ERRORS FROM DETERMINING SEX OF MOURNING DOVES BY PLUMAGE CHARACTERISTICS[a]

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Abstract: Errors generated when determining the sex of mourning doves (*Zenaida macroura*) from plumage characteristics and their effect on sex ratio projections from banded and shot samples were evaluated in a 2-year study in Louisiana. Error rates (percentage misclassified) of 3.8% and 5.0% were obtained from a sample of 236 banded and 1,820 hunter-killed doves, respectively. Converting data to sex ratios produced actual error rates of 13.1% for the banded sample and 1.1% for doves killed by hunters. No significant differences were detected in ability to determine sex in doves from plumage characteristics between sex, age, year, or status (livel-dead) classes. However, there was a significant sex X age interaction. An evaluation of the effectiveness of the 2 main methods of externally determining sex of mourning doves indicated that error rates when using either head or breast characteristics alone were approximately equal but higher than when using a combination of the 2 characteristics.

Proc. Ann. Conf. S.E. Assoc. Fish & Wildl. Agencies 32: 224-227

The value of population data gained from banding activities, wing surveys, and hunter bag checks depends on the accuracy of the aging and sexing techniques employed. The mourning dove is regarded as the most important migratory game species in the Southeast. Since thousands of doves are banded annually to augment mangement information, potential errors injected into data sets from misclassifying the sex of doves should be evaluated.

Error rates generated by determining sex of mourning doves by external characteristics have been reported between 0 and 8.3% in small samples by Petrides (1950) and Jenkins (1955). One objective of a 2-year study on the mourning dove in Louisiana was to evaluate more fully the magnitude of potential errors when determining sex of mourning doves during banding operations; the effect of misclassification errors on projected sex ratios in samples was also examined.

We gratefully acknowledge J. D. Newsom, Leader, Louisiana Cooperative Wildlife Research Unit for assistance in study design and logistics. K. L. Koonce and P. E. Schilling, Department of Experimental Statistics, Louisiana State University provided valuable help in experimental design and data evaluation. The project was funded by the Accelerated Research Program for Migratory Shore and Upland Game Birds, U.S. Fish and Wildlife Service, Contract No. 14-16-0008-2100.

METHODS

Study Area

A banding program and a series of controlled hunts beginning 1976 and ending January 1978 were conducted on the Louisiana State University Experimental Farm (Ben Hur Farm), East Baton Rouge Parish. Additionally, doves killed by hunters were examined on the surrounding privately-owned land and on farms located in Lafayette and Franklin Parishes. The 3 main crops grown on the study areas were corn, soybeans, and rice.

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[b]This study was part of a Master's thesis at Louisiana State University.

Errors from Banded and Shot Samples

Whenever possible the sex of mourning doves was determined both internally and externally to determine the amount of error involved when using only external sex characteristics. Sex was determined externally by examining the plumage of the head, nape, and breast (Reeves et al. 1968, Reeves and Amend 1970); internal determinations were accomplished through examination of the gonads. Age was classified into 2 groups: HY (hatch-year) and AHY (after hatch-year).

A series of band-shoot units were established on the Ben Hur Farm to make paired observations (alive-dead) on individual doves. Each unit consisted of approximately 38 days of intensive banding followed by a series of 2 hunts. Baiting for banding purposes was discontinued 10 days prior to the first hunt of each series to allow legal public participation in the controlled hunts. Two band-shoot units were conducted per year during 1976-77 and 1977-78 with the hunts held in November and January. The error involved in determining the sex of live birds externally (while banding in the field) was determined through the examination of direct recoveries during the controlled hunts. Information from birds killed by hunters on other areas was combined with the Ben Hur Farm data to evaluate rates of sex misclassification of dead birds.

Evaluation of Individual Sexing Characteristics

To determine which external sexual characteristic was the most reliable as a sexing technique, the sex of each dove killed during the controlled hunts was determined externally 3 times by KAM using separate external characteristics: once using only the head and nape coloration, once using only the breast coloration, and once using a combination of all the characteristics. To avoid bias, groups of birds were examined by randomly selecting without replacement individual birds for determination of sex by 1 of the 3 methods. Sampling was continued until all the characteristics of each bird were used in its classification.

Analysis

An analysis of variance was utilized to evaluate rates of missclassification of sex of live and dead doves utilizing the following model: year, sex, age, class (live-dead), year X sex, year X age, year X class, sex X age, sex X class, age X class, and error. Molt information was obtained for birds collected at Ben Hur Farm but not for doves collected from other areas. For analysis, the AHY classification for Ben Hur Farm doves included molt-complete HY birds since they had obtained adult plumage; doves collected at other areas were separated into age classes based on internal characteristics.

The effect a sex determination error has on the projected sex ratio within a data set of banded or shot doves was determined through the use of the following equation:

$$\text{Actual Error Rate} = \frac{\text{Actual Ratio - Called Ratio X 100.}}{\text{Actual Ratio}}$$

The actual ratio [males per female (M/F] was computed from sex data gained from internal examination and the called ratio (M/F) was derived from external sex determination data. To relate findings to actual field situations, percentage misclassified calculations were made using as a base the *actual* number in the class (i.e., number sexed incorrectly/actual number in class) and the number *called* in the class (i.e., number sexed incorrectly/number called as being in that class).

Comparisons of the overall accuracy of the 2 external sexual characteristics were evaluated by Chi-square tests (Siegel 1956:104-111). Orthogonal tests were employed to evaluate average errors committed in determining sex when using individual techniques: breast and head characteristics versus the combination of both techniques, and breast versus head characteristics.

Results

Errors From Banded and Shot Samples

During the controlled hunts in Ben Hur Farm, 236 banded doves were recovered; sex was determined incorrectly at the time of banding on 9 (3.8%) of the recoveries. When originally banded, 8 (8.2%) of 98 doves classified as males were actually females and 1 (0.7%) of 138 called females was a male. Based on actual numbers, 8 (5.5%) of 145 females were sexed incorrectly whereas only 1 (1.1%) of 91 males was misclassified when banded.

When the data from doves collected on Ben Hur Farm were combined with information obtained from doves collected on other areas in Louisiana, sex was determined externally on 1,820 harvested individuals. Of 900 doves called males, 43 (4.8%) were females and 48 (5.2%) of 920 called females were males. Actually 5.3% of 905 males were misclassified and 4.7% of 915 females were sexed incorrectly. Overall, 5% of all doves examined after harvest were sexed incorrectly by external characteristics.

No significant differences in error rates could be found in any of the sources of variation in the analysis of variance model ($P > 0.05$) except for the sex X age interaction ($P < 0.01$). Male HY doves were misclassified more than AHY males: 44 (7.2%) of 610 HY males were sexed incorrectly whereas only 4 (1.4%) of 288 AHY males were misclassified. However, female AHY doves were misclassified more than female HY birds: 20 (6.8%) of 292 AHY females were sexed incorrectly whereas only 23 (3.7%) of 620 HY females were misclassified.

External Characteristic Evaluation

To increase sample size, the 813 doves independently sexed by individual and combined characteristics were combined with the 1,820 sexed only by combined characteristics. As expected, the use of the combined characteristics produced more accurate sexing results than either of the two characteristics (head-nape or breast) used individually ($P < 0.01$). There was no difference in errors committed when sexing doves by only the breast or the head and nape ($P > 0.05$).

Actual Error

Sex and age class information are generally summarized as ratios for management decisions. The effect of misclassifying birds by external characters may result in an error discrepancy in ratios much higher or lower than the actual percentage misclassified. The called ratio from external characteristics of recovered banded birds was 0.710 M/F (98/138). However, the actual ratio was 0.628 M/F (91/145). Thus the actual error based on ratios was 13.1% rather than the apparent rate of 3.8% (9 misclassified of 236).

Of 1,820 hunter-killed doves, the called ratio was 0.978 M/F (900/920). Actually the true ratio, as determined internally, was 0.989 M/F (905/915). In this case the actual error, as determined by ratios, would only be 1.1% comapred to the 5.0% (91 of 1,820) that were misclassified.

DISCUSSION

Petrides (1950) determined the sex externally on 51 adult birds without any errors. Jenkins (1955) incorrectly sexed 4 (3.1%) of 127 adult doves and 5 (8.3%) of 60 juveniles.

Both Petrides (1950) and Jenkins (1955) had more difficulty correctly determining sex by external characteristics with juveniles than with adults. We found no significant differences in sexing error rates between ages. Sex was not determined in immature doves that had not yet molted their 5th primary unless their sex was obvious (Reeves and Amend 1970). However, there was a significant sex X age interaction. Our data for male doves was similar to results reported by Petrides (1950) and Jenkins (1955) (more HYmales were misclassified than AHY males). We do not know why the opposite was true for females. Some females have bluish crowns and pinkish breasts but these characteristics are not as pronounced as in male doves (Reeves and Amend 1970).

Perhaps a higher proportion of AHY females have these characteristics or sampling errors could be involved. Jenkin's (1955) total misclassification rate of 4.8% when externally sexing doves was similar to the 5.0% error rate from hunter-killed doves sampled in our study. However, the number misclassified while banding (3.8%) was somewhat, although not significantly, lower.

Apparently there is no one source of error when doves are incorrectly sexed by plumage characteristics. Error rates when using either head or breast characteristics alone were approximately equal but higher than when using a combination of the 2 characteristics.

With approximately equal numbers per class (as with our data), the actual error based on ratios will be inflated if proportionately more birds of one class are misclassified. For example, the actual error for the sample of banded birds was larger than the total called error because more females were misclassified than males. Similarly, the actual error from ratios will be greatly inflated if highly skewed class sizes are obtained (as is usually the case with age data) and nearly proportional errors are committed during classification. On the other hand, when class sizes approach unity and approximately equal numbers of each class are misclassified, the actual error tends to be lower than the actual percentage misclassified because of error cancellations when ratios are calculated. For this reason, the actual sex ratio error rate from the dead bird sample in this study was smaller than the actual number misclassified. Further complications arise, however, when employing data sets containing misclassification errors in computing estimates of differential vulnerability to shooting, productivity, and mortality from combined banding and kill data. To ameliorate potential errors, harvested doves could be sampled within each state of a management unit and pooled to derive an average calling error. This error rate could be used to correct misclassification errors generated when banding doves to prevent error compounding and erroneous results.

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