It was fully five feet above the ground, which I believe is the highest nest I have ever seen recorded. The young I estimated to be five days old. When I returned four days later, the nest was empty. I flushed the adults and heard the young peeping in the brush some one hundred and fifty feet away, so that I am assured of their safe departure.

SEX DIFFERENTIATION BY MEASUREMENTS

By a second method of procedure—systematic collecting from a flock a few miles away—I hoped to determine some way of differentiating the sexes at my stations by external means. In summer I had no difficulty, simply from their characteristic attitudes and behavior about the nest. But in winter, though I have handled some one hundred and fifty specimens, I am still baffled. The females average slightly smaller and lighter, sometimes duller, than the males, but overlap of measurements and individual variation are so prevalent that a guess is in the end only a guess and no more. After long and careful comparison of birds whose sexes I knew, I was able to guess correctly on unknowns about seventy-five per cent of the time. The most diagnostic character I was able to find was an infinitesimal difference in the width of the crown-patch, which seems to be slightly broader in the males. But here again there is no absolute diagnostic character, and I should hesitate seriously before I separated the sexes at my station on their external appearance.

RELATION OF SEXES

My studies yielded other data of greater import. The continually larger proportion of males eventually took on a significance beyond mere chance, and I began a drastic collecting campaign throughout February, March, and April that netted me some ten birds a week. I regret that I have only scattered records during the fall migration and early winter, but hope to complete the story this year. The proportions of the sexes, so far as I have data, are striking. During February and March males exceeded females two to one; with the

first week in April the pendulum swung abruptly to the side of the females, with three to every male. By May there were only five or six scattered individuals left, and only one, a female, was collected. The amount of singing—by which is meant the true summer song rather than the twittering note of the winter flock—corresponds also with these movements. The hedgerows rang with the clear little warble throughout March. During April there were a few singing until the 18th, thereafter none, although two males were collected as late as the 26th.

There is one striking discrepancy in my notes: on April 15th, in the full swing of the female migration, I collected a dozen birds from a flock of thirty or forty at a point twenty miles due north of Ithaca which had a proportion of three to one in favor of the males, and with weights that compared with an average of two weeks earlier at Ithaca. Could a short twenty miles delay migration two whole weeks, or do these birds perhaps represent the migration of the first-year birds?

It appears, then, that the majority of the females continue farther south to winter, though the fall migration (as far as I have collected material) brings adults and immature birds of both sexes together and in about equal proportions. But where do these females establish themselves? I wrote to all the leading museums of the country for lists of dates and sexes of their specimens, with the hope of plotting a graph that would show progressive increase and decrease of the sexes northward and southward during the non-migratory winter months. This period I arbitrarily limited by the dates December 20th and March 1st. I discovered, however, a marked paucity of Tree Sparrows in museum collections. Many museums had no material at all, and very few had specimens in sufficient quantities to offset the elements of chance and error. However, everywhere there appeared to be the same predominance of males, both in winter and in migration. It is encouraging to find on the northern limit of its range, in Ontario for example, sixteen males and no females. On the other hand it is rather surprising to find almost as many females as males in Nova Scotia and Massachusetts, two lone females in Montana, and two stray males in Texas.

SEASONAL VARIATION IN WEIGHT

A series of weighings throughout the year displays an interesting curve which correlates strikingly with the activities of the bird. My figures are still incomplete for some of the cycles, but I shall attempt to sketch briefly the high lights.

At the age of two weeks we find the young, with tails half grown, balancing the scales evenly with their parents, and the fully fledged juvenals throughout August average slightly heavier. The adults during July and early August are at their lowest ebb, averaging 17.3 and 16.5 grams for males and females respectively. The abrupt decrease in weight of almost twenty per cent for the males and ten

per cent for the females with the advent of the young is followed by an equally startling increase as soon as the youngsters begin to shift for themselves about the third week in August.

Some of this weight is lost in the subsequent migration, and maximum figures are not attained again until just preceding the spring departure during the first two weeks in March. At this time the males average 21.23 grams, the females 20.2 grams. Both males and females of late March and throughout April are some ten per cent lighter. Again the question arises whether this phenomenon is due to an influx of younger birds or to the hardships of migration.

MOLT

In the course of my collecting I had occasion to observe a spring molt that was more extensive than is generally accredited to the Tree Sparrow. It is an established fact that there is a partial molt about the head at this season, and practically every specimen that I examined showed fresh quills about the cheeks, chin, and throat. I also found occasional quills on every tract on the body, and several cases where the entire crown and dorsal tract were heavily sheathed, the feathers being as bright and fresh as on an October migrant. I first noticed this molt about the third week in March, and I traced it on both sexes throughout April. The last specimens collected, three females on April 30th and one on May 3d, showed only faint vestiges of quills about the head.

During August a large series of skins was made in an effort to trace the molt of both adult and juvenal birds. None of the July young were full grown; the weights averaged about sixteen grams and the tails were about two thirds their ultimate length, though the backs were already showing an occasional rufous-edged feather of winter.

On August 1st and 2d we found them fully fledged, though still a part of a family group. The upper back feathers were bright and heavily sheathed, quills bristled from every tract, and a few buffy feathers appeared on the sides of the belly. A few rufous feather were growing into the brown streaking of the crown.

On August 17th and 19th a series of sixteen exhibited every stage from full juvenal to practically complete first-winter plumage. The most advanced of these showed the back and head completely in winter dress, though nape and throat were still clothed in the soft, streaked plumage of the juvenal, and there were one or two scattered touches of dark on the sides and belly.

Among the adults the first evidence of molt was found on July 31st in 1933; this year on August 3d I noted a few scattered quills among the contour feathers. On the 5th there were three new quills among the primaries, and the wing-coverts were entirely lacking.

Seven specimens taken on the 19th were in complete winter plumage on dorsal and ventral tracts, though bases of the feathers were still heavily sheathed. Some of the heads showed strikingly both

old and new feathers. The napes were invariably still worn and dull, and apparently were the last region to be affected, as in the young also. Tails and wings were incomplete.

There is a gap in my Tree Sparrow records between my departure from Churchill on the 21st of August and the arrival of the first birds in Ithaca the 28th of October, at which time the young and old are alike resplendent in their fresh plumage of chestnut, buff, and black.

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SEASONAL AND INDIVIDUAL VARIATIONS IN HOUSE SPARROWS

By J. T. NICHOLS

THE sequence of plumages in the House Sparrow (*Passer d. domesticus*) by molt and wear, and the fact that the bill of the male is black in summer, are well and generally known. But in banding a good many individuals, this or that variation in bill-color or plumage has caught my interest, and I have some two hundred and seventy-five more or less fragmentary memoranda concerning the subject. Arranging and studying this material, I find three things: that the series of observations bearing on a given point is usually regrettably small, that I am in a better position to make further observations of interest, and that I am in the possession of some details and suggestions that seem worth recording.

BILL-COLOR OF ADULT HOUSE SPARROWS

I find no color difference in October between the bill of the male and that of the female. The upper mandible is brownish gray, sometimes lighter and sometimes darker. The lower mandible is variously pale, sometimes quite pale to the tip, sometimes merely paler at its base. There is almost always yellowish on the base of the bill adjacent to the rictus, which varies from a restricted faint tinge of yellowish to an appreciable area of yellow. This is a lemon yellow, to my eye identical with that of the conspicuous yellow skin of the rictus of a young bird, with which it possibly has some biological correlation, and quite unlike the more buffy yellow of the lower mandible of some juvenals. No yellow noted in one of twelve memoranda on males and in two of twelve on females. The bill of this aberrant male approached the summer color somewhat, being dark gray only slightly paler on base of lower mandible. To match it there is an October female with nearly uniform gray bill with a very slight yellowish touch near the corner of the mouth.

In November, three out of eleven males had uniformly dark gray