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Fla. Field Nat. 22(2): 48-51, 1994.

**DISTINGUISHING GENDER OF FLORIDA GRASSHOPPER SPARROWS
USING BODY MEASUREMENTS**

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The Florida Grasshopper Sparrow (*Ammodramus savannarum floridanus*) was federally classified as endangered in 1986 because of its restricted distribution, loss of habitat, and population decline (Fed. Reg. 1986). The recovery plan for the sparrow (USFWS 1988) provides for a captive breeding program if the population continues to decline. Identification of sex of individual Florida Grasshopper Sparrows would be important should that recovery effort become necessary. However, for this sexually monochromatic species (Smith 1968) the identification of sex is difficult outside the March-June breeding season in Florida. The sex of monomorphic passerines can be determined by laparotomy and laparoscopy, but the risk of injury or death by these procedures (*op. cit.* Richner 1989) may be unacceptably high with endangered birds. We examined wing-length and weight measurements of Florida Grasshopper Sparrows as a non-invasive method of distinguishing sex classes.

Wing-length and weight data are from a banding study conducted during March 1989 to June 1992 on the U.S. Air Force, Avon Park Air Force Range, in Highlands and Polk counties, Florida. The study area and banding methods are described by Delany et al. (1992). Sex was determined during the breeding season by the presence or absence of a cloacal protuberance. Age (juvenile, <1 year old; or adult, ≥1 year old) was determined by plumage (Smith 1968). Wing chord was measured to the nearest 0.5 mm with a ruler and end stop according to the North Am. Bird Banding Manual (1977). Weight was obtained with a 50-g Pesola spring balance calibrated in 0.5-g intervals, and estimated to the nearest 0.1 g. Measurements were made within 15 minutes following capture and the application of one USFWS aluminum band and two plastic bands.

Measurements of both wing chord and body weight were available for 25 adult males and eight adult females. Bartlett's test was used to test whether variances of individual measurements (Steel and Torrie 1980:471) or covariance matrices of measurement pairs (Morrison 1976) were heterogeneous with respect to sex. Gender means of wing chord and body weight were compared with a *t*-test. A linear discriminant function (Johnson and Wichern 1982:466) was estimated assuming equal prior assignment probabilities and misclassification costs. For this small sample, we followed Lachenbruch's (1975) jackknifing procedure for unbiased estimation of misclassification rate.

Normal probability plots and bivariate scatterplots of sparrow body measurements (Fig. 1) indicated no obvious departure from univariate and bivariate normal distributions. Tests of variance heterogeneity were not rejected for variables individually ($P \geq 0.237$) or for the variable pairs ($P = 0.702$). Thus, (co)variance estimates were pooled over sexes. Both wing chord and weight were highly distinguished by sex (Table 1, Fig. 1). The estimated discriminant function incorrectly classified 12% of the males (3 of 25) and 12.5% of the females (1 of 8) (Fig. 1), producing an average misclassification rate of 12.3%.

Measurement of both wing length and body weight appears to be a reliable indicator of sex for Florida Grasshopper Sparrows. A difference in wing length by sex also was reported for three individuals collected by Mearns (1902) during April 1901. The usefulness of these criteria, however, depends on their validity outside the breeding season when other identifying characters and behavior are absent. Grasshopper Sparrows undergo a postnuptial molt (Sutton 1935, Smith 1968) that may affect measurements of wing chord.

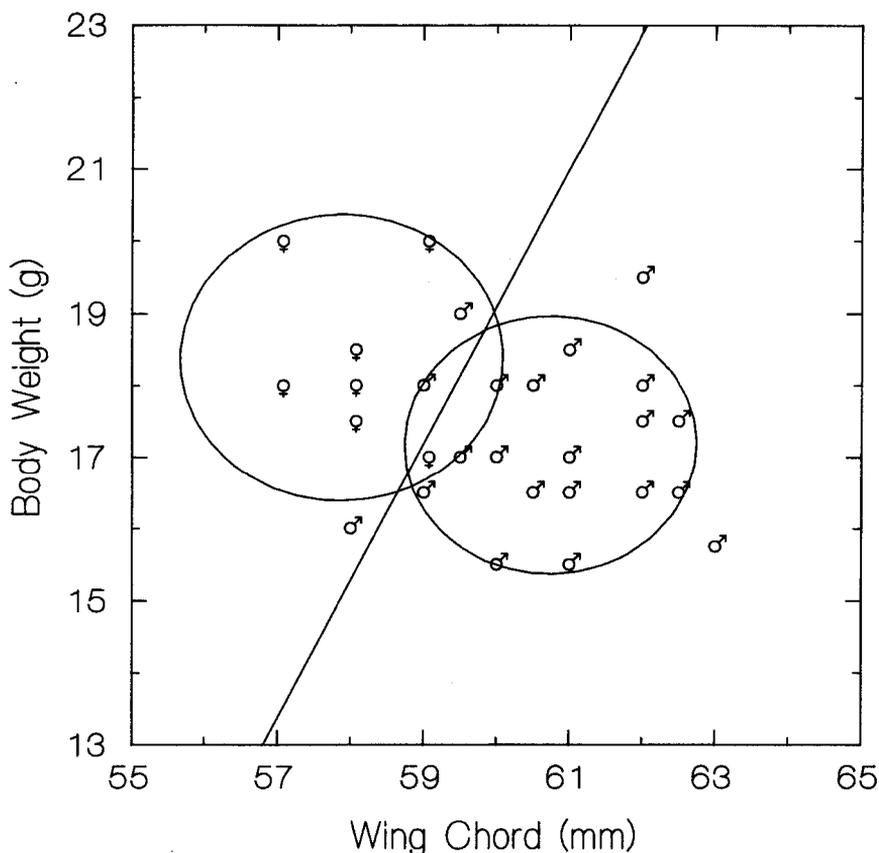


Fig. 1. Body weight (g) relative to wing chord (mm), by sex, with 50% prediction ellipse for adult Florida Grasshopper Sparrows. The estimated discriminant function was $y = 106.169 - 2.12403 \text{ chord} + 1.11419 \text{ weight}$. If sample means represent population means for gender, an individual would be classified as female for values of $y \geq 0$ and as males otherwise. Line represents weight and wing chord values yielding equal male/female classification probabilities.

Table 1. Comparison of body measurements of adult Florida Grasshopper Sparrows by sex, during the breeding season (March-June), 1989-1992, on the Avon Park Air Force Range, Highlands County, Florida.

Variables	Female (N=8)		Male (N=25)		<i>t</i>	<i>P</i>
	\bar{x}	SE	\bar{x}	SE		
Wing chord (mm)	57.88	0.30	60.74	0.25	6.06	<0.001
Weight (g)	18.38	0.39	17.17	0.21	2.83	0.008

Egg formation may cause variation in the weights of females (Clark 1979). Other caveats concerning measurements of wing chord (Yunick 1986) and weight (Collins and Atwood 1981) and their interpretation relative to sexual dimorphism (Clark 1979, Rising and Somers 1989) also apply to our data. Measurements from individuals of known sex outside the breeding season are needed to evaluate the efficacy of using wing chord and weight measurements to determine the sex of adult Florida Grasshopper Sparrows.

We thank H. Blackburn, R. Bowman, S. D. Coltman, P. Ebersbach, J. W. Fitzpatrick, C. Ford, D. Ford, G. Goldstein, J. Grier, S. A. Hedges, R. Hooten, T. Logue, K. Olsen, S. Penfield, J. Rogers, J. A. Rodgers, Jr., H. B. Tordoff, S. Van Hook, V. Wallers, P. B. Walsh, H. Whitaker, and G. Woolfenden for assistance with banding. J. M. Hamblen and T. L. Steele assisted with this manuscript. S. A. Nesbitt, J. D. Rising, J. A. Rodgers, Jr., T. A. Webber, and D. A. Wood reviewed previous drafts.

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