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## SEX, AGE AND INDIVIDUAL VARIATION OF WINTER TREE SPARROWS

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For the serious bird-bander, a student of the habits and component elements of the flocks about his feeding station, the brief descriptive phrase for the Tree Sparrow "Adult, sexes alike" is most inadequate. With the hope of finding positive external criteria for male and female, and for adult and first-year birds of each sex, a large number of specimens was collected in the fall of 1934, when skulls of the young were incompletely ossified and age as well as sex could be checked by dissection.

Skulls were found a reliable character until the first week in January. At the same time it was noted that immature males regularly showed smaller, whiter testes than the adults. On January 16th two of the eight males with small testes displayed skulls fully ossified, and thereafter this latter character had to be abandoned, though a trace of unossification was found as late as February 2d. Small testes were a reliable criterion of age until about the middle of March. Female gonads displayed no age differences on the wintering grounds, so that after January no females could be considered in age studies.

The relative values of various external characters were tested in 129 specimens taken from one locality near Ithaca, New York, between October 29th and January 3d. About a dozen a week were brought into the laboratory and arranged tentatively in four groups (presumably male adult, male immature, female adult, and female immature) on the basis of plumage characters. Next they were weighed and measured, and, if necessary, the groups were rearranged. Finally they were dissected for positive identification. On index cards for each individual were recorded the initial judgments and basis therefor, and the actual sex and age as determined by gonads and skull. In this way the most stable characters could be tested by actual practice, and features that represented mere individual variation could be weeded out. Since they were examined at once and only material of the same date compared, the element of seasonal variation was likewise eliminated.

The following characters were considered :

1. *Color of feet and legs.*—Since in juvenal birds on the nesting grounds these are light horn-color, it was hoped that the lighter legs in the fall might represent first-year birds, but the extremes of color from almost black to light brown were found indiscriminately in young and old of both sexes.

2. *Color of bill.*—Likewise horn-colored in juvenals, but found darkening before the birds had attained their full size in August, and indistinguishable by October.

3. *Color of iris.*—Uniformly dark brown.

4. *Feather wear on tails.*—A dangerous character, since it varies with the season and the individual, but young birds frequently showed more ragged rectrices than adults of the same date, and this was sometimes found useful in distinguishing adult females from first-year males.

5. *Amount of white edgings to tail feathers.*—This character, while it varies seasonally as the feathers wear down, is an individual matter.

6. *Amount of rusty wash on nape.*—This feature varies considerably with the geographical distribution and the season; there is no correlation with the present problem.

7. *Shade of rufous on back and crown, and ochraceous on sides.*—Females are often reputed to be duller or paler, and occasionally are, but they are just as likely to be brighter; and these differences, even when present, are so infinitesimal that they are scarcely a safe criterion.

8. *Width of crown.*—In live birds or freshly collected specimens, when the feathers are lying normally, there seems to be a minute but definite difference, the males being slightly wider across the top of the head. This criterion was frequently used successfully in judging the sexes, but since it is at best but a relative value and an exceedingly fine point, it is safer to rely on other characters discussed below.

9. *Amount of veiling of crown.*—This difficult character, although constantly shifting as the season progressed and exhibiting every shade of intergradation, was nevertheless one of the most usable. As accurately as was possible with such relative terms, the specimens were classified under four headings on the basis of crown plumage. Examples of each class, from the sex where that plumage seemed to predominate, are sketched below (Figure 1).

*Male.*—Adult males fell in equal proportions between classes A and B, with two or three heavily veiled. First-year males were more apt to be sparsely veiled, but over a third were as heavily marked as any adults. Three exhibited a vague trace of the dark shafts of first-year female plumage. Usually the male markings were distributed as loose fleckings of buff over the whole crown, whereas in the female it was more heavily concentrated toward the center.

*Female.*—Adult females were classed most frequently in C, a few in B, the concentration of buffy edgings toward the center crown

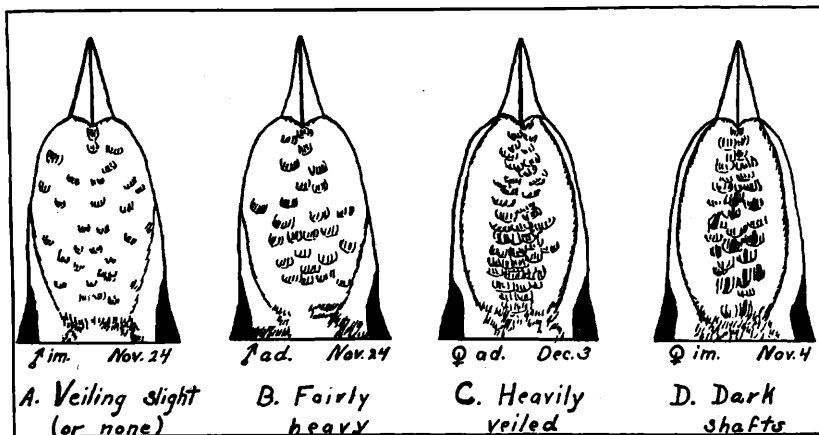
often (though not always) distinguishing them from males equally heavily veiled. Five showed more or less distinct dark shafts; two had practically no veiling whatever. Young females were frequently confused with adults of the same sex; and one exhibited no veiling whatever. The possession of distinct dark shafts in the center of lower crown feathers was, however, a characteristic feature of first-year females, being found in two-thirds of this group, and only suggested in a very small percentage of the other groups.

10. *Measurements*.—Here at last is a definite, though unfortunately not absolute, criterion for sexing this species externally. The following measurements were taken before skinning: *Total length* (from tip of bill to tip of tail), and *extent* (between tips of outstretched wings). Neither of these was found particularly valuable, varying too much with the degree of stretching given the birds. They would not, moreover, be applicable to living birds at the banding station.

*Wing*.—This measurement, since it differs quite markedly from Ridgway's figures, may require an explanation of the method followed in securing it. A thin celluloid rule was slipped between the bird's body and the folded wing, and the wing pressed gently against it in order to straighten any curvature of the primaries. The measurement was taken from bend of wing to tip of the longest primary. This method was found to give fairly uniform results with both live birds at the banding station and specimens in the laboratory.

*Tail*.—Here the celluloid rule was slipped along the tail and under the upper tail coverts until it just touched the oil gland, a point which was found especially convenient with living birds. Measurements were taken from that point to the tip of the longest tail feather.

FIGURE 1



Veiling of Tree Sparrow Crown Feathers

*Weight.*—While these figures were interesting in themselves, and showed differences in the average for each group, there was too much variation and overlapping to be of any value in differentiating sex or age.

In the accompanying table are given the average, normal range, and extremes of measurements of the 129 individuals used in this study.

MEASUREMENTS OF 129 SPECIMENS OF *SPIZELLA A. ARBOREA*

| <i>Measurements</i>        | <i>ad.</i>           |                      | <i>im.</i>           |                      |
|----------------------------|----------------------|----------------------|----------------------|----------------------|
|                            | <i>mm.</i>           | <i>mm.</i>           | <i>mm.</i>           | <i>mm.</i>           |
| <i>Wing</i>                |                      |                      |                      |                      |
| Average . . . . .          | 78.00                | 76.86                | 74.63                | 73.13                |
| Normal range . . . . .     | 80-77                | 79-75                | 76-72                | 74-71                |
| Extremes . . . . .         | 81, 74               | 79, 71               | 79, 72               | 79, 70               |
| <i>Tail</i>                |                      |                      |                      |                      |
| Average . . . . .          | 71.75                | 70.10                | 68.26                | 67.74                |
| Normal range . . . . .     | 73-70                | 72-68                | 70-67                | 70-66                |
| Extremes . . . . .         | 76, 68               | 76, 64               | 72, 65               | 70, 65               |
| <sup>1</sup> <i>Weight</i> |                      |                      |                      |                      |
| Average . . . . .          | <i>gms.</i><br>19.47 | <i>gms.</i><br>19.28 | <i>gms.</i><br>18.62 | <i>gms.</i><br>18.85 |
| Maximum . . . . .          | 22.70                | 22.60                | 20.70                | 20.00                |
| Minimum . . . . .          | 15.90                | 15.30                | 15.00                | 15.30                |

As can be seen, there is normally a complete overlapping within the sexes, which makes measurements useless for age study. Their value in determining sex, however, may be judged by the following figures:

Of the 129 *Wing* measurements:

- 3 males were unusually small,
- 4 females were unusually large,
- 30 were within border-line measurements of 76 and 75 mm. (chiefly young males and adult females).
- Total 37, or 28.68 per cent possibility of error.
- Only 6.20 per cent (adult males) } absolutely identifiable as to both age and sex by wing measurements.
- 5.66 per cent (young females) }

In *Tail* measurements only:

- 12.40 per cent of the males were above female figures,
- 17.05 per cent of the females were below male figures,
- Total 70.55 per cent possibility of error.

The danger of using only one character was forcefully brought home to me in two cases at my banding station. No. A186836, when banded in 1933, was classed as a female with a wing of 72 mm. Upon its return in 1935 it exhibited a 78-mm. wing and all the external features of a healthy male. No. A186832, likewise banded in 1933, was found dead in 1935, and although a female at least two and a half years old, showed decided dark shafts.

In *summary*, then, there is no one criterion for determining the sex

<sup>1</sup>Based on year's figures.

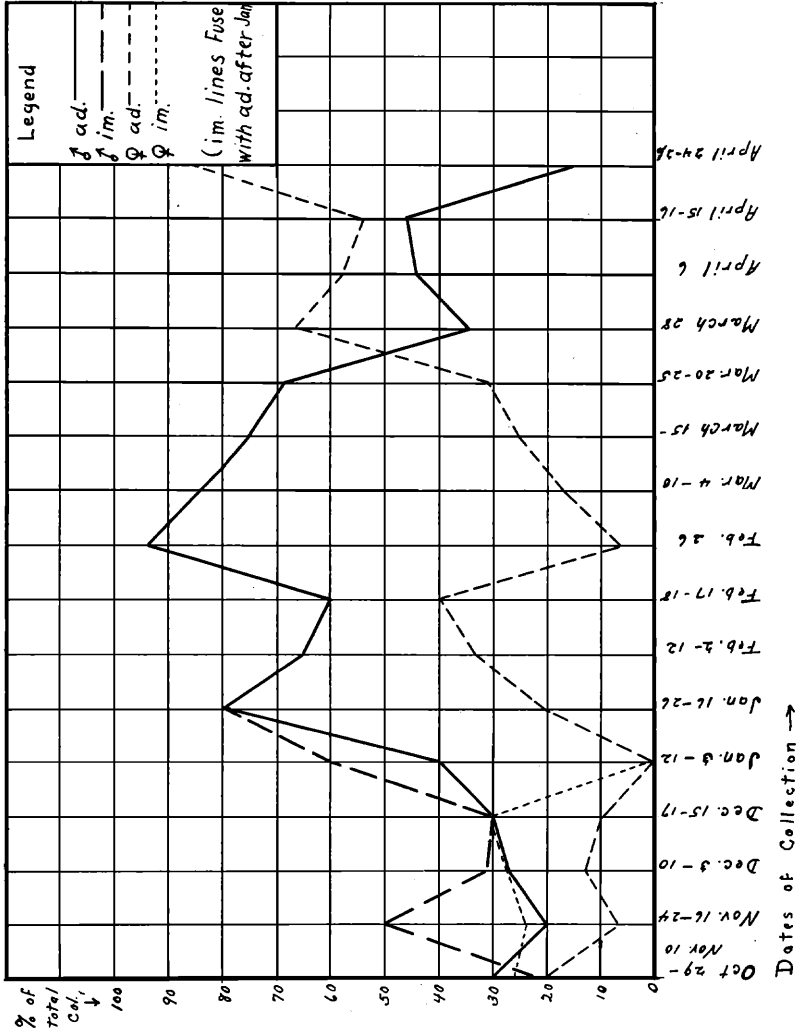


FIGURE 2 Migration of Sexes at Ithaca, N. Y.

or age of Tree Sparrows upon external evidence. In general, the unusually large birds are adult males, and the smallest ones, with distinct dark shafts on the crown feathers are first-year females. Greater feather wear of the tail may indicate a young bird. Age, however, cannot be definitely established externally. To determine sex, for most individuals a combination of factors must be considered: measurements, width of crown, and amount of veiling of crown. First-year males and adult females are most easily confused, and sometimes impossible to distinguish.

In a practical test with 129 birds judged on the basis of these external criteria, dissection disclosed the following results:

Male adult—36 birds all judged correctly.

Male immature—5 of 43 incorrect.

Female adult—7 of 19 incorrect.

Female immature—31 all correct.

Percentage of error—9.30 (all among adult female and young male groups).

#### RELATION OF SEXES AND AGES IN WINTER AND IN MIGRATION

Assuming, then, that with reasonable care, sex and sometimes age of Tree Sparrows can be determined by external characters with some degree of accuracy, to what use can such knowledge be applied? At Ithaca, New York, a number of interesting problems were begun, which might well be extended to other regions. While the Ithaca data are based on collected specimens, it is firmly believed that in the light of the above-mentioned facts, practically identical results could be obtained at the banding station.

The problem of family continuity among birds is always intriguing, and considerable seasonal variation was noted in the relations of sexes and ages of Tree Sparrows, as indicated in the accompanying graph (Figure 2). During the autumn migration young and old of both sexes were travelling together, and the guess may be hazarded that these flocks represented neighborhood groups, as is the case with other species. Throughout the unsettled fall months the sexes were more or less equally divided. With the midwinter settling, males were found conspicuously more abundant, maintaining their majority until near the end of March. Females began to increase proportionately during that month, definitely exceeding the males by the last week, the same period which at the banding station had marked the last appearance of so many residents and the greatest influx of new birds. From Clayton, Illinois, Mr. R. S. Davis writes me that the first females appeared at his banding station on March 22d, 25th, and 23d of three recent seasons. Dr. L. E. Hicks found a similar proportion among thirty-one Tree Sparrows collected in Ohio during the spring of 1935. While the first of the female migration thus coincides with the male movement, the main bulk appears during April, and the last birds of the season are almost entirely

females, accompanied by one or two small males, possibly first-year birds.

Since these figures indicated with reasonable certainty that the bulk of the females must winter farther south, I wrote to all the leading museums of the country for lists of their Tree Sparrow specimens, in the hope of plotting the respective winter territories. The dates, December 20th and March 1st, were arbitrarily set as the limits of the non-migratory winter period. While there is considerable possibility of error due to late or early migrations, to inexperienced determination of sexes, or to lack of a representative number of specimens for many localities, the results are nevertheless suggestive.

In three regions these elements of chance were eliminated by personal collection or by sufficient data to assure a good cross-section, with results that are in perfect accordance with our theory:

| Part of Range<br>of Species | Locality  | No. of Winter |         |
|-----------------------------|---|---------------|---------|
|                             |   | Males         | Females |
| North.                      | New York State (chiefly from Ithaca, personal collection) . . . . .           | 102           | 31      |
| Central.                    | Indiana (Indianapolis, col. January 3, 1935, dissected by A. M. H.) . . . . . | 16            | 22      |
| South Central.              | Kansas (U. S. Biol. Surv. and University of Kansas collections) . . . . .     | 185           | 158     |

#### NORMAL INDIVIDUAL VARIATIONS

Many of these have already been discussed in the preceding section, e.g., measurements; color of legs and feet; amount of white edgings to tail feathers; veiling of crown; shade and amount of rufous on crown, nape, back, of ochraceous buff on sides. In the latter particular fall specimens from Ithaca, New York, range from extremely rich plumages where the rufous edgings of the back are the predominant color, to pale sandy individuals whose coloring is not far removed from the Western sub-species (*ochracea*). There is also some variation in the amount of rufous and buffy in the cheek region and on bend of wing. Some individuals have an almost continuous band of pale rufous or buff across the breast, distinct from the grayer throat and whiter belly. The dark breast spot varies in size and distinctness and may be almost totally concealed or double.

The two white wing-bars are a constant feature, but may or may not be in evidence, depending upon the manner in which the bird is fluffing the feathers on breast, side, or scapulars. The same individual seen several times in one day may appear different in this respect every time.

The bill occasionally shows variation in length of the upper mandible. Normally it barely overlaps the lower, but in a few cases it has been found to exceed its mate by a full millimeter.

Mr. C. L. Whittle (*Bulletin of Northeastern Bird-Banding Association*, 1928), comments on a structural peculiarity of the superciliary stripe which he designates as horns. It was observed particularly on one banded bird at least two and one half years old, but is not accidental, as he has seen one or more such birds every winter, among his oldest returns. In order to observe this phenomenon, Mr. Whittle writes me, the bird must be viewed tangentially and at very close range, when the elongation at the central superciliary feathers may appear as distinct points above the crown.

#### ABNORMAL COLORATION

Although the Tree Sparrow is one of the most frequent visitors at banding stations and is richly represented in museum collections, there are few cases in the literature of albinism, either complete or partial, and none of other plumage abnormalities. The following cases represent the only records I was able to obtain from ornithological literature or museum specimens.

1. *Complete albinism*.—*The Ornithologist and Oologist* (13, 1, p. 13, 1888) cites a perfect case, shot on Cape Cod, Massachusetts, November 18, 1887, and brought to F. B. Webster. William Moody informs me that he observed one near Chicago, Illinois, October, 1934, in company with a flock of normal birds. It was positively identified by the size, shape, bill, and general behavior.

2. *Incomplete albinism*.—Four specimens have been collected in which albinism is generally distributed over the body, but color is faded rather than completely lost. These are deposited at Ohio State (specimen examined), Carnegie (Todd, 1904), Princeton (described for me by C. H. Rogers), and U. S. National (specimen examined) Museums. In these, the blackish areas—wings, tail, streakings on back, pectoral spot, upper mandible, and legs—are faded to pale brownish grey, dirty white, or cream. The other areas are correspondingly lighter, so that the chestnut of crown, postocular streak, edgings to back and wing feathers, and patch at bend of wing are faded to the same color as the buffy edgings and sides, giving the whole bird an even tawny yellowish appearance. In the last two specimens the chestnut and buffy areas are practically normal, producing an effect of unrelieved brightness. The whitish areas of under parts are somewhat lighter than normal.

3. *Localized albinism*.—Mrs. Sadie B. Knox<sup>2</sup>, in banding A23575 on November 3, 1925, observed that two inner tail feathers were white, and that when it returned the next year, these feathers were again white, indicating a true case of albinism.

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<sup>2</sup> *Bulletin of the Northeastern Bird-Banding Association*, Vol. III, p. 56, 1927.