Comparison of Two Change-In-Ratio Ring-necked Pheasant Harvest Estimators

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Sex ratios provide wildlife managers with readily collectable data for estimating harvest of a population. Sex ratios are indispensable, for example, in estimating population productivity, and developing management prescriptions for polygynous species such as ring-necked pheasants (Phasianus colchicus Linnaeus). Sex ratios are conventionally expressed as males per 100 females (Giles 1978).

The purpose of this paper is to examine two different and independently developed models for using the change-in-ratio (CIR) between pre- and post-harvest to estimate harvest of ring-necked pheasants. The CIR harvest estimate is then applied to an independent population estimate derived from a distance sampling method (Buckland et al. 2001) or from a mark-recapture/resight estimate (White et al. 1982).

¹ Deceased. Dr. Edwards suggested this topic and guided its completion. He assisted with several earlier drafts of this report that were never published.
Both models make three assumptions:
1. Observed sex ratios approximate the true sex ratio within the observed population.
2. Sex ratios vary with rate of harvest (Wagner et al. 1965), and
3. Rates of non-hunting mortality are essentially similar for males and females during fall and winter.

The Models
The first model was published by Selleck and Hart (1957):

*Equation 1a*

\[
\frac{(K + 1)(B - A)}{(B + 1)(K - A)}
\]

*For one segment of the population:*

*Equation 1b*

\[
\frac{(B - A)}{(K - A)}
\]

Where:
- \(A\) = males per 100 females in postseason counts
- \(B\) = males per 100 females in preseason counts
- \(K\) = males per 100 females in harvest

The model developed by Edwards (1963) is:

*Equation 2*

\[
\frac{(F_1) - (F_k)}{(M_1) - (M_k)} = \frac{F_2}{M_2}
\]

Where:
- \(F_1\) = females in preseason sex ratio
- \(F_2\) = females in postseason sex ratio
- \(F_k\) = females in harvest
- \(M_1\) = males in preseason sex ratio
- \(M_2\) = males in postseason sex ratio
- \(M_k\) = males in harvest

An Example
To compare the results of both models take the following values:
- \(B\) or \(M_1\) = 80
- \(A\) or \(M_2\) = 20
- \(K\) = 1000
- \(F_1\) and \(F_2\) = 100
- \(M_k\) = 10 \(F_k\) (kill ratio is 1 female:10 males)

By equation 1a:

\[
\frac{(1000 + 1)(80 - 20)}{(80 + 1)(1000 - 20)} = 0.75
\]

75% male harvest

By equation 1b:
\[
\frac{80 - 2}{1000 - 20} = 0.06
\]

6% female harvest

By equation 2:

\[
\frac{100 - Fk}{80 - 10Fk} = \frac{100}{20} = 5
\]

100 - Fk = 400 - 50Fk

49Fk = 300

Fk = 6

Mk = (10 x 6) = 60

Female harvest =

\[
\sqrt[100]{6} = 0.06
\]

Male harvest =

\[
\sqrt[80]{60} = 0.75
\]

Both CIR models arrive at the same results. The major requirement is random pre- and post-season sex ratio counts as outlined in Wagner et al. (1965). The potential problems are 1) sex differential in count detectability and harvest, and 2) expression of sex ratios in anything other than adult males, juvenile males, and juvenile females per 100 adult hens (J. E. Warnock, personal communication, October 1974). In addition, equation 2 is more computationally complex although easily programmed into Excel, Mathcad or other software.

In conjunction with an independent population estimator, managers may use sex-ratio counts and either of these equations to estimate harvest of ring-necked pheasants on management or research areas. Since hen pheasants are generally not legal game, estimates of hen harvest will reflect incidental or illegal take.

Acknowledgments.

Work for this report began exactly 30 years ago while the senior author was employed by the Section of Wildlife Research, Illinois Natural History Survey under Illinois Federal Aid Project W-66-R, Cooperative Wildlife Research (Illinois Department of Conservation, Illinois Natural History Survey, and U. S. Fish and Wildlife Service cooperating). This was the senior author’s student project for Game Management, taught by Dr. John E. Warnock, at Western Illinois University, Macomb. Our colleagues Steve Webber, Fred Paveglio, Don Steffleck, and Dr. J. Henry Sather, provided assistance and comments on this project and earlier drafts of this paper.

Literature Cited


