

INDIRECT ESTIMATES OF POPULATION SIZE INDICES

Methods Relying on Animal Signs and Related Objects: These are the methods most widely used by State Game Departments. They have varying utility. Some indicate only the presence or absence of a species. Methods relying on animal sign are normally used to indicate trends in the population but there are situations where they provide estimates of the total population.

Auditory indices, track counts, and pellet counts are examples of these methods. Auditory counts are used to survey birds that are highly vocal during courting behavior or that sing a territorial song. They are commonly used for woodcock, grouse, quail, dove, turkey and pheasant. Again there

are many factors influencing these counts and they are standardized and calibrated.

Pellet counts are used to inventory deer, other hooved big game animals and rabbits. Considerable research has been conducted on pellet group counts for deer. Michigan¹ and other northern and western states now rely heavily on this census technique. The observer counts the number of pellet groups on stratified random sample areas. Generally the counts are made in winter or spring and only those pellets deposited since leaf fall are counted. The average date of leaf fall has previously been determined so it is possible to estimate the period during which the pellets were deposited. The average deer deposits about 13 pellet groups per day.

From this information it is fairly easy to estimate the total herd size. This type of inventory is not suitable in the south because dung beetles remove the pellets. **Methods Involving Marked Animals:** Variations of this approach can involve fairly complex mathematical modeling. These methods also fit into the category of pseudo-samples because the observer does not know initially what part of the study area is sampling. There are many variations of these methods and the Petersen or Lincoln

Index is probably the best known example.

Most of these methods involve trapping, marking and releasing a sample of the population and then some type of resampling. Information on mortality and

movement can also be collected on the marked animals. One problem frequently encountered with this method is that of trap-happy animals that are captured repeatedly. Sometimes the **multiple-capture individual** is treated in the data as though he was taken only once. Another means of avoiding this problem is to use different sampling devices during the two sampling periods. For example, one might use an automatic tagging device for deer which utilizes snares set along deer runways and automatically places a colored collar on the deer's neck. The second sampling method could involve recording observations of the marked and unmarked deer or sampling during the regular hunting season. One census method actually capitalizes on the problem of animals

which are recaptured repeatedly and uses frequency of recapture to estimate total population.

The Lincoln or Petersen Index

method has been used for everything from mice and rabbits to elk. In this case the word "Index" is a misnomer because this technique provides estimates of the entire population. A brief example will serve to convey the general idea of this method. We are interested in the number of foxes residing in a 10,000-acre study area. Padded steel traps are used to capture 12 foxes which are ear clipped and the pelage is marked with Nyanzol black dye. Two weeks later we resample the population using a predator call and spotlight at night and calling foxes close enough to observe them for color marking. Fifteen foxes

are observed in five evenings of calling and seven of these are marked. We assume that our first sample of 12 has the same relationship to the total population as our second sample of 7 marked animals had to the 15 in the total sample. We then solve for the unknown total population and the answer is 26. The Lincoln Index technique can be stratified to allow for different sampling probabilities in different age groupings or

in areas of varying population density.

Accuracy of the Lincoln estimate is dependent on the proportion of the population sampled. Strangaard studied roe deer populations and concluded that trap-recapture procedures seldom provide acceptable population estimates unless 66

percent or more of the calculated population was studied gray squirrels and found that population estimates based on trap-recapture techniques were lower than the actual numbers known, from time-specific data, to be present. It is suggested that more than one-half of the squirrel population should probably be sampled to ensure an accurate inventory.

The Lincoln Index Method has been used to census rabbits in Michigan.' It was apparently not valid because tagged rabbits were more vulnerable to recovery by hunting than rabbits that were not tagged.

The Schnabel Method

is a variation of the Lincoln Index. In this situation samples are taken on a series of occasions in the same manner one would use a Lincoln Index and on each occasion it is

possible to calculate a **Lincoln Index** estimate. In each sample period all of the captured animals would be marked. The model permits an averaging of the estimates.

Methods involving "Reduction" of Population Size & Rate of Capture:

These methods are based on the principle that rate of capture or observation decreases as the population decreases. Several models have been used including the Graphical Solution, the Leslie Method and DeLury's Method. All of these methods assume that the only change in the population is due to those animals removed by trapping or some other removal method. Animals which are captured and marked need not be removed from the study area but if they are recaptured they are treated as if

they did not exist. If the sample period is lengthy it is best to make some allowance for emigration, immigration, reproduction and mortality. These reduction methods also assume that the probability of capture remains constant throughout the study. This is probably the greatest weakness of these methods.

Probability of capture will often vary seasonally as well as among individuals. In some circumstances it may be possible to add correction factors for these problems.

Traps with a fixed location throughout the study will make certain individuals more vulnerable to capture simply because the trap is close to their center of activity.

Moving the traps several times during the sampling period will reduce this chance

for error. We used the Leslie Method to estimate the size of a deer herd within a 2,500-acre enclosure. Over a nine year period 1,554 deer were removed from this enclosure for use in a deer stocking program. An average of one deer per 14.4 acres was removed annually from the study area. This method involves plotting trapping success against cumulative removal and extrapolating to the number that will be removed when trapping success becomes zero. In this situation we underestimated herd size because we were unable to meet one of the conditions for use of this method: that the vulnerability of the population should not change during the census period. Salt was the only bait used for trapping and apparently the deer's physiological desire for salt increased in the

spring and decreased in the fall. This problem could have been overcome by monitoring the intensity of use of open salt licks throughout the spring and fall. The Lincoln Index method was also used on this herd, and gave what seemed reasonable estimates considering the number of deer removed annually and the herd's ability to produce replacements.

The Method of Selective Reduction or increase:

Kelker was the first to make use of this method and he used it to estimate deer herd size. It could be used with any species in which two or more sex and age groups are distinguishable. There are two sampling periods and an intervening period when the population decreases or increases by some known amount. As a

simplified example, suppose the pre-hunt buck-to-doe ratio was 100 bucks to 200 does. Checking station information indicated 350 bucks were harvested during the regular season. The post-hunt sex ratio was 75 bucks to 200 does. What was the total herd size prior to hunting? We know that for every 300 deer present prior to hunting, 25 were harvested. A total of 350 bucks were harvested, or 14 groups of 25. Forty-two hundred deer were present prior to the hunt (14×300).