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Chapter 10

A Field Trip for Applied Biology: Mark-Recapture of White-footed Mice in a Local Woodlot

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Introduction

Bowling Green, Ohio, is situated in an area historically known as the Great Black Swamp. The draining of the Swamp in the late 1800s resulted in some of the most fertile farmland in America. Since then, continual clearing of the land to increase agricultural acreage has resulted in the formation of fragmented woodlots. One such woodlot is known as Carter Woods, and this area has been the site for a long-term population study of *Peromyscus leucopus*, the white-footed mouse.

Workshop participants were taken to Carter Woods to collect census data on the mouse population in these woods using mark-recapture techniques.

Methods

Eight trap rows were established within the woods, with each row containing 26 trap stations. Sherman live traps were present at each trap station. Each captured mouse was marked by attaching a Monel fish fingerling tag to its ear, and then was released.

After all traps were checked, an estimate of the mouse population in the woods was calculated using a Lincoln-Peterson Estimate and a Jolly Estimate.

Lincoln-Peterson Estimate

A Lincoln-Peterson estimate requires two sampling periods. During phase I, all captured individuals are marked and released. A second phase of trapping is required. Many of the animals caught during phase II will already be marked, but some will be novel, unmarked individuals. The population size estimate can then be calculated using the following equation:

$PE = (T_2 \times M_1)/M_2$, where

T_2 = total number of different individuals caught during phase II (marked or unmarked)
M_1 = number of individuals that were marked and released during phase I
M_2 = number of individuals captured during phase II that were already marked
PE = population size estimate

Using data collected during the workshop, the size of the mouse population in Carter Woods was calculated as follows:

$PE = (27x52)/19 = 73.9$

Jolly Estimate

A Jolly estimate is obtained from data collected over multiple sampling periods. A table referred to as a Method B table is constructed for each individual caught. This table compares the time of capture for each individual to the time of its last capture. In essence, it provides information on when a particular marked individual was last captured. The information is then used to determine the size of the marked population.

Data collected prior to, and during the workshop, were used to construct a Method B table. Trapping occurred once per month for the months of April, May, and June 2004. Thirty-two mice were captured in April, and all were unmarked. Fifty-two mice were captured in May, and 15 of them were marked. Finally, 27 mice were captured in June, and eight of them were marked. The Method B table for these data is presented below.

		Time of Capture		
		April	May	June
Time of Last Capture				
	April	0	15	10
	May	0	0	6
	June	0	0	0
Total Marked		0	15	8
Total Unmarked		32	37	19
Total Caught		32	52	27
Total Released		32	52	27

A Jolly estimate of population size can be determined for any of the sampling periods. The first step is to calculate the marked population size at a particular time using the following equation:

$M_i = ((S_i \times Z_i)/R_i + m_i$, where

M_i = marked population size at time i
M_i = marked individuals caught at time i
S_i = total number of individuals released at time i
Z_i = number of individuals marked before time i, not caught in the ith session but caught in a session after time i
R_i = number of S_i individuals released at time i that are caught in a later session

For the workshop, the size of the marked population during the May sampling period was calculated as follows:

$M_{May} = ((52x2)/13) + 15 = 23$

A Jolly estimate was then calculated using the following equation:

$PE = M_{may}/(\text{total marked}_{May}/\text{total caught}_{May}) = 23/(15/52) = 79.7$

Notes for Instructor

For a Lincoln-Peterson estimate to be valid, the following assumptions must be met:

1. The population being studied is stable, i.e. there are no births, deaths, immigration or emigration.
2. All individuals have an equal likelihood of being captured.
3. The marking technique does not affect the individual.
4. The number of marked individuals will remain constant (i.e. the mark will not fade or appear by chance.)

Inevitably, assumption 1 is violated, and this reduces the accuracy of the population size estimate. To reduce the probability of recruitment or loss from the population, the study can be performed over a short period of time, or at a time when births/deaths and/or migration are minimal. Hence, a good knowledge of the biology of the species under study is required.

For an open population, one which experiences recruitment and loss, the Jolly estimate should be used as the size estimator.

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