MICHIGAN DEPARTMENT OF CONSERVATION
Game Division

Report No. 2051
May 6, 1955

Aerial Dead Deer Searches

In April of this year a limited study was made of the possible utility of combination air-ground searches for estimating numbers of dead deer on the ground.

Two flights were made, one on April 6 and the other on April 22. The first flight was purely exploratory. Pilot Van Valin, A. P. Boyce and L. L. Eberhardt flew about 2½ hours over southeastern Roscommon County and over the Gladwin Refuge. Eleven dead deer were located, three of which were previously located on the ground. An effort was made to cover the Gladwin Refuge thoroughly, but no dead deer could be located from the air, even using a map showing location of illegal kills from the previous hunting season of which there were probably about 15 on the area. A check of five locations was made on the ground and all five deer found. It was apparent that these deer could not reasonably be expected to be seen from the air. The carcasses were mostly intact, but they blended into the (leaf) background very well and patches of white hair were not present.

A more extensive test of the possibilities was made on April 22 when the 23 plots in Stratum I of the dead deer survey (see report number 2050) were searched by Van Valin, Eberhardt and Conservation Officer Warren Fitzpatrick in a little over three hours of flying.

Three passes were made over the half-section which included the ground plot. Air speed was about 80 m.p.h. and altitude about 500 feet. Area covered was not well determined, effective coverage being perhaps 200 - 300 feet on each side of the airplane. This was estimated by making passes over the 200 foot wide airstrip at Roscommon.

Record of deer seen is as follows:

Plot Number	Right Side (Eberhardt)	Left Side (Fitzpatrick)	Total
1	0	1	1
2	2	0	2
3	0	0	0
4	0	2	2
5	0	0	0
6	0	2	2
7	4	2	6
8	2	0	2
9	1	1	2
10	0	0	0
11	2	1	3
12	0	0	0
13	1	1	2
14	1	1	2
15	1	1	2

Plot Number	Right Side (Eberhardt)	Left Side (Fitzpatrick)	Total
16	0	0	0
17	3	3	6
18	2	2	4
19	1	3	4
20	0	0	0
21	1	2	3
22	0	0	0
23	1	0	1
	22	22	44

Weather conditions were good during the flight with a light overcast but good visibility and smooth flying. An attempt to fly these plots on April 21 was unsuccessful due to high winds making for very rough air.

A comparison with results of the counts on the 80 acre ground plots is shown in the attached table. No detailed attempt at analysis has been made except for an estimation of the variance of the ratio of air to ground counts. This approximate analysis indicates as many as 90 such plots may be needed for ratio limits of ± 30% (2 standard errors as % of mean) under this system. It seems likely that much of the variability may be due to highly variable distribution of deer on the ground so that larger ground plots and perhaps exact marking of the ground plots might permit precise estimate of the air to ground ratio with fewer ground plots.

Further analysis should be made to investigate:

(1) Validity of equations used here.
(2) "Within-plots" variance and type of distribution for ground plots.
(3) Optimal size of ground plot for ratio estimates.
(4) Effects of including all strata in determination of the ratio.

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LE:gj

Aerial Dead Deer Search - April 22, 1955
(Search of plots in Stratum I of ground survey)

Plot Number	y_i Dead deer seen from the air	x_i Dead deer found on ground search
1	1	0
2	2	1
3	0	0
4	2	3
5	0	0
6	2	2
7	6	0
8	2	3
9	2	3
10	0	3
11	3	1
12	0	1
13	2	8
14	2	0
15	2	0
16	0	1
17	6	2
18	4	6
19	4	2
20	0	5
21	3	0
22	0	0
23	1	1
Total	44	42

$\sum y_i^2 = 156 \quad \sum x_i^2 = 178$

$\sum y_i x_i = 88$

$\hat{R} = \frac{44}{42} = 1.048$

$\bar{x} = 1.826$

$N = 408\ (2) = 816$ = Number of half-sections in Stratum I.

$$V(\hat{R}) = \frac{(N-n)}{Nn\,(n-1)\,\bar{x}^2}\left(\sum y_i^2 + \hat{R}^2 \sum x_i^2 - 2\hat{R}\sum y_i x_i\right)$$

(Cochran, Sampling Techniques, page 119)

$$V(\hat{R}) = \frac{(816-23)}{816\,(23)(22)(1.826)^2}\left[156 + (1.048)^2\,(178) - 2(1.048)(88)\right]$$

$$= \frac{793}{1.376.709}\left[156 + 195.444 - 184.448\right]$$

$$= .000576 \quad \left[166.996\right]$$

$V(\hat{R}) = .0962$

S.E.$(\hat{R}) = .310$

2 S.E. as % of mean $= \frac{.62}{1.048} = 59\%$

If the F.P.C. term $\frac{N-n}{N}$ is neglected, and since the term in parenthesis along with $\frac{1}{n-1}$ is apparently an estimate of σ^2; one might roughly estimate plots needed for narrower limits as follows:

For $\pm$ 30% (2 S.E.); S.E. = .15 (1.048) = .157

$$(.157)^2 \cong \frac{1}{n}\,\frac{166.996}{22(1.826)^2} = \frac{1}{n}\,\frac{166.996}{73.348} = \frac{2.28}{n}$$

$$.025 \cong \frac{2.28}{n} \qquad n \cong \frac{2.28}{.025} = 91$$