EVALUATION AND APPLICATION OF DRIVE COUNTS FOR PHEASANTS[1]

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Abstract: Drive counts of pheasants (*Phasianus colchicus* subsp.) were evaluated on playa basins in the High Plains of Texas. The counts were 97-99% precise when the density of counters averaged 1/0.85 ha. The change-in-ratio estimator was modified to estimate pre-hunt population size when post-hunt population size and the proportion of cocks in the harvest are assumed known. Problems associated with drive counts of pheasants are discussed. Costs averaged $38/playa basin ($1.52/ha).

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To obtain data on pheasant populations, many wildlife agencies have used population indices such as counts of adults along roadsides (Randall and Bennett 1939, McClure 1945, Mohler 1948, Baxter and Wolfe 1973, Farris 1973, Gates and Hale 1975), counts of crowing cocks (Kimball 1949), and counts of broods along roadsides (Wooley et al. 1978). These indices provide useful information on population trends, but total counts of pheasants are valuable in specific areas (Robertson 1958). This is particularly true when data on numerical response to habitat management or land use are required, or when intense hunting pressure dictates that harvest quotas be set.

The drive count is one method of determining the number of birds in pheasant populations. This paper evaluates the precision and cost-effectiveness of drive counts, presents and illustrates a revised change-in-ratio estimator that can be used to estimate population size when removals of hens and cocks are unknown, and alerts biologists to the assets and problems associated with drive counts.

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METHODS

Pheasants were counted on 30 playa basins in Castro County and 2 in Deaf Smith County of the Texas High Plains during the pre-hunt (November) and post-hunt (February - March) periods of 1979 - 80 and 1980 - 81. Playa basins are predominantly wind-deflated depressions (Reeves 1966) that occur throughout the

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Southern Great Plains. In the High Plains of Texas, which is intensively cultivated, these habitats become concentration points for wildlife, including pheasants, because they provide most of the available cover during the late fall and winter (Bolen et al. 1979, Curtis and Beierman 1980, Guthery 1981, Whiteside and Guthery 1981).

Playa basins were systematically searched by teams of 12 - 15 individuals using a modificiation of Overton's (1969) method for counting deer. Three monitors were stationed on basin boundaries; 2 counted pheasants that flushed in the space to their right up to the next monitor and the 3rd counted pheasants that flushed to his right up to the left member of the drive crew. The drive crew, spaced evenly on the one side of a playa basin, moved in a "zig-zag" manner through the basin and created disturbance by yelling and clapping. Also, 1 - 3 dogs were used to flush birds (Wight 1930). Each member of the drive crew recorded the sex and number of pheasants passing through the drive line to their right up to the next person in the line. The right member of the drive line counted birds that flushed to his right up to the 1st monitor. Counts of the drive crew and monitors were summed to get the total number of pheasants in a playa basin.

Precision of drive counts was measured on 5 playa basins by making an additional drive count immediately following the 1st count. During the 1st count records were kept of the number of birds that flushed out of the playa basin and the number that returned to the basin. On the 2nd drive count, birds in excess of the number that returned to the basin during the 1st count were recorded.

Additional drive counts were conducted on 5 playa basins 2 weeks after the initial count to determine if population closure was a valid assumption for the change-in-ratio estimator (Seber 1973). The 2nd counts were made at the same time of day and under similar weather conditions as the 1st counts.

RESULTS AND DISCUSSION

Evaluation of Counts

On the 5 playas checked for precision, additional birds were counted during the repeat drive (Table 1). However, most birds ($\overline{X}$ = 98%, SE = 0.45%) were seen during the 1st count. Playas checked for precision of drive counts were sampled with an average density of 1 crew member/0.85 ha of basin (average of 12 crew members on an average playa basin of 14.2 ha). A minimum density of 1 crew member/1.30 ha measured pheasant populations with 97% precision. Using an

Table 1. Precision of pheasant drive counts on 5 playa basins in the High Plains of Texas. Second counts were conducted immediately after 1st count.

	Population estimates		Percent
Area	1st count	2nd count	precision
1	99	102	97
2	173	176	98
3	70	71	99
4	76	78	97
5	77	78	99

appropriate density of counters, biologists apparently can obtain a precise estimate of the number of pheasants in a given area at a given time.

Recounts indicated high population stability ($\bar{X}$ = 90%, SE = 1.26%) in the number of birds observed during the 2nd count compared to the 1st (Table 2). These declines may have been the result of egress because of the initial sampling disturbance and/or mortality and natural egress within the population. Even with these declines, pheasant populations on the playa basins sampled were relatively stable throughout the 2-week period.

Table 2. Pheasant population stability on 5 playa basins in the High Plains of Texas. Second counts were conducted 2 weeks after 1st counts.

	Population estimates		Percent
Area	1st count	2nd count	stability
1	90	78	87
2	14	13	93
3	263	244	93
4	162	143	88
5	66	59	89

Application of Data

Drive counts also give basic information on pheasant populations such as sex ratios. Further information on population parameters, such as productivity (chicks/hen, chicks/adult), survival ratios (survival rate of hens divided by survival rates of cocks), and population size, can be derived with change-in-ratio analysis (Hanson 1963, Seber 1973). Published estimators of population size require that removals of hens and cocks be known exactly, or that the total removal and the proportion of cocks in this removal are known.

We modified the change-in-ratio estimator because of the unique situation in the High Plains of Texas. After the December hunting season, pheasants mass in playa basins because they provide nearly all available cover (Guthery et al. 1980, Guthery 1981). Thus, drive counts in February or early March represent a total population count of the pheasants associated with a playa basin, whereas counts prior to December do not because the birds are then still dispersed in croplands. With the February-March census data and spy-blind measurements of the proportion of cocks in the total harvest, it is possible to estimate the pre-season population without knowing the number of birds removed.

Define:

X_1 = the number of cocks in the pre-hunt drive count,

Y_1 = the number of hens in the pre-hunt drive count,

$P_1 = \dfrac{X_1}{X_1 + Y_1}$ = the proportion of cocks in the pre-hunt drive count,

N_1 = the number of birds in the pre-hunt population,

X_2 = the number of cocks in the post-hunt drive count,

Y_2 = the number of hens in the post-hunt drive count,

$$P_2 = \frac{X_2}{X_2 + Y_2} = \text{the proportion of cocks in the post-hunt drive count,}$$

$N_2 = X_2 + Y_2$ = the number of birds in the post-hunt population, and
f = the proportion of cocks in the harvest.

Note that because of our situation, all values obtained in the post-hunt drive count are assumed to be known population parameters. We estimated a value for f using spy-blind studies.

If removals (R_x = number of cocks killed, R_y = number of hens killed, and $R = R_x + R_y$) are known, the pre-hunt population is (Seber 1973)

$$N_1 = \frac{R_x - RP_2}{P_1 - P_2} \qquad (1).$$

Because

$R = N_1 - N_2$ and

$R_x = fR = f(N_1 - N_2)$

these values can be substituted into equation (1) to obtain

$$N_1 = \frac{f(N_1 - N_2) - (N_1 - N_2)P_2}{P_1 - P_2} \qquad (2).$$

Solving equation (2) for N_1 gives the estimator

$$\hat{N}_1 = \frac{N_2(\hat{P}_2 - \hat{f})}{\hat{P}_1 - \hat{f}} \qquad (3).$$

Using the delta method (Seber 1973) an approximate estimate of the variance of N_1 is

$$\mathrm{Var}(\hat{N}_1) \cong \frac{N_2^2(\hat{P}_2 - \hat{f})^2}{(\hat{P}_1 - \hat{f})^4}(\mathrm{Var}(\hat{P}_1)) + \frac{N_2^2}{(\hat{P}_1 - \hat{f})^2}(\mathrm{Var}(\hat{P}_2)) + \frac{N_2^2(\hat{P}_2 - \hat{P}_1)^2}{(\hat{P}_1 - \hat{f})^4}(\mathrm{Var}(\hat{f})) \qquad (4).$$

Because P_2 is a known population parameter, it has no variance; the 2nd term of equation (4) drops out to give

$$\mathrm{Var}(\hat{N}_1) \cong \frac{N_2^2(\hat{P}_2 - \hat{f})^2}{(\hat{P}_1 - \hat{f})^4}(\mathrm{Var}(\hat{P}_1)) + \frac{N_2^2(\hat{P}_2 - \hat{P}_1)^2}{(\hat{P}_1 - \hat{f})^4}(\mathrm{Var}(\hat{f})). \qquad (5).$$

$\mathrm{Var}(\hat{P}_1)$ can be estimated with a finite population correction (Cochran 1963) as

$$\mathrm{Var}(\hat{P}_1) = \frac{\hat{N}_1 - (X_1 + Y_1)}{(X_1 + Y_1 - 1)\hat{N}_1}(\hat{P}_1)(1 - \hat{P}_1). \qquad (6).$$

To estimate Var (f), determine the proportion of cocks (p) and the proportion of hens (q) in a sample (n) of birds seen killed during spy-bling studies. Then

$$\mathrm{Var}(\hat{f}) = \frac{pq}{n - 1}. \qquad (7).$$

Note also that the sex-specific survival rate during the hunting season can be estimated by

S_x = survival rate of cocks = $X_2/(\hat{P}_1\hat{N}_1)$ and (8).

S_y = survival rate of hens = $Y_2/((1 - \hat{P}_1)\hat{N}_1)$.

Field data from one playa basin (Table 3) are used to illustrate the calculations. It was determined from field surveys that f = 0.85.

Table 3. Measured and estimated attributes of a pheasant population on a playa basin in the High Plains of Texas during 2 fall-winter periods.

Time	Year	X	Y	P	N	S_x	S_y
Pre-hunt	1979	33	42	0.44	167	0.10	0.88
Post-hunt	1980	7	82	0.08	89		
Pre-hunt	1980	22	32	0.41	141	0.16	0.90
Post-hunt	1981	9	75	0.11	84		

$$\hat{N}_1 = \frac{89(0.08 - 0.85)}{0.44 - 0.85} = 167$$

$$Var(\hat{P}_1) = \frac{167 - 75}{(75 - 1)(167)}(0.44)(0.56) = 0.0018$$

$$Var(\hat{f}) = \frac{(0.152)(0.848)}{66 - 1} = 0.002$$

$$Var(\hat{N}_1) = \frac{89^2(0.08 - 0.85)^2}{(0.44 - 0.85)^4}(0.0018) + \frac{89^2(0.08 - 0.44)^2}{(0.44 - 0.85)^4}(0.002) = 371.8$$

$$s(\hat{N}_1) = \sqrt{Var(\hat{N}_1)} = 19.3$$

Adding and subtracting 2 standard deviations sets the 95% confidence limits on N_1 at 128 to 206 pheasants.

Problems

There are some problems inherent with drive-count sampling for pheasants as there are in all wildlife enumeration techniques. During the post-hunt count, care should be taken that the census crew get into position quickly and quietly. After hunting season, pheasants are extremely sensitive to the sound of human voices and slamming of vehicle doors. Upon hearing these noises, many will run out of playas before counts begin.

The most experienced and observant personnel should be stationed as monitors and as the right-hand member of the drive line. These people must be alert for pheasants running or flying out of playas over large distances; they must carry binoculars unless the census area is small.

Members of the drive crew should stay in a straight line as they cross the census line. If they do not, the distance between individuals will increase, which in turn increases the likelihood of pheasants running back through the drive line without being seen.

A last problem may arise when N_1 is calculated by equation (3). We obtained lower estimates of N_1 than actually observed in some situations. This possibly occurred because of pheasant populations shifting among playas and/or because the general value of f was inappropriate in some instances. The problem could be addressed by selecting relatively isolated playas to minimize problems associated with population shifts among more closely aligned concentration points, by sampling 5 or more playa basins as a single unit, and/or by determining a value of f for each sample area.

Cost

Expenses for labor (12 people working 9 hours/day at $3.25/hour) and gasoline indicated the cost of drive counts averaged $38/playa basin; 10 basins/day were sampled. The cost estimate is conservative because it does not include depreciation on vehicles. Simultaneous population information also can be obtained in the Texas High Plains for coyotes *(Canis latrans)*, black-tailed jackrabbits *(Lepus californicus)*, cottontails *(Sylvilagus auduboni* and *S. floridanus)*, and raptors, thus increasing cost-efficiency.

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