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NESTING HABITS OF THE TREE SPARROW AT CHURCHILL, MANITOBA¹

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CHURCHILL, Manitoba, situated at latitude 58° N., halfway up the west coast of Hudson Bay and five miles beyond timberline, proved to be an ideal locality to study the nesting habits of the Eastern Tree Sparrow (*Spizella a. arborea*). Connected by rail with the outside world in 1929, it was perhaps the only spot on the North American continent which could be reached early enough in the season to trace the complete nesting cycle of this species without spending a winter in the North. The town, while far from luxurious, was hospitable, and through the kindness of the United Church missionaries, comfortable living quarters were obtained within half a mile of my nearest nest. The River Flats, a bouldery, hummocky, pool-dotted stretch of tundra extending back to timberline, was interspersed with patches of scrub birch and willow reaching a maximum height of four or five feet, in which Tree Sparrows were one of the most abundant species.

Five months were spent on the nesting grounds—throughout June and July in 1933, and from June 4th to August 21st in 1934. A total of twenty-six nests were found, nine of which were under constant observation from the time of their discovery. While the birds were common, their nests, usually located in the densest tangles of the scrubby thickets, were difficult to find, and attention was therefore concentrated on one small area and on relatively few nests which, however, showed such uniformity that I was satisfied that my observations were both normal and typical of the species.

In 1933 no adults were marked for fear of disturbing their normal activities. Males could be distinguished from females with surprising readiness, for in addition to the singing, they had a more erect bearing, the crown was raised so as to appear almost crested, and their approach to the nest was more direct and free from nervousness. In a concentrated area like that of nests III-VI² where territorial problems were studied, individuals could be readily recognized by their songs. Could my return in 1934 have been anticipated, these birds should certainly have been banded to trace their movements the second season, but unfortunately this was not

¹ Presented as a portion of a doctorate thesis at Cornell University in 1935.

² This diagram (Map II) was included in the paper "A Comparison of Winter and Summer Territories of the Tree Sparrow," Heydweiller, *Bird-Banding*, Vol. VI, January, 1935, p. 5.

done. In 1934 a few adults were decorated with the gay chicken feathers (see Heydweiller, 1934) to confirm 1933 observations, and the birds were found to pay little attention to the extraneous material.

TIME OF REPRODUCTIVE CYCLE

According to Taverner and Sutton (1934) the Tree Sparrow spends about four months at Churchill, arriving about May 25th, and were last seen on September 29th. The occasional few of the first two days (Sutton's field notes) were followed almost immediately by enormous numbers including both sexes (none in flocks) scattered through the willows of the river flats. In Alaska, Nelson (1887) likewise noted that flocks were broken when they reached the breeding grounds and that the birds were mated soon after.

Upon my arrival at Churchill on June 5, 1933, birds were already paired and several had begun to build. Selection of territory and mates consequently could not be observed. Table I has been prepared to show the successive phases of the nesting cycle, giving the normal length of time involved in each stage, and the dates inclusive of three typical nests. The proportions of nests were about equally divided between the dates of Nest III and IX, with only two in the Nest I class.

TABLE I
TIME OF REPRODUCTIVE CYCLE OF TREE SPARROW,
CHURCHILL, MANITOBA
(Nests—1933, August Data—1934)

Activity	Dates of Period			Average Length of Period
	Nest I	Nest III	Nest IX	
Building.....	Completed June 5th	Completed June 13th		7 days (Nest II)
Rest.....	5 days	2 days		Several days
Laying.....	June 11th–16th 5 eggs	June 16th–21st 6 eggs	June 25th–28th 4 eggs	4–6 days, usually daily
Incubation....	June 16th–28th	June 20th– July 3d	June 27th– July 10th	12–13 days
Hatching.....	June 28th, 1 at 4 P.M. June 29th, 3 by 7 A.M.	July 3d, 3 by 10 A.M. 2 by 2 P.M.	July 9th, 1 at 9 A.M., 1 at 8 P.M. July 10th, 1 by noon	all within 7– 30 hours
Young leaving nest.....	last left July 8th, at noon	July 11th, 3 oldest (disturbed) July 13th, 2 younger	July 18th (only 1 young)	9–9¾ days (8 if disturbed)
Fledglings fed by parents...	until first week of August (a few August 19th)			about 2 weeks
Molt.....	throughout August (adults and young)			about 3 weeks
Fall Flocking..	first seen August 17th and 19th			about a month

In 1934 the season was almost a week later. The earliest set of eggs was completed on June 19th, and the great majority of the dates corresponded with the IX class.

DISPLAY AND BREEDING

Song is, of course, the Tree Sparrow's chief means of asserting or displaying himself, since the species is plain colored and sexes are alike. In the breeding manoeuvres either sex may be the aggressor, pursuing the other and flaunting its humble beauties. Of a pair which was watched for some time, the pursued bird was finally collected, and proved to be the male. During the building of Nest C the female, approaching the nest with a Ptarmigan feather, was filled with a sudden excitement when her mate came to sing near-by. Dropping the feather, she hopped to a twig about a foot from the ground, spread her wings and fluttered, uttering an alluring *wehy wehy wehy wehy*. The male sang on indifferently; she picked up her feather and went on to the nest.

In another case the female fed quietly on the ground while her suitor sat on a bush above her, and uttered a rapid series of staccato chips, puffing his plumage, spreading his wings, and darting to the ground with much fluttering. In acknowledgment, she preened daintily, fluttered her wings with neck much extended, and murmured the soft *wehy* notes which brought him to her. Fluttering over her for an instant, he darted back to his perch, repeating the procedure several times in the next two minutes. There was no singing at this time. Sometimes breeding takes place without display of any kind, the male simply flying to his mate while feeding, or at the nest. The pair at Nest I were observed breeding at the nest on three occasions, once during building, twice within half an hour the day before the laying of the second egg.

THE NEST SITE

In the wet, brushy wastes of the Canadian Northland, from the northern third of the Hudsonian spruce timber as far north as there is any scrubby growth, the Tree Sparrows find the best conditions for nesting and for rearing their young. Within this general habitat the specific sites for the twenty-six nests studied fall into three classes as grouped below:

1. Willow-birch thickets—20 nests in tussocks of grass or depressions in the ground at the base of shaggy bushes, concealed by dry grasses and dead branches.

2. Open tundra, near patch of brush—4 nests in depressions in mossy hummocks, concealed by grasses or semi-prostrate shrubs.

3. Spruces at timberline—1 nest at base of stunted spruce on open tundra; 1 nest five feet up in a small spruce under overhanging branches.

All but one of these were either on or within a few inches of the ground. McFarlane (1891), who examined over two hundred nests in the Anderson River valley, found them mostly on the ground, but occasionally in dwarf willows one to four feet high. The nest last listed above, besides being a fully foot higher than any previous record, was uniquely placed on the remains of an old Redpoll nest.

THE NEST

Description. The nest of the Tree Sparrow is built usually in three layers, an outer shell 20 to 40 mm. thick, composed of heavy grass and weed stems, rootlets, bits of moss, lichens, shreds of bark, and an occasional leaf or twig; an inner coat of fine, dry grass stems, about 10 mm. thick; and finally a soft lining of Ptarmigan feathers. Generally the nests are compact, well-built, and rather heavy, opening to the sky, though a few had their opening at the side. One, located in a deeper depression, lacked almost entirely the outer shell, and was light and loosely woven. The feathers, ranging from 29 to 152 in number, were frequently interwoven into the inner shell. Other materials may be used for linings besides the Ptarmigan's winter dress. Pintail feathers were found in five nests, and exclusively in one. In another, dog hairs were interspersed among the feathers of the lining. One nest contained a soft mass of thin, wiry sporophytes of the mosses that carpet the ground. The presence of a small patch of Lemming fur in the bottom of another suggests that the birds may sometimes raid the old winter nests of this animal that are found everywhere. Shreds of waste cloth were utilized by one enterprising bird built near the railway station.

TABLE II
AVERAGE DIMENSIONS OF TREE SPARROW NESTS
CHURCHILL, MANITOBA

	<i>Exterior diam. (top)</i>	<i>Interior diam. (top)</i>	<i>Interior depth</i>	<i>Depth overall</i>	<i>Weight</i>
Average.....	130 mm.	50 mm.	35 mm.	54 mm.	15.6 gms.
Maximum.....	150	55	45	70	25.9
Minimum.....	110	40	30	45	4.9

Building. Nest building with this species was found to be a function of the female alone, but her mate took an active interest in the activities and was never far away. Singing a few feet above her while she worked at the nest, he frisked dutifully after her when she left for another feather or straw, then back to his perch when she returned, or down to the nest to mate with her. The source of the material was never far distant for grasses and moss were the stuff of the tundra itself, and Ptarmigan feathers were scattered everywhere as these birds shed their winter dress. Building was a leisurely process, and after three or four trips for material, the pair flitted off



Nest 1 Male Tree Sparrow Visiting Nest

to feed about the marshy edges of a pool, and the observer might sit and shiver for two hours or the rest of the day before they returned. Nor did they evince any annoyance at intrusions at this time. My visits caused no apparent concern. A Lapland Longspur, also nest-building, once spied a nest, wandered over and helped herself to a feather for her own home.

The construction of a nest (see photograph), under observation almost from the beginning, is briefly outlined below:

June 5th and 6th—Pair seen feeding together; no indications of building though territory defined, as indicated by feeding range and attacks on others of this species.

June 11th—8:30 A.M., nest found, barely started; a small depression in the damp ground. Moss padded partly across the back, bits of straw thinly woven across the front, and two or three soggy bits of dry grass on the floor. Female came to nest three times in two hours.

3:00 P.M., floor sparsely laid with soggy straws from the front to one-third of way back.

June 12th, 7:30 A.M.—Nest much more rounded and built up in front. Yesterday's flooring covered with bits of moss and peaty sod.

7:30 P.M.—Rim built up an inch above yesterday's mark, broader, measuring now one-quarter inch thick, in back as well as front of nest. Floor well padded with moss and sod. Length of time for outer shell approximately three days.

June 13th, 3:00 P.M.—Nest has a beautifully-woven inner coat of fine dead grass, stems, and one Ptarmigan feather. Inner coat practically completed in one-half day.

June 14th, 6:15 P.M.—three feathers in nest.

June 15th, 7 P.M.—ten feathers more and finer grasses added to inner shell, burying one feather.

June 16th, 10:30 A.M.—one new feather.

June 17th, 18th, and 19th—no change, nest looks complete.

June 21st, 12:30 P.M.—one egg.

Lining completed in three days, followed by rest of five days. Upon examination of this nest at the end of the season 43 feathers were counted.

The material carried to the nest does not apparently follow a rigid sequence; nor does building always cease before laying begins, as noted above. At Nest B, which on June 21st contained one egg on a sparse lining of feathers, the female brought in a bill-full of grasses, which she scattered over the floor of the nest. At Nest III the addition of brown Ptarmigan feathers was noted overlying the white of the original lining after the young were well grown.

Defense. The chief defense of the territory against invasion is song, strengthened by an occasional brisk assault upon an intruder.

While this is the work chiefly of the male, his mate occasionally assumes the offensive. At Nest I when young were a day old, the brooding female suddenly darted from the nest and made a vicious attack upon another Tree Sparrow. At Nest IV an incubating female flew at a Yellow Warbler which had carelessly perched 15-20 feet from her. Her mate was singing only 150 feet from the nest, but she apparently considered the case too urgent to wait for him to expel the trespasser.

At human intrusion the parent birds chipped anxiously, but neither attacked, as will Terns, Owls, Jays, etc., nor did they feign lameness like their neighbors the shore birds, though if followed they would guilefully lead one farther and farther afield. The chief defense of the incubating female was her streaky coloration, upon which she relied until almost stepped upon.

THE EGGS

Description. In color, size, and shape of the Churchill eggs a striking variation was noted not only in the different nests but within a single set. The ground color ranged from pale blue to greenish, and from a clear, almost bright hue to a dull, leaden appearance. In some the brown fleckings were so evenly washed over the whole surface that the ground color was almost obliterated, though generally they were more concentrated at the large end of the egg. The shape has been described as oval, ovate, or ovoidal. Frequently one egg in a nest was conspicuously more rounded than the others.

TABLE III
WEIGHTS AND MEASUREMENTS FROM FORTY EGGS OF
EIGHT NESTS OF TREE SPARROWS AT CHURCHILL, MANITOBA

	<i>Length</i>	<i>Width</i>	<i>Circumference</i>	<i>Weight</i>
Average.....	19.1 mm.	14.2 mm.	44.0 mm.	2.12 gm.
Maximum.....	21.0	15.5	48.0	2.40
Minimum.....	17.5	14.0	41.0	1.82
Variation in 1 set (Nest VI)	21.0	14.5	long and oval	2.40
	19.5	14.0	normal shape	2.08

The average egg weight equals 11.37 per cent of the yearly average weight of the female bird (18.62 gm.). The above egg weights were taken during early incubation. At Nest I weights were taken at intervals of three or four days to check the per cent of loss. Average figures obtained are as follows:

TABLE IV
LOSS IN EGG WEIGHT DURING INCUBATION

Weight at 4 days.....	2.05 gm.	Weight of newly-hatched young.....	1.62 gm.
Weight at 8 days.....	1.88 gm.	Weight of shell (from sets collected and blown)...	0.162 gm.
Weight at 12 days.....	1.75 gm.		
Total loss.....	0.30 gm.		
Per cent of loss—	14.63 per cent		

Number. A normal clutch of the Tree Sparrow at Churchill ranged from four to six eggs, the majority consisting of five. McFarlane's records (1891) for 216 nests was four to five, with occasional sets of six or seven. Sets of two and three are apt to be incomplete. It is interesting to speculate on the comparatively large proportion of four-egg sets in 1934, which may possibly be correlated with the retarded season. Further evidence for this theory is suggested by the fact that the latest nest in 1933 contained only four eggs, one of which, moreover, was infertile. Sets recorded by Dr. Sutton in 1931 (field notes), and my own for two seasons, rank as follows:

TABLE V
SIZE OF CLUTCHES IN THREE SEASONS
AT CHURCHILL, MANITOBA

	<i>4 eggs</i>	<i>5 eggs</i>	<i>6 eggs</i>
1931.....	2 sets	8 sets	2 sets
1933.....	1 "	10 "	1 "
1934.....	6 "	5 "	1 (3 infertile eggs)

In order to determine the capacity for laying of this species, the third egg at Nest II was removed each morning. Unlike the famous Flicker which laid 71 eggs, the female settled down on her fifth egg and would toil no more. The experiment was not repeated, and may represent only an individual case.

Fertility. Of 66 eggs in 14 nests which were watched through an undisturbed hatching, 5 eggs or seven per cent never hatched and were presumably infertile. Of these 3 belonged to the 6-egg set, 1 to a belated 4-egg set, the other to a normal set of 5 whose complete history could not be traced.

Casualties. Several other natural causes affected the population of the Tree Sparrow tribe:

Nests A and C were found unoccupied with both adults gone, and in one case two of its five eggs had completely disappeared, cause unknown, but probably was either from desertion or the destruction of the birds.

At Nest IX the third (and last) young bird hatched twenty-four hours after the first, and died during the first day. This suggests that it could not maintain itself against its larger brothers, and consequently starved. At Nest III the last of six eggs was noticeably pipped when I left for a week's absence. Upon my return only five young were found, and the guess is hazarded that the fate of this nestling was the same as that of the Nest IX bird.

Summarizing the pre-nestling mortality, then, of a total of 75 potential eggs, 16, or 21.33 per cent never lived beyond the day of hatching.

Number of Broods. Due to the briefness of the northern summer, only one brood can be reared in a season. While it is possible that

an observer might miss an occasional case, a study of the table of dates and times required for each phase of the cycle shows the unlikelihood of a second nesting. Since the earliest known young left the nest on July 8th and had to be fed for two or more weeks by both parents, activities for a second brood could not be commenced until at least July 22d. The 70 days required to bring those young through the post-juvenal molt would make the date at the earliest September 28th, one day before the last date the species was seen in the region. There would be no time for recuperation from the molt or for fall flocking. This calculation is based on minimum figures, so that it is extremely improbable that a second brood of Tree Sparrows is often if ever reared in this region.

Laying. After the nest was completed there was usually a rest of several days, during which the birds seldom visited the nest. Thereafter an egg was laid daily. Of five nests observed only one bird skipped a day (between the second and third eggs). It is interesting to note that in two sets where the eggs were marked in order of laying the second was noticeably smaller.

The eggs were laid in the early morning, between 6:00 and 7:30 A.M. At Nest I the second egg had not been deposited at 6:45, but was laid before I returned at 7:45. On the fourth day the new egg was in the nest when I arrived at 6:30.

During egg-laying somewhat more interest was evinced in the nest. Of ten visits to Nest I during this time, the female was found covering the eggs on two occasions, once from 5:30 to 6:00 A.M., returning at 6:25 to lay, and once in mid afternoon. In addition the male visited her twice, and came once when she was absent. Other females were found on their nests at various hours of the day. When Nest B contained one egg, the bird was flushed at noon, returning in about fifteen minutes with a bill full of grasses. From the scanty evidence of two nests, it is believed that the female roosted there at this time, as Nest II (with four eggs) was occupied at 10:15 P.M., and one (with one egg) at 5:30 A.M.

INCUBATION

Time. Incubation, performed by the female only, begins normally with the laying of the last egg, though, as just indicated, she visits the nest occasionally during laying, and probably spends every night there. At Nests III and IX another egg was laid after incubation had apparently commenced. It may be significant that at both nests one egg hatched much later than the others, and this last young died before its first day was over.

During the first days, the female at Nest I was absent frequently for long periods, and on the morning of June 18th, two days after the set had been completed, the eggs felt ominously cold. Twenty minutes later I found her incubating persistently, and thereafter

she was seldom long absent. About two-thirds of the working day she spent on duty, a ratio which she maintained throughout the period. While the per cent of time did not vary appreciably, it was noted that during late incubation the periods on and off the nest were of much shorter duration. These facts are indicated by the following figures, compiled from three- and two-hour observations respectively at mid and late incubation. Interestingly enough the maximum period away from the nest occurred during a brief cold shower.

TABLE VI
INCUBATION PERIODS OF THE TREE SPARROW

	<i>6 days'</i> <i>incubation</i>	<i>11 days'</i> <i>incubation</i>
Time on nest.....	61.80 per cent	61.78 per cent
Time off nest.....	38.20 per cent	38.22 per cent
Av. length of period on nest	21.6 (max. 31)	7.6 (max. 34)
Av. length of period off nest	14.0 (max. 33)	5.2 (max. 12)

Position on Nest. During incubation the female crouched low in the nest, with neck drawn in, wings laid compactly against and back and tips of primaries crossed over the rump, only the bill and tail extending beyond the rim of the nest. This position was conspicuously different from the brooding posture, when she sat high over the nest, frequently panting from heat, neck outstretched, wings drooping over the rim of the nest. At Nest VII, after one young had hatched, the parent alternated these positions at frequent intervals.

Activities of Male. During this period the male continued to show a direct interest in home and mate, visiting the nest frequently. At Nest III he appeared three times during two hours, and the pair flitted away together to feed. During the night males of four nests were flushed from twenty to sixty feet from their nests. From the ground or the base of the bushes they scudded low a few feet ahead of me, silently or with a low tsip. One sang a few bars of song and trailed off to silence in the middle of a note.

After an incubation period of from 12-13 days the young emerged, scrawny and naked and eternally hungry. The development of the young will be the subject of a succeeding paper.

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