STA 2232 ECOLOGICAL SAMPLING TECHNIQUES

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Contents

Chapter 1

Resources for Distance Sampling

Books and Papers

- Buckland, S.T., Rexstad, E., Marques, T.A. and Oedekoven, C.S. 2015. Distance Sampling: Methods and Applications. Springer, Heidelberg.
- Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. and Thomas, L. 2001. Introduction to Distance Sampling: Estimating Abundance of Biological Populations. Oxford University Press, Oxford, UK
- Buckland, S.T. 2006. Point-transect surveys for songbirds: robust methodologies. The Auk 123:345-357.
- L. Thomas, S. T. Buckland, E. A. Rexstad, J. L. Laake, S. Strindberg, S. L. Hedley, J. R. B. Bishop, T. A. Marques, K. P. Burnham, Distance software: Design and analysis of distance sampling surveys for estimating population size. J. Appl. Ecol. 47, 5–14 (2010).

Chapter 2

Distance Sampling for Line and Point transect

2.1 What is distance sampling?

- Distance sampling is a widely used methodology for estimating animal density or abundance.
- Distance sampling is a widely-used group of closely related methods for estimating the density and/or abundance of biological populations.
- Its name derives from the fact that the information used for inference are the recorded distances to objects of interest (usually animals) obtained by surveying lines or points.
- In the case of lines the perpendicular distances to detected animals are recorded, while in the case of points the radial distances from the point to detected animals are recorded.
- A key underlying concept is that the probability of detecting an animal decreases as its distance from the observer increases.
- Much of distance sampling methodology is concentrated on detection functions, which model the probability of detecting an animal, given its distance from the transect.
- The main methods are line transects and point transects (also called variable circular plots).

2.2 Methods of distance sampling

The term **'distance sampling'** covers a range of methods for assessing abundance:

1. **Line transect sampling**, in which the distances sampled are distances of detected objects (usually animals) from the line along which the observer travels

2. **Point transect sampling**, in which the distances sampled are distances of detected objects (usually birds) from the point at which the observer stands

3. **Cue counting**, in which the distances sampled are distances from a moving observer to each detected cue given by the objects of interest (usually whales)

4. **Migration counts**, in which the 'distances' sampled are actually times of detection during the migration of objects (usually whales) past a watch point

2.2.1 Line transec Sampling

Line transect surveys are conducted by traversing randomly placed transects in a study area with the objective of estimating density or abundance of a particular organism. Data collected during line transect surveys consists of sighting records for targets, usually either individuals or groups of some species. Among the collected data, off-transect distances are recorded or computed from other information such as sighting distance and angle. Off-transect distances are the perpendicular distances from the transect to the location of the initial sighting cue. The physical locations of sighted targets are often recorded or computed. When groups are the target, the number of individuals in the group is recorded.

A fundamental characteristic of distance sampling analyses is that sightability (probability of detection) of targets is assumed to decline as off-transect distances increase. Targets far from the transect are assumed to be harder to detect than targets close to the transect.

In most classical line transect studies, targets on the transect (off-transect distance = 0) are assume to be sighted with 100% probability. This assumption

allows estimation of the proportion of targets missed during the survey, and thus adjust the actual number of sighted targets by this proportion. Some studies utilize two observers searching the same areas to estimate the proportion of indivivduals missed and thereby eliminating the assumption that all individuals on the line have been observed.

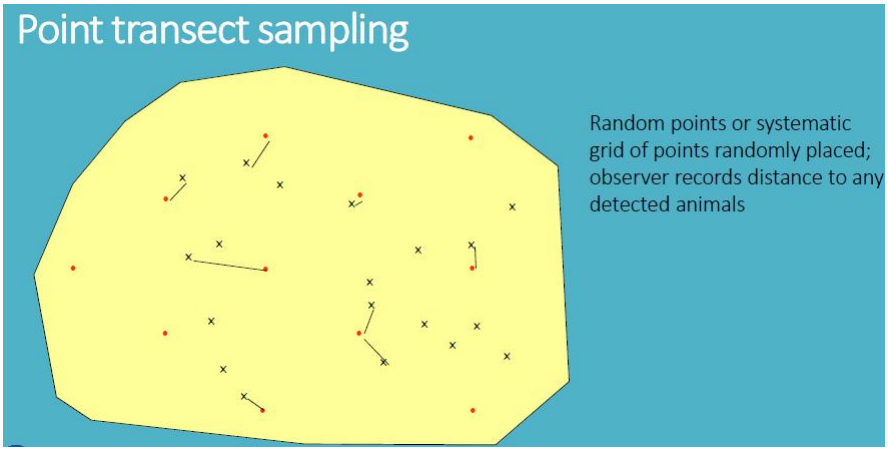
A line transect is characterized by a detectability function giving the probability that an animal (or plant) at a given location is detected. In most situations, the probability of detection can be expected to decrease as distance from the transect line increases. In many cases, detectability on the line itself can be assumed perfect. In other cases, avoidance by the animals of the observer can result in detectability reaching a maximum at some distance from the line.

Density Estimation Methods for Line and Point Transects

- Line transect sampling is usually used to sample objects for which detectability depends on location relative to the observer.
- The objective is to estimate the density of objects in the study region.
  - Examples include birds, mammals, and plant species.
- Here is a picture for line transect method.

2.2.2 Point transect sampling

This section describes methods associated with point transect sampling. Analyses of this type of data is inherently more difficult, for reasons explained in this material. A comparative study of songbird density estimated is presented, describing the advantages of the snapshot field procedure to minimise the effect of animal movement upon estimates.



For k point counts with certain detection to distance w:

2.3 Detection function, $\hat{D}$