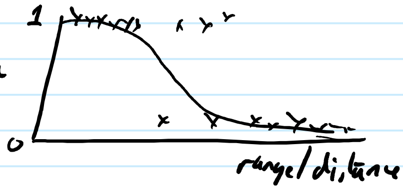
DS - recap and assumptions

31 July 2017 08:53

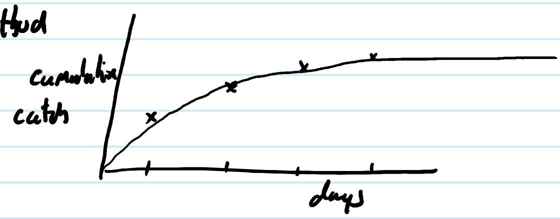
- Census → count everything
- Plot sampling
  - strip transect
  - quadrat
  - circular plots, hoop plots, point count

  } extend to include multipliers
- Distance sampling
  - line transect
  - point transect

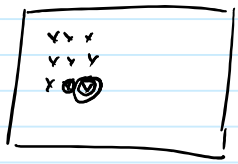
  } indirect sampling / cue sampling
- Mark recapture
- Pop size from occupancy data w/ mixture models.
- Lure counts



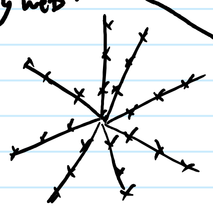
- Effort-based surveys in fisheries
  ↳ type of plot sampling
- Removal method



- Spatially explicit capture recapture SECR
  SCR



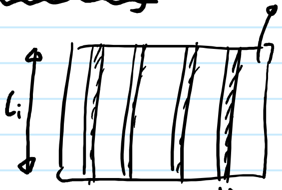
Trapping web → better to use SECR



<u>Plot sampling</u>

A = study area size   n = number of animals counted.

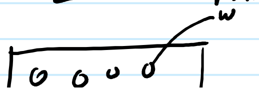
strip



$$\hat{N} = \frac{nA}{2wL}$$

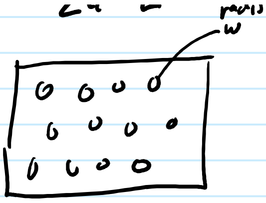
$$\sum l_i = L \quad 2w$$

circle



$$\hat{N} = \frac{n \quad A}{}$$

circle



$$\hat{N} = \frac{n A}{k \pi w^2}$$

Stage 1 How many in surveyed area n

Stage 2 How many in study area

$$\frac{n}{\text{proportion of area surveyed}} = \frac{n}{\frac{a}{A}} = \frac{n}{\frac{2wL}{A}} = \frac{nA}{2wL}$$

Horvitz-Thompson estimator

$$N = \frac{n}{\text{inclusion probability}}$$

For plot sampling $= \frac{n}{a/A}$

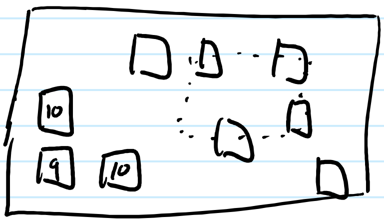
Variance - line transect

$$var\left(\frac{n}{L}\right) = \frac{n}{L^2(k-1)} \sum_{i=1}^{k} l_i^2 \left(\frac{n_i}{l_i} - \frac{n}{L}\right)^2$$

Assumption of plot sampling

1. All animals inside plots are counted.
2. Transects laid out at random

Design-based vs Model-based sampling



Design based → robust

Model based → less robust
don't need a design
better precision
possible gain in ecological understanding

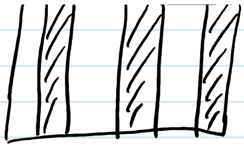
~~Simple model - independent animals~~

~~$var\left(\frac{n}{L}\right) = \frac{n}{L^2}$~~

Distance sampling

Miss some animals in strips

$$\hat{N} = \frac{n A}{2wL \hat{p}}$$ ← probability



$$\hat{N} = \frac{n A}{2wL\hat{p}}$$ — $\hat{p}$: probability of detection

Horvitz-Thompson-like $\hat{N} = \frac{\text{count}}{\text{inclusion prob}} = \frac{n}{(a/A) \times \hat{p}}$

Asymptotically unbiased

Stage 1 - how many in surveyed area

$$N_a = \frac{n}{p}$$

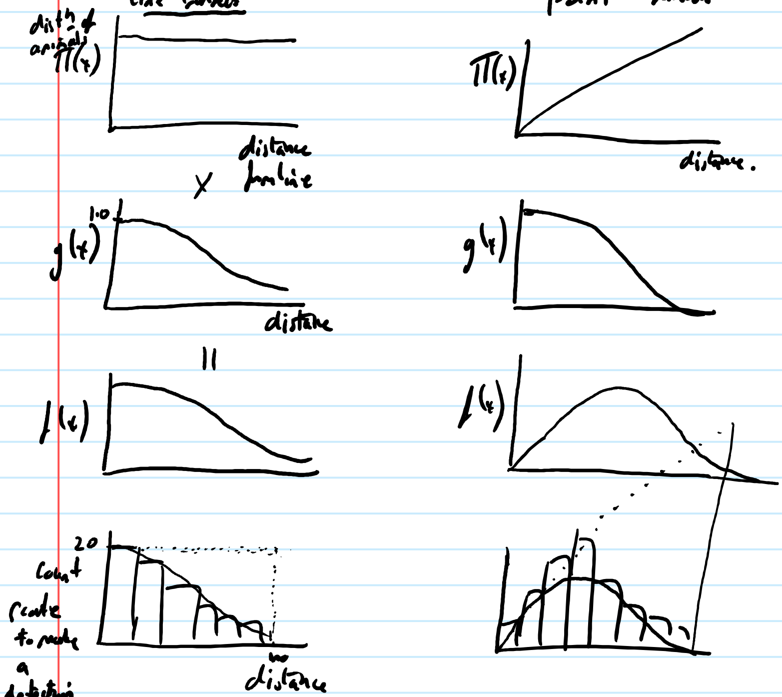
Stage 2 - how many in survey area

$$N = \frac{N_a}{a/A} = \frac{n/p}{a/A} = \frac{nA}{ap}$$

Where do we get prob of detection from

Additional info - distances

line transects — point transects

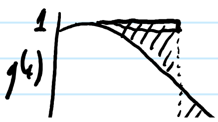


$$\hat{p} = \frac{\text{area under curve}}{\text{area of rectangle}}$$

$$p = \frac{\int_0^w g(x)}{1 \times w}$$

$$= \frac{\int g(x)}{w}$$ — effective strip half width μ

$$= \frac{\hat{\mu}}{w} \qquad \hat{\mu} = \hat{p}w$$



$$\hat{N} = \frac{n}{2wL\hat{p}} = \frac{n}{2wL\frac{\hat{\mu}}{w}}$$

$$= \frac{n}{2\hat{\mu}L}$$

effective detection area

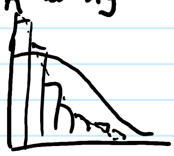
useful when no truncation.

Assumptions of distance sampling

1. Detect everything at zero distance → underestimate
2. Accurate measurements of distance. → can be a problem for point transects
3. Survey is a snapshot
4. Random transects → known distribution of animals wrt the transect → transects representative of study area.
5. (Detections are independent)

→ random movement causes positive bias

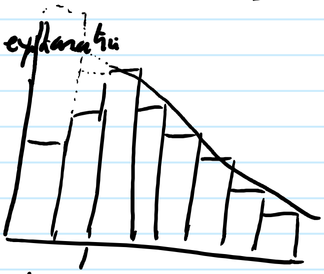
(1) n too big



(2) p too low $N = \frac{n}{2wLp}$

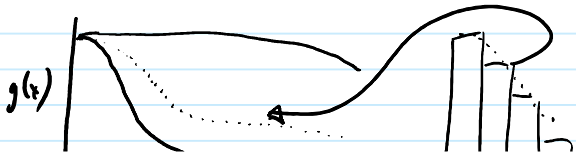
Responsive movement - Line transect.

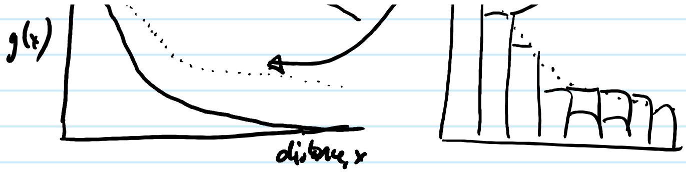
Alternative explanation



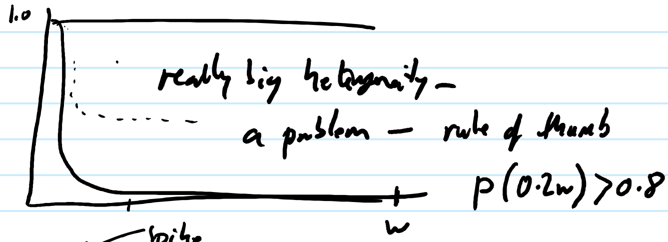
left transect

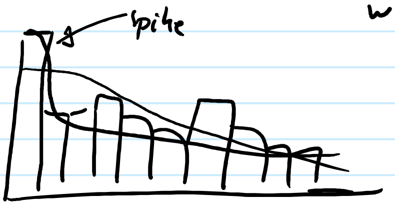
Pooling robustness





Heterogeneity in detection probability does not cause big bias — up to a point.





Multiple covariate distance sampling MCDS

Why? – Strong heterogeneity
- Detection function by stratum
- Interest in factors affecting detectability.

$$\hat{N} = \frac{n A}{2wLp} = \left(\sum_{i=1}^{n} \frac{1}{p}\right) \frac{A}{2wL} = \left(\sum_{i=1}^{n} \frac{1}{p_i}\right) \frac{A}{2wL}$$

Animals in clusters

$$N_c = \frac{n_c A}{2wLp} \qquad N = N_c E(s)$$

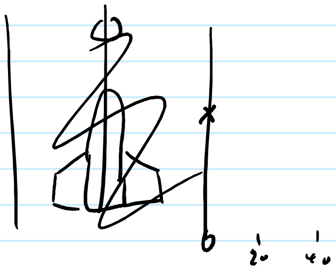
$E(s)$: population average cluster size

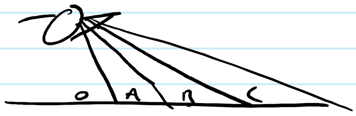
MCDS – cluster size as a covariate

$$N = \left(\sum_{i=1}^{n} \frac{s_i}{p_i}\right) \frac{A}{2wL}$$

Questions.

$$\hat{N} = \frac{n}{2wL\hat{p}}$$


x
0
20
40


O
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