Introduction to Distance Sampling

Overview of wildlife population assessment methods

Plot sampling

Distance sampling

- Basic idea
- Types of distance sampling

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Wildlife Population Assessment

How many are there?

What are their trends?

Why?

- Vital rates (survival, fecundity, etc)

What might happen if…?

- Scenario planning
- Risk assessment
- Decision support

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Rapid assessment methods and indices

Perhaps emphasis is just on trends

- Questionnaire surveys
  - *e.g. UK adder survey*
- Presence/absence
  - *e.g. UK otter surveys*
- Index methods
  - *e.g., Point counts for birds (US Breeding Bird Survey)*

Warning!

- For estimating trends, must assume no trend in proportion detected

Methods of estimating abundance

- Complete census
- Plot sampling
- Distance sampling
- Mark-recapture
- Removal method

Complete census

Let

N = population size (abundance)

A = size of study region = 5000

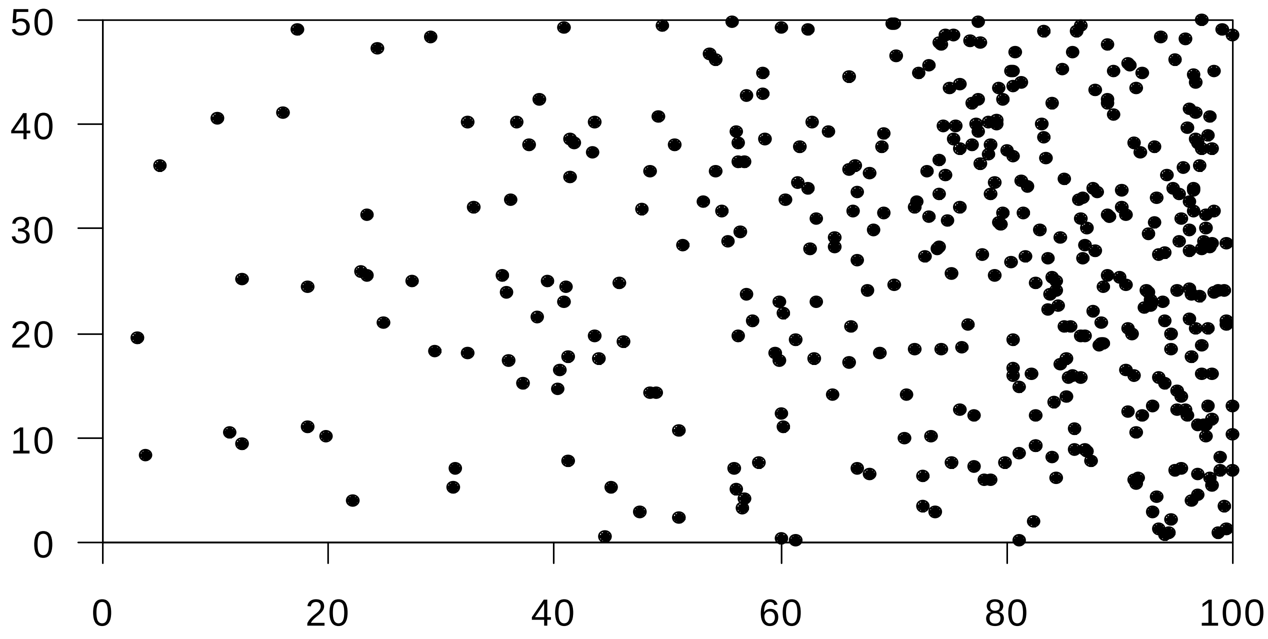
D = animal density = *N/A*

Method: count everything!

N = 412

D = 412/5000 = 0.0824

Rarely possible in practice!



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Plot sampling (or strip transect)

- Let

  k = number of strips = 5

  L = total line length = 50x5 = 250

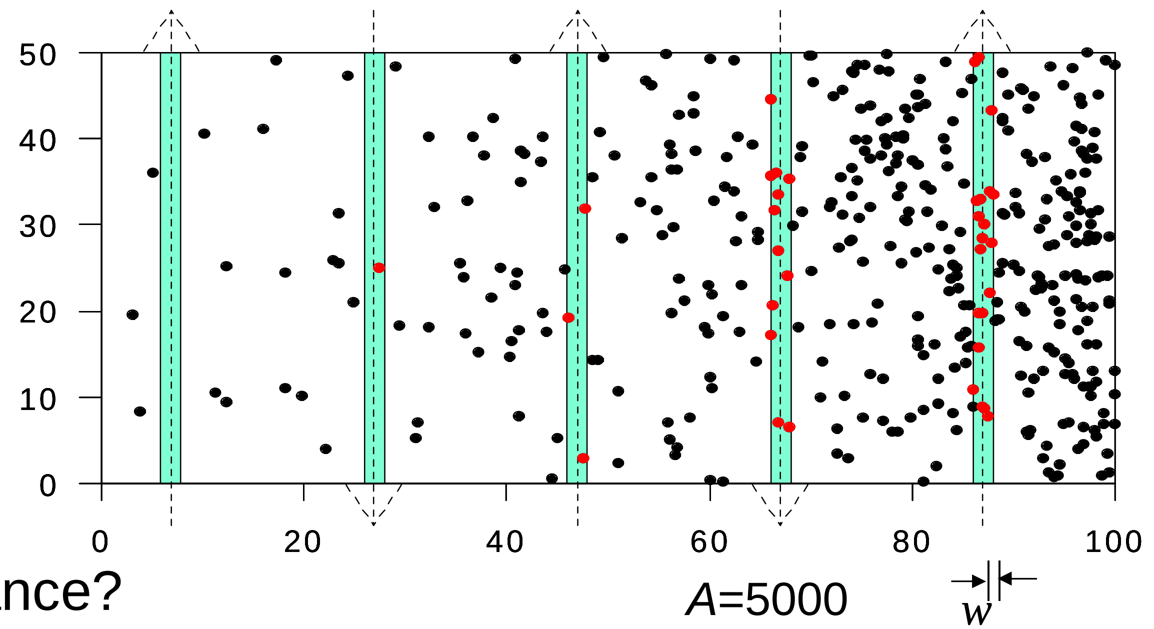
  w = the strip half-width = 1

  a = area of region covered

  = $2wL$ = 2x1x250 = 500

  n = number of animals counted = 36

- From this, how do we estimate abundance?



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Intuitive estimator of abundance

I saw 36 animals

I covered 500/5000 = 1/10th of the study region

So, I estimate there are 36/(1/10) = 36x10 = 360 animals

$$\hat{N} = \frac{n}{a/A} = \frac{nA}{a} = \frac{36 \times 5000}{500} = 360$$

(Hat "^" means an estimate.)

Concept – Plot sampling

Step 1: How many in covered region, N_a?

Plot sampling: $N_a = n$

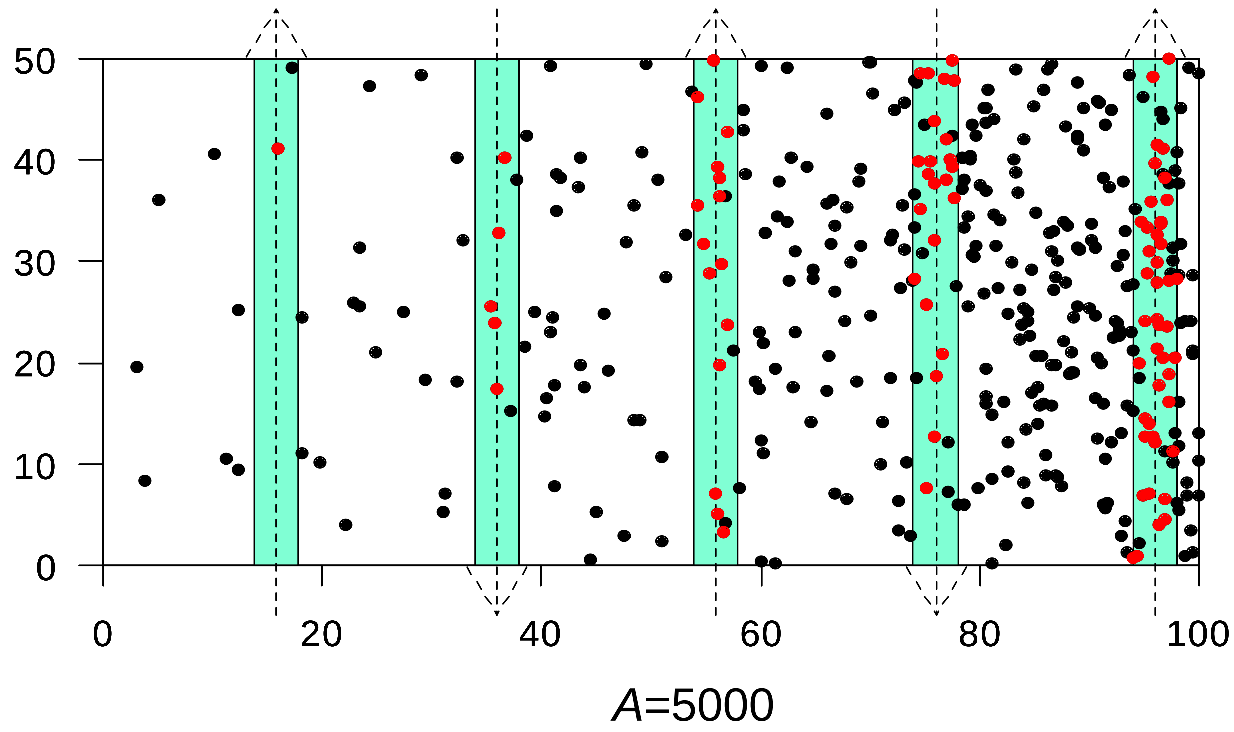
Step 2: Given N_a, how many in study region, N

If transcects placed at random: $\hat{N} = \frac{N_a}{a/A}$

Overall: $\hat{N} = \frac{n}{a/A} = \frac{nA}{a} = \frac{nA}{2wL}$ for strip transects

Distance (line transect) sampling

- An extension of plot sampling where not all animals in the covered region are detected
- Here
  - w = 2 (strip can be wider, as don't have to see everything)
  - a = 1000
  - n = 68 (more animals seen)
- Let
  - P_a = proportion of animals detected within covered region
- Imagine we know (or can estimate) $\hat{P}_a = 0.7$



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Intuitive estimator of abundance

I saw 68 animals

The estimated proportion seen was 0.7

So, I estimate the true number of animals in the strips was 68/0.7 = 97.1

I covered 1000/5000 = 1/5th of the study region

So, I estimate there are 97.1/(1/5) = 485.7 animals

$$\hat{N} = \frac{n / \hat{P}_a}{a / A} = \frac{nA}{a\hat{P}_a} = \frac{68 \times 5000}{1000 \times 0.7} = 485.7$$

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Concept – Distance sampling

Step 1: How many in covered region, N_a?

Distance sampling: $\hat{N}_a = n / \hat{P}_a$

Step 2: Given N_a, how many in study region, N

If transects placed at random: $\hat{N} = \dfrac{\hat{N}_a}{a/A}$

Overall: $$\hat{N} = \frac{n/\hat{P}_a}{a/A} = \frac{nA}{a\hat{P}_a} = \frac{nA}{2wL\hat{P}_a}$$

for line transects

- So how do we estimate P_a?

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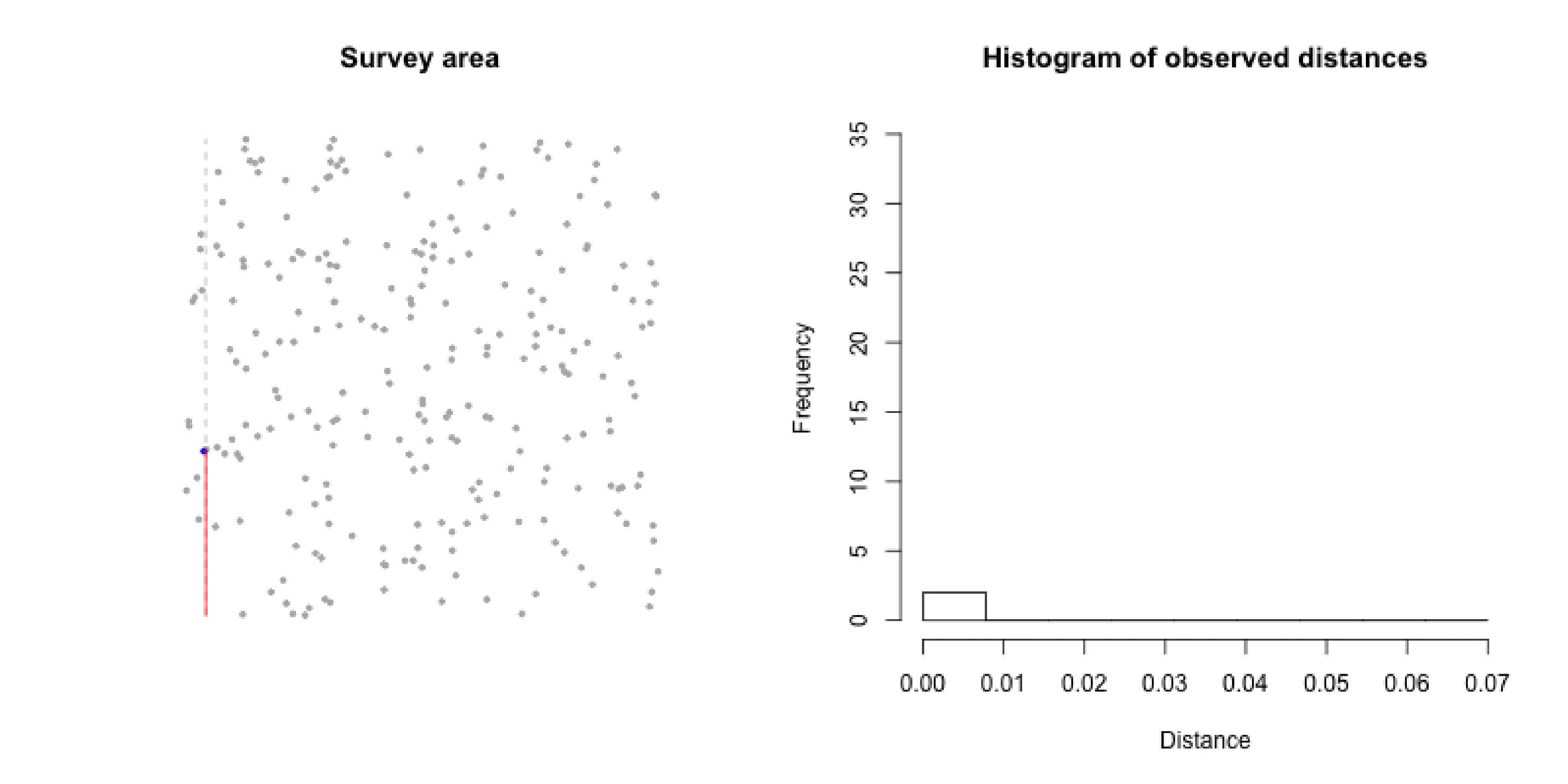
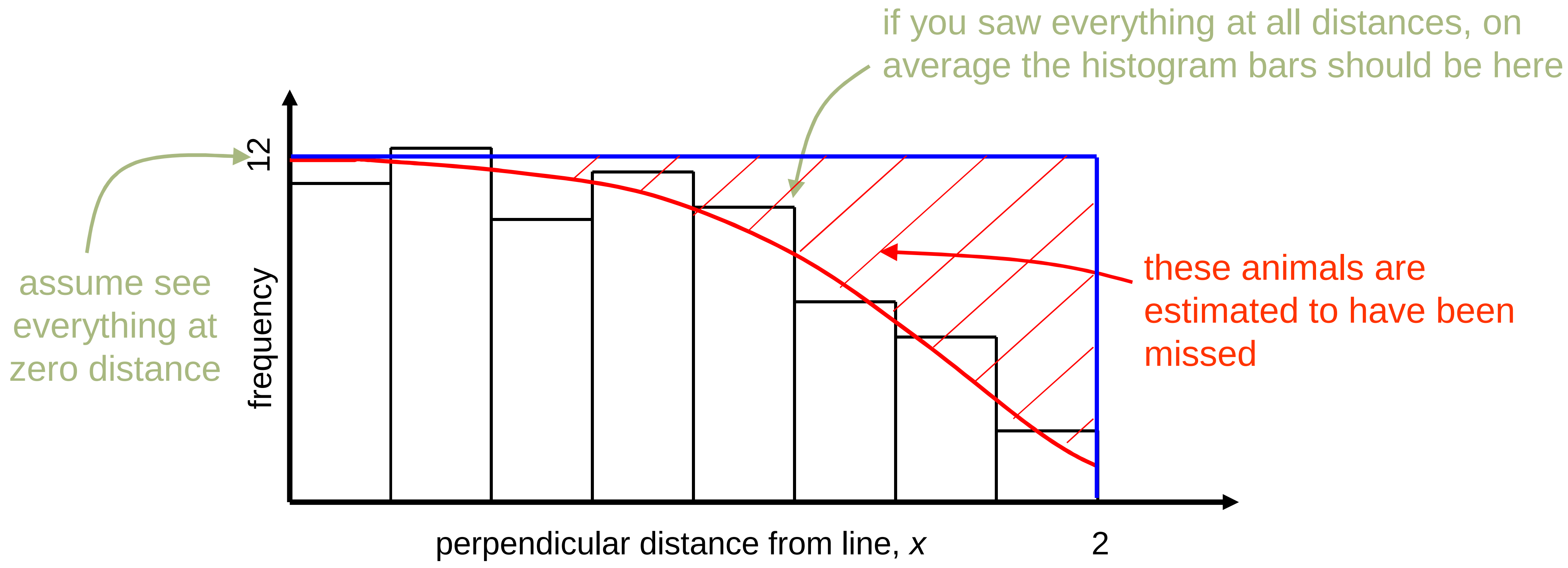
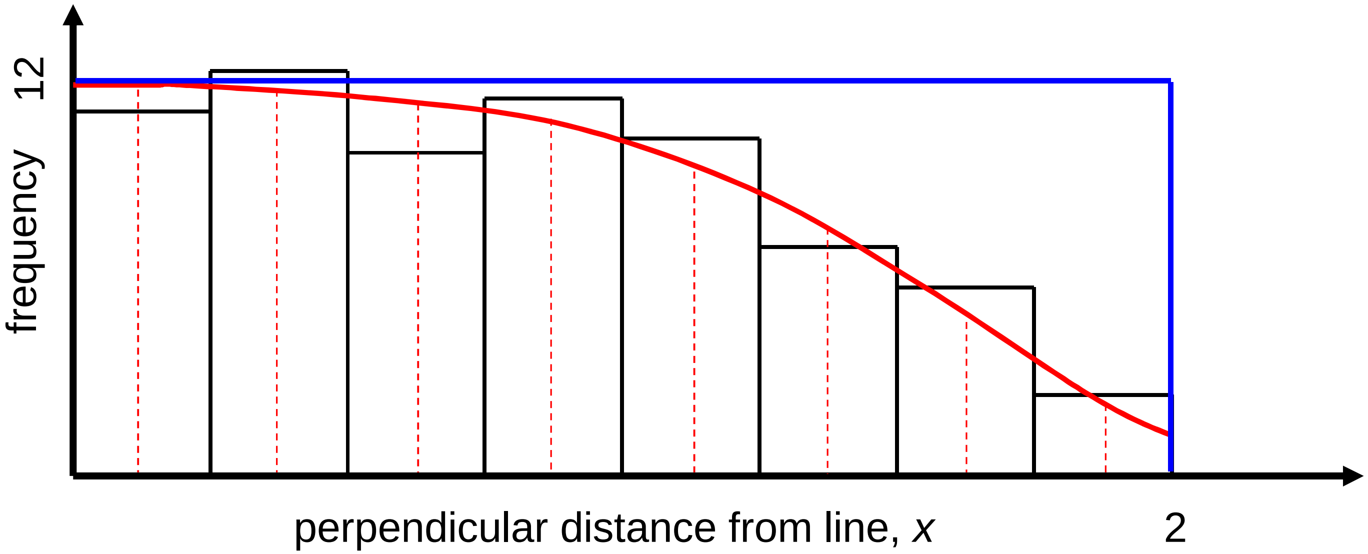
Record perpendicular distance, *x*, from transect line to each observed object



Estimating P_a



Estimating P_a



$$\hat{P}_a = \frac{\text{area under curve}}{\text{area under rectangle}}$$

Area of rectangle = 12x2 = 24

Area under curve = 0.25x(12+11.5+11+10.5+9+7+4+3) = 17

So

$$\hat{P}_a = \frac{17}{24} = 0.7$$