be possible to weigh birds at perches electronically. John Kanwisher provided some helpful suggestions for circuit components and perch design in the early stages of this project. Tasha Kotliar helped patiently with the field testing of the scales, and Gil and Jo Fernandez built accessible nesting platforms and some of the initial Osprey perches that encouraged us to begin thinking about weighing Ospreys in the Westport Rivers, MA. Jerome Jackson made many helpful suggestions for improvements in the manuscript. This study was funded in part by the Dartmouth (MA) Natural Resources Trust and by NSF doctoral dissertation grant 6029-5 to Poole.

LITERATURE CITED

DRENT, R., AND S. DAAN. 1980. The prudent parent: energetic adjustments in avian breeding. Ardea 68:225–252.

HALL, T. R., W. E. HOWARD, AND R. E. MARSH. 1981. Raptor use of artificial perches. Wildl. Soc. Bull. 9:296–298.

HEATHKIT. 1977. Manual for the digital scale, model GD-1186. Heath Co., Benton Harbor, Mich.

NEWTON, I. 1979. Population ecology of raptors. Buteo Books, Vermillion, South Dakota.

PALMER, R. S. 1963. Handbook of North American birds, Vol. 1–2. Yale Univ. Press, New Haven, Connecticut.

SPITZER, P., AND A. POOLE. 1980. Coastal Ospreys between New York City and Boston: a decade of reproductive recovery 1969–1979. Am. Birds 34:234–241.

SIBLY, R. M., AND R. H. MCCLEERY. 1980. A balance for weighing ground nesting birds. J. Appl. Ecol. 17:323–327.

ALAN POOLE, *Boston University Marine Program, Marine Biological Laboratory, Woods Hole, Massachusetts 02543;* and JON SHOUKIMAS, *Laboratory of Biophysics, Marine Biological Laboratory, Woods Hole, Massachusetts 02543.* Received 14 Oct. 1981; accepted 5 Apr. 1982.

Sex Determination of Adult Whimbrels.—The sex of an adult Whimbrel (*Numenius phaeopus*) is not readily distinguishable in the field. Whimbrels are monomorphic with respect to plumage pattern and color. Although females tend to be larger than males, size overlap for any individual character is too high to enable separation of a useful proportion of a sample into male and female groups.

In the course of a field study of the Whimbrel, I used discriminant function analysis (DFA) to sex live birds. DFA weighs characters by their power of discriminating between groups (the discriminant weight) using data from a reference group (Cooley and Lohnes, Multivariate Data Analysis, John Wiley and Sons, Inc. Toronto, 1971). A discriminant score was calculated for each individual in the reference and field group by summing the products of the discriminant weight and the measurement for each character. The discriminant score of each individual in the field group was then compared with the critical scores for the 2 sexes in the reference group. Two computer programs were used: Discriminant Analysis Program for 2 Groups (DISCR2, D. Power) to determine the discriminant score of all individuals, and the BMD07M Stepwise Discriminant Analysis (Health Sciences Computing Facility, UCLA) to determine a posteriori probability values of correct classification.

In this study, the reference group consisted of study skins of 20 female and 20 male adult Whimbrels housed in the Department of Ornithology at the Royal Ontario Museum, Toronto, Ontario. Specimens were collected from across Canada with over 80% from Manitoba and Ontario; only those taken in May, June, or July were included. Ten characters were measured on the museum specimens to 1 mm using dial calipers. The same measurements were taken to 1 mm using vernier calipers on 79 live birds nest-trapped in June and early July of 1973 to 1976 near Churchill, Manitoba. A series of histograms revealed that shrinkage due to drying in the museum specimens distorted 6 of the characters thus preventing their use for comparisons with field measurements. Tarso-meta-

TABLE 1. Discriminant weights and mean measurements (mm) of reference specimens of Whimbrels.

Character	Discriminant weight	Sex[1]	Mean	Range	SE	*t*-statistic
Wing	0.270	F	242.1	223–252	1.34	15.11**
		M	229.4	221–238	1.04	
Culmen	0.580	F	90.8	86–95	0.59	13.36**
		M	82.8	76–92	1.04	
Tail	0.516	F	93.8	88–101	0.71	7.72**
		M	89.9	84–94	0.76	

[1] N = 20 for female (F) and male (M) samples in all cases.
** indicates $P < 0.01$.

tarsus length had a discriminant weight close to 0 so was also excluded. The 3 measurements used were:

1. chord of the exposed culmen—from the edge of the feathers to the tip of the bill
2. wing length—the right closed wing (unflattened) from the wrist to the end of the longest primary
3. tail length—from the base of the center rectrices to the tip of the longest rectrix of the closed tail.

The discriminant weights of each character, and the data for the reference groups, are presented (Table 1). Females were significantly larger than males for each character ($P <$ .01). An index for sex determination of a Whimbrel of unknown sex can be calculated by taking the sum of the products of each measurement and its discriminant weight. The critical scores at the .95 level of accuracy are 158.9 and 163.6. Birds with scores falling between these values would have a probability of <.95 of being a particular sex. Birds with values of ≥163.6 would have a probability of ≥.95 of being female, and birds with values of ≤158.9 would have the same probability of being male (Fig. 1a). The mean discriminant score of males in the reference group was 156.2, and of females was 166.4 (SD = .82).

Using the criterion level of an a posteriori probability value of >.95, 34 of the 40 reference specimens (85.0%) were classified as the correct sex, and 4 as of unknown sex. Two (5.0%) were incorrectly classified.

As an example, this technique was used to classify 79 Whimbrels trapped in the field near Churchill, Manitoba (Fig. 1b). By comparing the discriminant score of each bird with the above critical scores, 73.4% (58 of 79) were classified as either male or female. In-

TABLE 2. Mean weights of live adult Whimbrels (g).

Sex[1]	N	Mean	Range	SE	*t*-statistic
F	36	403.9	345–459	4.85	7.51***
M	29	354.8	310–403	4.11	
U	12	369.3	338–415	7.97	

[1] F = female, M = male, and U = sex unknown.
*** Indicates $P < 0.001$.

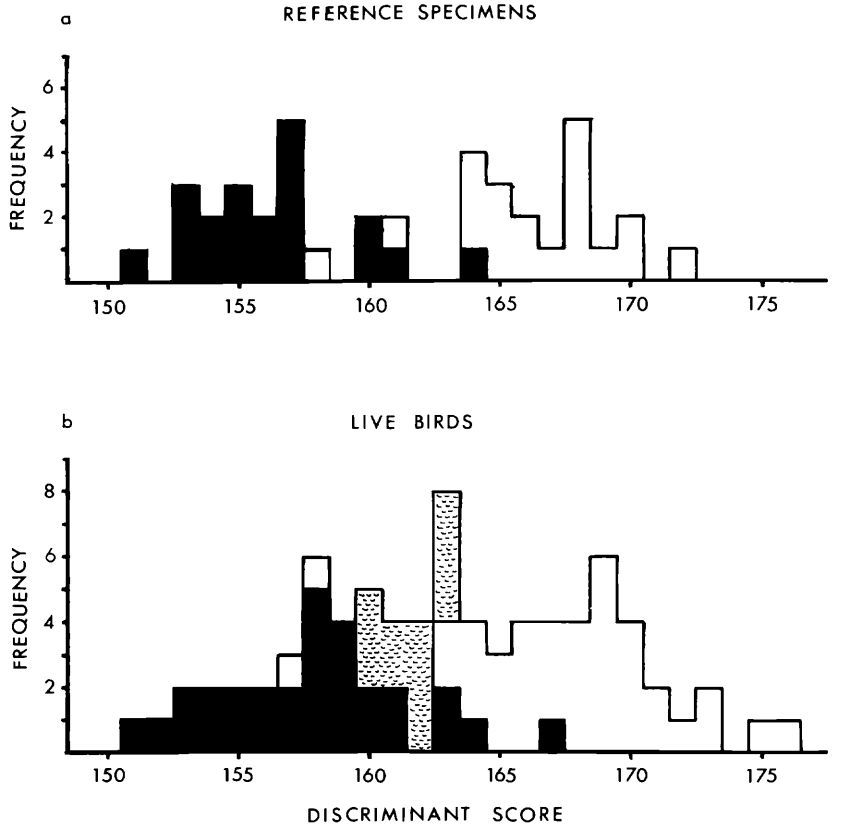

FIGURE 1. Discriminant scores of male (solid) and female (open) reference specimens, and of live birds classified as male or female. Live birds with an a posteriori probability of <.95 of being either sex are considered to be of unknown sex (speckled) except when the mate was classified as male or female.

cluding knowledge I had of mated pairs, 83.5% could be classified (6 birds with scores between 158.9 and 163.6 were considered to be of the sex opposite that of their classified mates). Four birds were known to be incorrectly classified: both mates of 2 pairs were classified as male, and both of 2 pairs were classified as female. The smaller mate has a higher probability of being male.

Weight could not be used as a character in the DFA due to scarcity of this information on museum specimens. A comparison of weights of live birds classified as males and females suggests that females are significantly heavier than males (Table 2). Although weight cannot be used here to classify individuals, it is useful as a confirmation of the sex of individuals with borderline discriminant scores.—MARGARET A. SKEEL, *Department of Zoology, University of Toronto, Toronto, Ontario.* (Present address: *4147-122 St., Edmonton, Alberta T6J 1Z1*). Received 16 Dec. 1981; accepted 13 June 1982.