Variable Circular Plots: Station Placement and the Independence Assumption

Master's Research Project

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Distance Sampling

- Population Density Estimation

- Used often in Ecological Sciences

- Began with roadside surveys in early 1900s

- Theory developed through mid-1900s

Distance Sampling: History

- Emlen—1971
- Ramsey, Scott—1979, 1980 Papers
- Burnham, Anderson, and Jeffrey L. Laake—1980 Monograph
- Buckland et. al. 1993, 2001—text
- Continued Development into 2000s
    - Combined with Mark-Recapture Methods
    - Extended for use with underwater acoustics for estimates of krill populations
    - Combined with camera traps to estimate populations

Line Vs. Point Transects

- Line transects are walked
  - Distances perpendicular to transect are recorded, as projected on ground

- Point transects: observer(s) stand at station, observe everything within 360°
  - Alternately: Variable Circular Plots (VCP)
  - Allow "cooling" period
  - Safer for observer
  - Straight line distance from Observer is recorded, as projected on ground

- Observations can be from visual sightings, auditory clues, or a combination

Detection Curve: $g(r)$
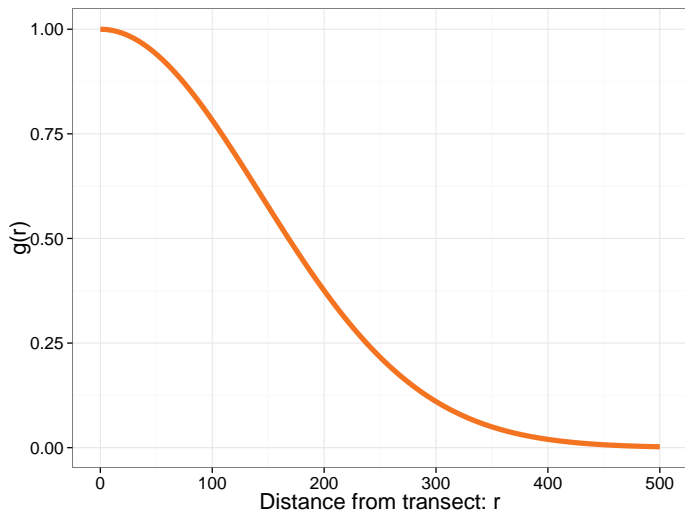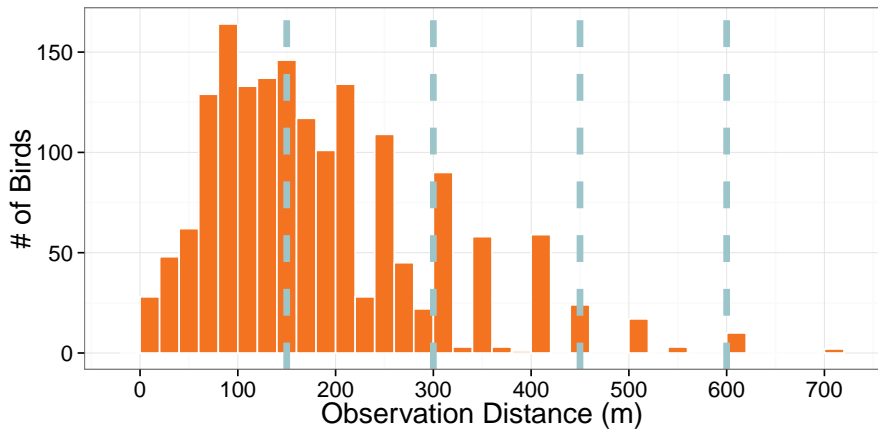
Density Estimation

$$\hat{D} = \frac{n}{\text{Area} * P(\text{observing object}|\text{distance } r)}$$

$$\hat{D} = \frac{n}{\text{Area} * g(r)}$$

Micronesian Forest Bird Survey: 1982

- Engbring, Ramsey & Wildman (1986)

- Used VCP to survey several bird species in the Micronesian islands

- Each of 5 Islands divided into regions

- Transect randomly placed within region (angle & starting position selected randomly)

- Stations placed every 150 m along transect

- Additional transects placed 2 km parallel

Collared Kingfisher Observation Data

Research Question

Do overlapping observation areas violate any underlying independence assumptions?

Will it make a difference in our final population density estimates if a bird is observed from more than one station?

VCP Indepencence

- Ramsey and Scott (1979), Buckland (1987), and Thompson (2012) discuss assumption that VCPs are randomly placed.
  - Implicit, but not explicit, possibility of overlap

- Reynolds, Scott, and Nussbaum (1980) state the possibility of observing the same bird from more than one station should be avoided.

- Buckland et al. (2001) states "Transects are normally spaced at a sufficient distance to avoid detecting an object from two neighboring transacts, although this is not usually critical unless sampling a line changes the animal distribution at neighboring, as yet un-sampled lines."

Final Words

"All models are wrong, but some are useful." –George E. P. Box