Sex Determination by Wing and Tail Measurements in the Song Sparrow and Field Sparrow

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ABSTRACT

Wing and tail data from fifteen years of breeding bird population studies in Hopewell, NJ, indicate that sex determination by wing and tail is possible in the locally breeding Song Sparrows *(Melospiza melodia)* and Field Sparrows *(Spizella pusilla)*. After-hatching-year (AHY) Song Sparrows had significantly longer wing chords than hatching-year (HY) birds, but AHY Field Sparrows had not. Neither were significantly longer in tail. After-second-year (ASY) or older returns during the breeding season showed no further increase in wing and tail measurements over initial AHY measurements (older than SY) except in the male Field Sparrow wing chords. In both species and each age, males were significantly longer in wing and than females. Separation of the subadults from adult Song Sparrows did not widen the average wing length differences between adult males and females. A tentative scheme for separating the sexes of both species is suggested based on the measurements that extend beyond the overlap of two standard deviations.

INTRODUCTION

An ongoing study of habitat use by breeding passerines, started in 1978 in old successional fields of the Sourlands, New Jersey (Suthers 1988), provided abundant sample sizes of Song Sparrows and Field Sparrows before they declined due to vegetative overgrowth. These birds, among other species with sexes alike, were chosen to elucidate the problem of sexing monomorphically plumaged birds by wing and tail measurement. Results have been published (Suthers & Suthers 1990) on the Gray Catbird *(Dumetella carolinensis)*, and (Suthers 1993) on the Wood Thrush *(Hylocichla mustelina)* and Veery *(Catharus fucescens)*.

This study explores the possibility that we can get past geographical size differences to sex the sparrows regionally by wing and tail measurement. The Song Sparrow has been called the most highly variable bird in North America; its tremendous plasticity enabling it to adapt to influences of physical environment (Bent 1968). The A.O.U. Checklist (1957) recognizes 31 subspecies. Various species accounts relate the brighter rufescent color of the eastern race; the darker coloration of the Allegheny Mountain birds (Whetmore 1939); a darker, duller, more sooty bird of Ohio; and a lighter, grayer race in Mississippi (Oberholser 1974). Aldrich (1984), in his monograph on Song Sparrows, documents significant size differences according to cline, migratory or sedentary habits of the races, life areas, and ecoregion province. The Bird Banding Manual, Vol. II (1977), species account raised the question if a wing-tail ratio would be helpful in separating and sexing the many races of the Song Sparrow.

The Field Sparrow shows geographical differences over two broad regions: the eastern birds averaging browner in coloration; the western birds being paler and grayer. Mengel (1965) found that all fell within the range of measurements (not given) expected for the eastern races. He cited Whetmore (1939) who found western birds slightly larger than eastern birds (measurements not given). Oberholser (1974) described four subspecies in Texas with measurements. The A.O.U. Checklist (1957) lists one subspecies.

METHODS

All birds were sexed by brood patch or cloacal protuberance. Birds were aged HY or AHY by skull (Wood 1969). Though some SY Song Sparrows may show small windows in the skull into March (Bird Banding Manual, Vol II (1977), Key to Age and Sex), SY birds mist netted in May could be determined only by retained, worn central rectrices contrasting with newer feathers. Banded fledglings returning to natal grounds to breed also provided known SY birds. Wing chords were measured to the nearest mm on the closed wing using a ruler with shoulder stop. Tails were measured by slipping a ruler between the central pair of rectrices.

Sample means, sample standard deviations (SD), minimum and maximum measurements were calculated and plotted for a quick evaluation (Figure 1). Where measurements of one sample lay beyond 2 SD of the other sample, possible real differences between the mean were indicated, so the sample means were tested by the *t* test (cf Schneider 1984, Aldrich 1984) and a one factor model of ANOVA (analysis of variance) together with the multiple comparison tests Scheffe F-test and Fisher Protected Least Significant Difference (Feldman and Gagnon 1991). Increases in wing and tail measurements over initial adult measurements in returning birds were tested by the two-tailed, paired *t* test.

To get a handle on the question for further study in the Bird Banding Manual Vol. II (1977) whether the wing-tail ratio would be helpful in separating the many races of Song Sparrows, wing and tail measurements of males and females of the subspecies that may be encountered in eastern United States (Bent 1968, Oberholser 1974), in various Life Areas and Ecoregion Provinces (Aldrich 1984 Tables) were taken from the literature. Wing and tail plus and minus 2 SD's were calculated. To be consistent and comparable with Aldrich, the ratio of tail length to wing length and 2 SD's were calculated. Data on the Field Sparrow (Oberholser 1974) were treated in a similar way.

RESULTS AND DISCUSSION

Samples were ample (see Tables) and the data were homogeneous within the age and sex classes by the F-test for similarity between two variances.

Age: AHY Song Sparrows that have gone through the first complete molt had significantly longer wing chords than HY birds that still retained their juvenile remiges and rectrices, but Field Sparrows had not (see species accounts). Smith et al. (1986) working on Song Sparrows on Mandarte Island, British Columbia, Canada, also found significant increases from young birds to adults after the first complete adult molt.

Older Age: Wing and tail length were tested for increase in adult birds in subsequent molts beyond the first complete molt. AHY encounters and the first sequential returns (ASY) of these individual birds of both species, tested by the two-tailed, paired *t* test for increase in wing and tail measurements, showed significant increase only in the male Field Sparrow wing. Adult male Field Sparrow wings averaged 62.2 mm (SD 2.70) and returned at 63.4 (SD 1.60), (t = 2.540, df = 15, P = .0226). ATY and older returns of both species were not significantly larger in encounters up to A6Y in Song Sparrows (n = 9) and A7Y in Field Sparrows (n = 12). Smith et al. (1986) also did not find further increase in the Song Sparrow wing beyond the first complete adult molt.

Sex: Wings and tails of females were shorter than males in all classes (Fig. 1), statistically significant by the *t* test and ANOVA (see tables in species accounts). The shaded 2 SD areas in Figure 1 demonstrate the extent of overlapping of males and females in combined and separated age classes. Birds that do not overlap 2 SD presumably can be sexed by wing and tail measurement and the outliers (minimum and maximum) should cause less than 5% error.

Song Sparrows: AHY birds were significantly longer than HY birds in wing (One Factor ANOVA F = 5.06, df = 1, 223, P = .0071), but not tail. The sparse sample of SY birds, sexes combined, were not different than either HY or AHY in wing and tail measurements and tail-wing ratio.

According to Dwight (1900), first brood Song Sparrows are very likely to molt five or six outer primaries in some clines. In the New Jersey Sourlands breeding population, such molt was seen in only one hatching year bird out of 400. It was growing in primary 7 and greater secondary coverts in mid-August (17 August 1980). Another fall HY bird (24 October 1992) showed sheaths at the bases of growing 9th primaries. Winter banding in November 1981 through January 1982, and December 1982 yielded 17 Song Sparrows with incompletely ossified skulls and no sign of molt. Through the years in the spring, retained, worn remiges, and especially central rectrices contrasting with newer feathers could be seen on some SY returns. This molt evidently did not occur on natal grounds. Smith et al. (1986) suggest that the major increase in wing length is at the first adult molt.

Males were significantly longer than females in wing (One Factor ANOVA F = 48.56, *df* = 2, 223, *P* = .0001), tail ANOVA F = 40.28, *df* = 2, 223, *P* = .0001) and tail-wing ratio (ANOVA F = 4.56, *df* = 2, 223, *P* = .0115). Males were significantly longer in wing and tail than HY of unknown sex (statistics as above). Like the thrushes (Suthers 1993), females were not longer in wing but were longer in tail than HY of unknown sex (statistics as above). Aldrich (1984) discusses adaptive implications of these differences in proportion. There were not enough young females (n = 5 HY, 4 SY) to test further for age-sex interaction.

Table 1. Song Sparrow descriptions. Mean, mm; Standard Deviation (SD)

			WING		TAIL		TAIL/WING	
Count	Age	Sex	Mean	SD	Mean	SD	Mean	SD
60	AHY	M	64.8	2.22	66.0	2.74	1.019	.03
			=		=		=	
9	SY	M	64.6	1.41	65.6	1.81	1.016	.02
			=		=		=	
8	HY	M	64.9	0.99	66.0	1.28	1.014	.03
			>		>		>	
43	AHY	F	61.3	2.37	61.1	3.62	.999	.03
			=		=		=	
4	SY	F	61.2	0.96	61.8	3.20	1.008	.04
			=		=		>	
5	HY	F	62.2	3.03	61.6	1.52	.992	.05
			=		=		=	
102	HY	U	62.1	2.11	62.8	3.21	1.011	.05

Reading down, Means, in respective wing, tail, and tail/wing columns are statistically longer (>) at the .05 level (p=0.01 to 0.0001); or statistically equivalent (=) by multiple comparison tests.

The different tail-wing ratios for New Jersey males (1.019) and females (0.999) were consistent with Aldrich in that males had larger tail-wing ratios than females. The New Jersey Sourlands birds measured smaller by one to two mm than those described by Aldrich (1984, Table 1,2) for the life area of eastern deciduous forest. (For a quick look at a life area map derived from J.W. Aldrich, see page 7 in Robbins et al. 1966 or 1983). Aldrich used museum specimens taken from the broad geographic areas. Song Sparrows in this section were described by Aldrich as having relatively short wings and medium length tails.

The mathematical exercise with tail-wing ratios, wing, tail and 2 SD's showed similar averages, but great spread in SD's among birds in EBBA territory (eastern United States). The biggest difference in average wing was 1.90 mm, between the largest male wing of 66.66 mm (northern conifer forest, maritime Maine) and the smallest of 64.80 mm (NJ Sourlands, this study). Corresponding female wing figures are 62.15 mm (63.54 - 61.39). The biggest difference between the male tail-wing ratios is 0.038 mm (NJ Sourlands 1.019 mm - Laurentian Forest, Quebec, 0.981 mm). The female difference is 0.001 mm (0.977 - 0.996). These measurements are too similar to separate the subspecies. Tail minus wing differences were not helpful either. However, within each ecogeographical area, related to subspecies (A.O.U. 1957, Oberholser 1974), it seems on paper that males could be distinguished from females by using nonoverlapping measurements beyond 2 DS's.

Wing tip measurements may be useful in separating clines. Aldrich (1984) found that Boreal and Laurentian Forest Birds had the most pointed wing (wing tip), adaptive for stronger and more sustained flight. Birds of the eastern deciduous forest and coastal marshes had rounded wings, an adaptation to more sedentary flight habits. Wing tip measurements plotted from Aldrich's tables showed overlapping. If birds with wing tips measuring 9.5 and above were considered of northern clines, then perhaps the extremes could be sexed by wing in both EBBA and boreal areas.

Aldrich (1984), upon examining recovery records from the Bird Banding Laboratory, indicated that birds of the boreal Yukon, Laurentian Forest, New England northern hardwood-conifer and Maine maritime populations were migratory. If, according to theory, they leap-frog past the regions of semimigratory or sedentary populations of Eastern deciduous forest regions and Atlantic coastal marsh, these regions may have only wintering local breeding birds. Then the conclusion derived from this exercise would be that the wintering birds in EBBA territory may be sufficiently similar in wing and tail length to be sexed by wing length. Perhaps the Operation Wing Chord project (Graedel 1992) would have some input here.

Song Sparrow Key: In the clinal breeding population of the New Jersey Sourlands, a wing 58 mm and under would be female, 69 mm and over male, and a tail 59 mm and under female, 70 mm and over male.

Field Sparrows: HY birds in New Jersey could be detected into November by skull (Schneider 1981). There was no evidence of wing or tail molt in 132 HY birds with the exception of one, on 1 September 1980, with head, body, greater secondary coverts and tail molt. Age classes, sexes combined, were not significantly different by One Factor ANOVA in wing, tail, and tail-wing ratio.

Sex classes, ages combined, were significantly different (One Factor ANOVA F= 49.336, $df = 2, 290$, $P = .0001$). Males were longer than HY of unknown sex in wing (statistics as above) but not in tail, and the tail-wing ratio was significantly different (F = 4.524, $df = 2, 290$, $P = .0116$). Older females, unlike the thrushes (Suthers 1993) were significantly longer than HY of unknown sex in both wing and tail ($P = .0001$ as above).

Table 2. Field Sparrow descriptions.						Mean, mm; Standard Deviation (SD)		
			WING		TAIL		TAIL/WING	
Count	Age	Sex	Mean	SD	Mean	SD	Mean	SD
84	AHY	M	62.2	2.19	61.5	2.86	.989	.04
			=		=		=	
3	SY	M	61.7	2.89	61.3	0.58	.996	.05
			=		=		=	
2	HY	M	59.5	-	60.0	-	1.008	-
			>		>		=	
69	AHY	F	58.7	2.06	58.8	2.45	1.002	.03
			>		=		=	
129	HY	U	60.4	2.35	60.8	2.92	1.006	.04
			=		=		=	
4	SY	F	59.2	1.53	59.3	1.15	1.000	.01
			=		=		=	
2	HY	F	58.0	-	57.0	-	.983	-

Reading down, Means, in respective wing, tail, and tail/wing columns are statistically longer (>) at the .05 level (p=0.01 to 0.0001); or statistically equivalent (=) by multiple comparison tests.

Field Sparrow Key: In the breeding population of the New Jersey Sourlands, a wing 55 mm or less would be female, 64 mm or more male, and a tail of 54 mm or less female, 65 mm or more male.

As in the Song Sparrow mathematical exercise, with wing and tail measurements and maximum-minimum values from Oberholser (1974), the calculated tail-wing ratios and tail minus wing differences showed considerable overlapping even though the great plains and western (Utah) averages were distinctly larger than the eastern average. It would seem that the eastern birds could be sexed by wing and tail in EBBA territory. It would be worth while to add the Field Sparrow to the Operation Wing Chord project initiated by Graedel (1992).

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Figure 1: Comparative wing and tail measurements of age and sex classes of two monomorphic sparrows, the Song Sparrow and Field Sparrow. Mean, heavy horizontal bar; ± two Standard Deviations, shaded box; spread, minimum and maximum values, vertical bar with caps. Measurements of one sex that go beyond the 2 SDs of the other sex may be used for separating the sexes, with tolerable errror, as 95.44% of a sample falls within ± 2SDs of the sample mean.