A METHOD FOR EXTERNALLY SEXING GULLS

By Gary W. Shugart

A common problem among gull researchers has been the refinement of a field technique for sexing *Larus* gulls which are essentially monomorphic with respect to plumage characters. Several investigators have devised methods for sexing gulls but the approaches have been limited in their degree of accuracy or could be used only on the breeding grounds. The latter problem occurs with a method described by Tinbergen (1960) for sexing Herring Gulls (*Larus argentatus*). He found that within pairs, the bird with the relatively larger body and sturdier head was almost always the male. This was confirmed by observation of copulation. Other methods have relied on standard measurements and comparison of measurements separately (Smith, 1966) or comparison of measurements using discriminant analysis as Mills (1971) did for Silver Gulls (*Larus novaehollandiae scopulinus*). The latter two methods, involving measurements, are more useful than the former because they permit the sexing of gulls away from breeding colonies and at any time of the year. Of these latter two methods, the use of the discriminant analysis is favored because it results in a clear division of the groups. If the discriminant function were not used, but if X number of measurements or variables were analyzed through the use of *t*-tests, for example, X number of individual differences and probability levels would result. This does not lend itself to determining the overall group difference, but merely shows to what degree each measurement differs. Significance levels would also be severely affected by comparison of related measurements or variables individually (Tatsuoka, 1970) when examining group differences.

For reasons given above, I used discriminant analysis to analyze Herring Gull and Ring-billed Gull (*Larus delawarensis*) measurements. The resulting functions can be used to sex externally the two species accurately without observation of sexual activity, comparison of relative size, or comparison of individual measurements (see below: use of the sexing formulas).

Gulls used in my analysis were from the South Manitou Island gull colony (Leelanau Co., Mich.). While studying at this colony during the 1973 and 1974 breeding seasons, I measured gulls that died because of local environmental perturbations. All birds were measured in the flesh within three days of their death. After measuring each gull, the sex was determined through examination of the gonads. Data were obtained from 22 female and 32 male Herring Gulls and 48 female and 45 male Ring-billed Gulls. Standard measurements and the combined head and bill length, the distance from the tip of the bill to the most posterior point of the occiput, were taken. The latter was measured after Tinbergen (1960) mentioned that the sturdier head of the male could be used to differentiate between sexes.

Of the measurements taken, the culmen, right tarsus, right wing chord, total length, and combined head and bill lengths were used in the analysis (Table 1). I used these measurements because they give a good indication of overall body size without repetition and

TABLE 1.

Herring and Ring-billed gull measurements used to determine formulas for external sexing of adults

Measurement	Male		Female	
	Mean (mm)	SD (mm)	Mean (mm)	SD (mm)
Herring Gull				
Head length[1]	127.2	3.0	116.8	2.4
Wing chord[2]	432.2	10.8	405.5	8.5
Total length	632.9	14.7	597.8	15.1
Tarsus[2]	68.3	2.7	63.3	1.6
Culmen	56.7	2.2	51.6	2.1
Ring-billed Gull				
Head length[1]	98.7	2.3	92.2	2.0
Wing chord[2]	363.4	9.2	348.9	7.8
Total length	501.5	12.7	469.0	11.3
Tarsus[2]	58.7	2.0	55.2	1.6
Culmen	44.3	1.7	40.9	1.7

[1]Actually the combined head and bill length.
[2]The right wing chord and right tarsus measurements are listed.

can be taken easily and accurately from a live bird. Data were analyzed using the subprogram DISCRIMINANT (Klecka, 1975) in the Statistical Package for the Social Sciences (SPSS) at Northern Illinois University. In this case, the program determines which measurements are significant for classifying individuals as male or female and calculates classification coefficients for each group using the significant measurements.

The coefficients are used below in formulas that allow classification of individuals by substitution of the appropriate measurements in millimeters into both male and female functions and calculating the discriminant scores (D.S.). The function giving the largest discriminant score indicates the group (male or female) to which that individual belongs.

Herring Gulls. Of the five characters used in analysis, only the combined head and bill, and wing chord measurements, listed in order of importance, were different enough between groups for use in classification. Using the classification coefficients, the formula for male Herring Gulls was:

(13.866 × head and bill) + (3.664 × wing chord) − 1673.246 = D.S.,

and for females the formula was:

(12.680 × head and bill) + (3.454 × wing chord) − 1441.105 = D.S.

Wilks' lambda = 0.1829 for the Herring Gull functions with a corresponding χ^2 = 86.950, $P<0.0001$. Wilks' lambda is a test statistic that indicates the discriminatory ability of the functions and is the value of the inverse power of discrimination. A low Wilks' lambda is associated with high Chi-square values and significance. Using the classification functions, 98.15% (54 of 55) of the Herring Gulls were classified correctly.

Ring-billed Gulls. The combined head and bill, wing chord, and total length measurements were different enough between groups for use in classification. The classification function for Ring-billed Gull males was:

(17.349 × head and bill) + (4.077 × wing chord)
+ (1.090 × total length) − 1692.491 = D.S.,

and for females the formula was:

(16.223 × head and bill) + (3.951 × wing chord)
+ (1.090 × total length) − 1692.492 = D.S.

Wilks' lambda − 0.2356 with a corresponding χ^2 = 129.365, $P<0.0001$. Using the above functions, 97.85% (91 of 93) of the Ring-billed Gulls were correctly classified.

Percentages of classifications of 98.15% and 97.85% for Herring and Ring-billed gulls, respectively, are higher than that of 90.1% reported by Mills (1971) for Silver Gulls. The lower percentage of classifications reported by Mills (1971) may have been because he did not use the combined head and bill length, but used only bill length and bill depth at gonys. The combined head and bill length was the most important character in discrimination of Herring and Ring-billed gull sexes as indicated by the larger classification coefficients for this character in each case.

Use of the sexing formulas: The sex of a Herring Gull with a combined head and bill length of 120.0 mm and wing chord length of 405 mm is determined by substituting the measurements into the male and female formulas and calculating the discriminant score (D.S.).

Male:

(13.866 × head and bill) + (3.664 × wing chord) − 1673.246 = D.S.

(13.866 × 120.0) + (3.664 × 405.0) − 1673.246 = 1474.5.

Female:

(12.680 × head and bill) + (3.454 × wing chord) − 1441.705 = D.S.

(12.680 × 120.0) + (3.454 × 405.0) − 1441.105 = 1479.3.

The female formula gives the largest discriminant score; therefore, the bird is a female.

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LITERATURE CITED

KLECKA, W. R. 1975. Discriminant Analysis in SPSS: 2nd edition. N. H. Nie, C. H. Hall, J. G. Jenkins, K. Steinbrenner and D. H. Bent, Eds. New York, McGraw-Hill.

MILLS, J. A. 1971. Sexing Red-billed Gulls from standard measurements. *N. Z. J. of Marine and Freshwater Research*, **5**: 326-328.

SMITH, N. G. 1966. Evolution of some Arctic gulls (Laridae): an experimental study of isolating mechanisms. *Ornithol. Monogr.*, No. 4.

TATSUOKA, M. M. 1970. Discriminant analysis: the study of group differences. Institute for Personality and Ability Testing, Champaign, Ill.

TINBERGEN, N. 1960. The Herring Gull's World. New York, Harper and Row.

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