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Evaluation of Techniques in Estimating a Mearns Cottontail Population

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Field research to obtain information on the productivity and population of Mearns cottontail was conducted from June 17 to December 4, 1953. The study area of about 80 acres was part of a dairy farm, Section 13, Woodland Township, Decatur County, a central southernmost county of Iowa.

The plant cover consisted of alfalfa 30 acres, oats 20, pastured grasses 10 acres, fallow forbs 10 acres, and trees and shrubs, chiefly along fence lines and gullies, 10 acres. The precipitation of 13 inches during the period, little more than one-half the normal, reduced the plant growth considerably. Reduction in cover through close grazing by cattle of one-half of the alfalfa was offset to rabbits in part by 15 acres of oats left unharvested.

The major portion of the population data was obtained by use of 50 box traps, tagging and recapturing. Nearly all of the cottontails were taken in traps set close to tree and shrub cover along field and gully edges. Frequent moving of the traps helped in meeting assumptions that the tagged population will disperse evenly among the untagged populations, and that a sample taken from the total population will give the best estimate of the true proportion of tagged individuals. After a trap had not caught a rabbit in three successive days and nights, it was moved a short distance to, or near, a site where an untagged, unmarked rabbit had been seen. The tails of captured rabbits were stained yellow with a picric acid solution to aid in observations. Seventy-one cottontails were tagged and recaptured a total of 176 times.

The estimation of populations of small animals with trapping, tagging and recapture data is accepted generally as more reliable than with data obtained in other ways. From 80 methods devised to employ trapping data, five considered most applicable were selected for comparison in estimation of a Mearns cottontail population.

The first method was described by Cox (1952) for the estimation of an orchard population of mice. The formula involved is $N = n(n-1)/2Sn$, in which N represents the population estimate at a given time, n the total of first captures and the number of

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recaptures multiplied by the number of times of recapturing. Sn is the summation of the values representing the initial captures and the number of recaptures. As an example, of 16 different cottontails captured, 13 were caught once, one was caught twice, and two were caught three times. Therefore, Sn is one plus two plus three, or 6.

Although Cox did not list the assumptions, they are believed to be that the animal population remains constant through the sampling period, and that the traps make a random selection from the population, all members of which have an equal probability of capture. These assumptions do not fit well an expanding summer population and a decreasing fall population of various ages, which by age and animal individuality are not equally sampled. The method's estimates by four-week periods climbed irregularly to a peak of 189 on October 19.

The second is a modified ratio method proposed by Hayne (1949). It yields a population estimate from the increasing proportion of tagged animals observed in successive segments taken from the gross sample. This proportion plotted on a graph with accumulated catch produces a straight line, which passes through the origin of the coordinate system ($X = 0$, $Y = 0$). The reciprocal of this line is the estimated population. A constant population and an equal probability of capture for each member of the population is assumed. The method estimated the peak population at 93 cottontails on, or near, September 10.

The third method employs a formula devised by the senior writer, $N = LH/Y$, wherein Y is the regression estimate of the proportion of catch previously handled, LH is the observed number of living cottontails bearing tags on the date for which the populations estimate is to be made, and N is the estimated population. This formula was suggested by the trapping and tagging procedures in which cottontails were continuously tagged and released into the population. Because the number of rabbits tagged in relation to the total population was increasing progressively through time, population estimates based on the assumption of an increasing proportion might be more appropriate than those based on a constant proportion with this formula. This method, aided by life history chart data described by Kline and Hendrickson (1954), estimated a peak of 54 cottontails on August 14.

The fourth method was proposed by Green and Evans (1940) to estimate snowshoe hare populations. It involves a modified form of the Lincoln Index (Lincoln, 1930). The formula is $A/X = B/C$, where A is the number of rabbits tagged in the precensus period, B is the number of rabbits tagged in the precensus period and retrapped in the census period, C is the number of rabbits tagged in

the census period, X is the estimated number of rabbits at midpoint of the precensus period. With the aid of the life history chart the method gave an estimate of 100 cottontails on September 1.

The fifth method uses the Lincoln Index, $A/X = B/C$, where A is the number of rabbits tagged prior to September 1, B is the number of rabbits tagged prior to September 1 and recaptured after September 1, C is the total number of rabbits captured after September 1, and X is the total estimated population of rabbits resident on the area at some time in the study period. By substitution of numbers for symbols the proportion of the index becomes $38/X = 22/55$, and $X = 95$ cottontails. With the aid of the life history chart the estimated peak population was 83 rabbits on September 1.

To evaluate the several methods it is advisable to seek the true value of the population of rabbits residing on the area at sometime during the study.

A total of 71 rabbits had been tagged from an estimated population of 95. Therefore, 74.7 percent of the estimated total population had been tagged, or there were 1.338 times as many rabbits in the total population as had been tagged. Confidence limits of 95 percent can be put around this estimate by use of Table 1.1 in Snedecor (1946). For example size 55, which is C of the preceding formula, the confidence interval in percent for the proportion of number tagged in the precensus period and recaptured in the census period to total sample in the census period, $22/55 = 0.40$, is 28 and 54 percent. Therefore, the upper limit $L_1 = 38/0.28 = 136$, and the lower limit $L_2 = 38/0.54 = 70$. We can say then, with 95 percent confidence, that the true value of the population which resided on the area at some time during the study lies somewhere between 70 and 136, and the best estimate of the parameter is 95.

The fourth and fifth methods, employing modified forms of the Lincoln Index and life history chart data gave the more nearly correct estimates of the populations, it is thought. They indicated a population of 80-100 cottontails on 80 acres late in August and early in September.

In summary, field research on the productivity and population dynamics of the Mearns cottontail was conducted from June 17 to December 4, 1953, on 80 acres of a dairy farm in Decatur County, Iowa. Data collected from the use of 50 live traps discriminately placed throughout the study area were analyzed by five different methods. Three methods were judged to give peak population estimates too low or too high, and too early or too late in the season. The fourth and fifth methods, thought to be most nearly accurate, employed modified forms of the Lincoln Index. They indicated a population of 80-100 late in August and early in September.

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