Field Methods:
(given an adequate survey design has been used)

- Objectives of adequate field methods
- General recommendations
- A few special circumstances
- Checklist
- Analysis hints

References

- Chapter 7 of Buckland et al. (2001) Introduction to Distance Sampling
- Chapters 4, 10 and 12 of Buckland et al. (2015) Distance Sampling: Methods and Applications

"Considerable potential exists for poor field procedures to ruin an otherwise good survey"

Goal: ensure key assumptions met

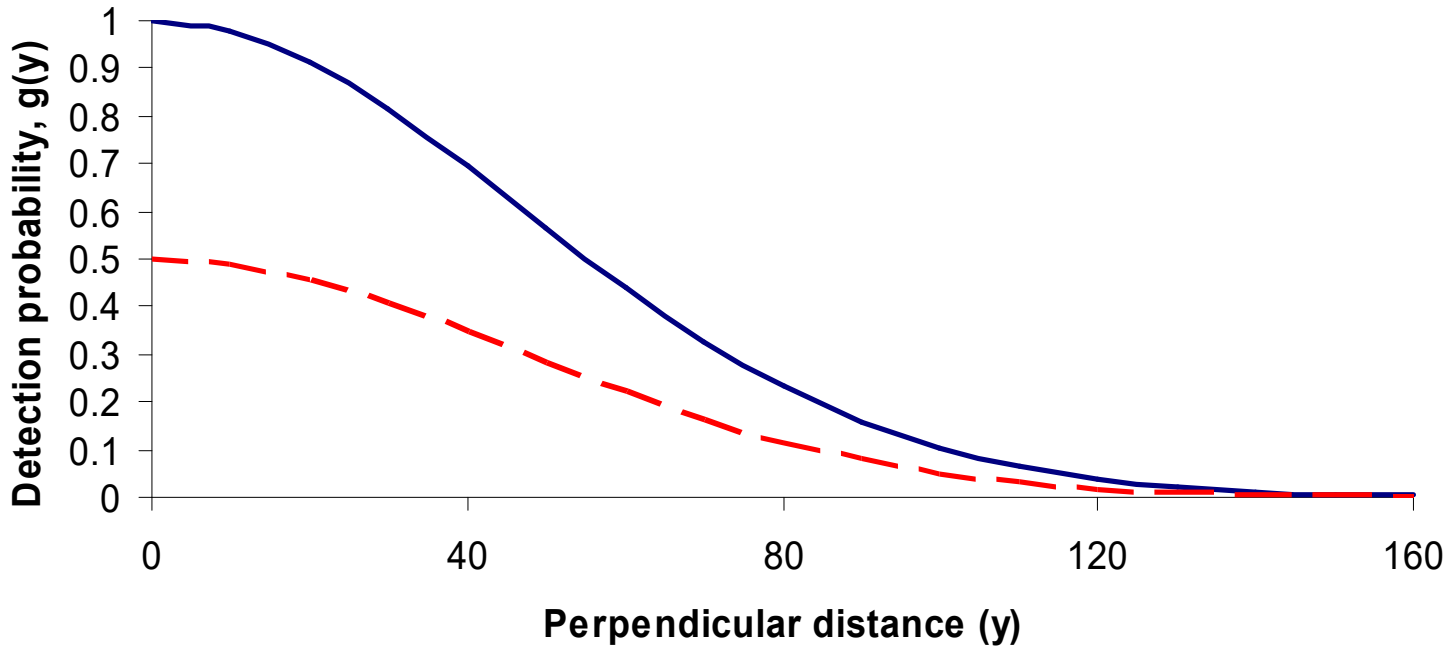
- $g(0)=1$
- no responsive movement prior to detection
- distances measured without error
- detection function has a wide shoulder

Try to ensure g(0)=1

Make sure that g(0) is 1

Traditional data tells you nothing about g(0)

Good field methods and common sense help to achieve it



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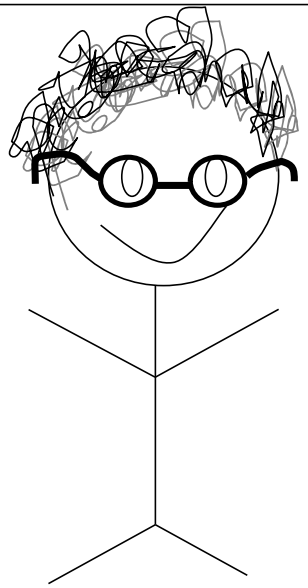
Make sure that g(0) is 1

- Do not try to see everything
- But try to see everything on the line
- *More detections do not necessarily equate to better data*

Wooden Stake Surveys $N = 150$



$$n = 55$$

$$\hat{N} = 138$$

$$n = 72$$

$$\hat{N} = 106$$

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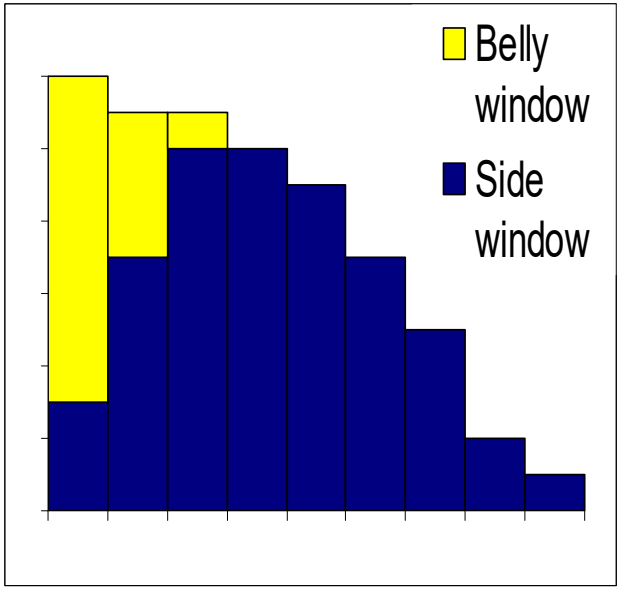
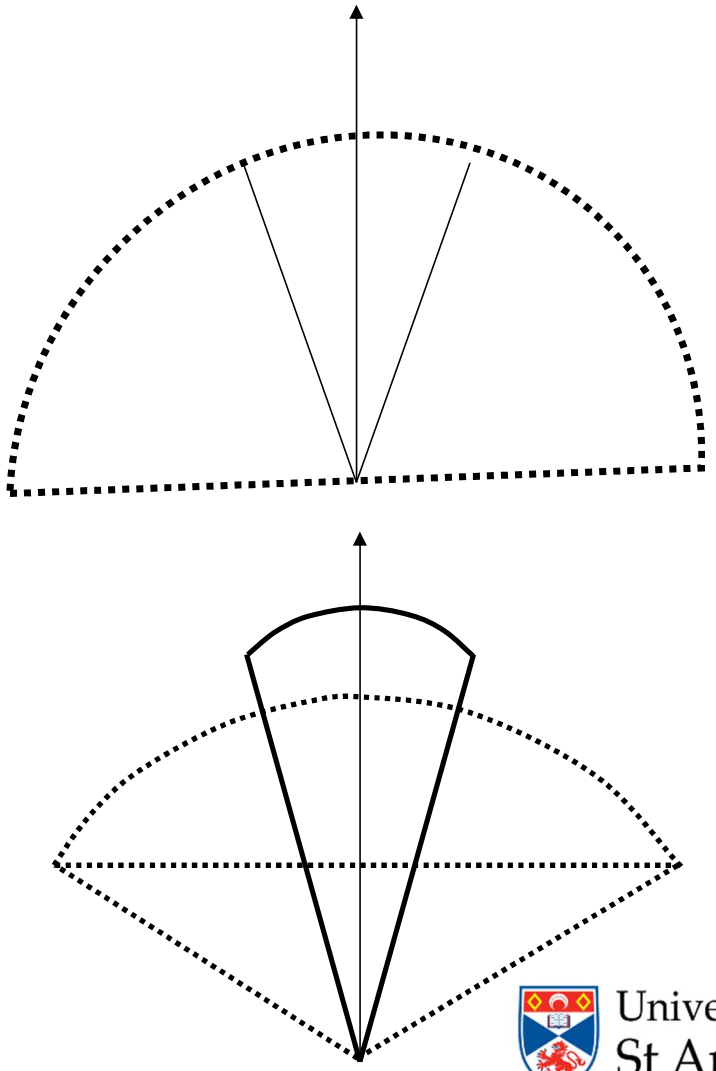
Make sure that g(0) is 1

- Use multiple observers
- But avoid spiked data…





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Warning – $g(0)$ is probably < 1 !

Situation

- Even with a well-defined search protocol and good observers, animals near the line may be missed

Problems

- Underestimation in density/abundance
- Added variability (if g(0) changes with survey period) reduces power

Solutions

- Independent observers to estimate $g(0)$
- Technology (Video Camera, Infrared)
- Change methods (go slower, lower)
- Independent estimates of g(0)
- Trials on animals of known location

Avoid effects of animal movement

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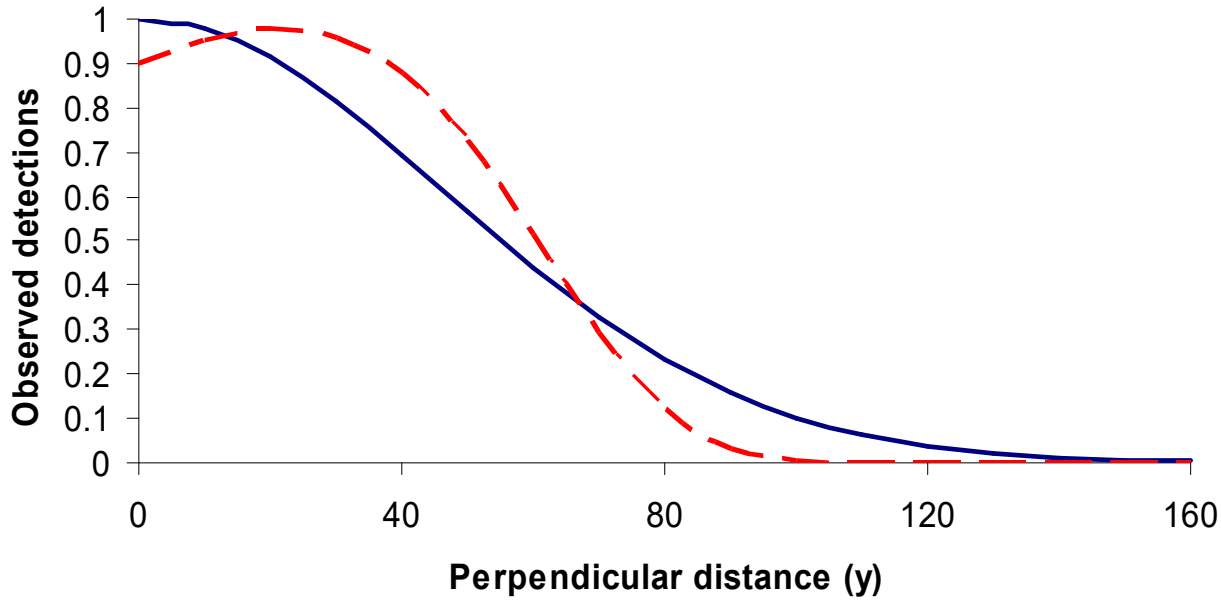
Avoid the effect of movement

detect animals prior to responsive movement



- effect on data is not always obvious

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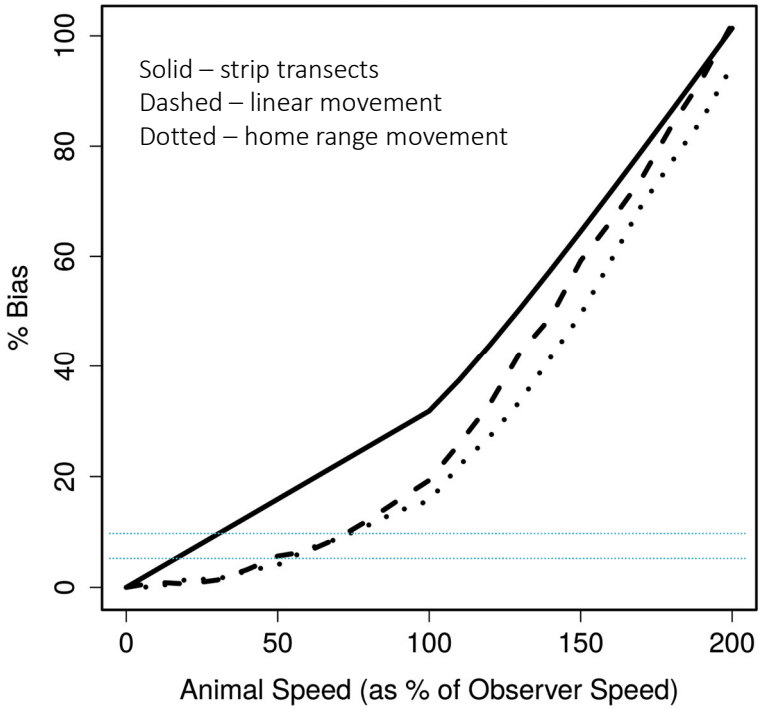
Avoid the effect of movement

For points:

- Snapshot method, waiting periods (before and after)
- Use cues rather than individuals?

For lines:

- Look ahead
- Move slowly, carefully, quietly
- *but if observer speed < 2-3 times average animal speed, see Section 6.5 of Introduction to Distance Sampling book*
- *Glennie R, Buckland ST, and Thomas L (2015) The effect of animal movement on line transect estimates of abundance. PLoS ONE 10(3): e0121333. https://doi.org/10.1371/journal.pone.0121333*
- *R. Glennie, S. T. Buckland, R. Langrock, T. Gerrodette, L. T. Ballance, S. J. Chivers and M. D. Scott (2020) Incorporating animal movement into distance sampling, Journal of the American Statistical Association, DOI: 10.1080/01621459.2020.1764362*



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Measure distances accurately

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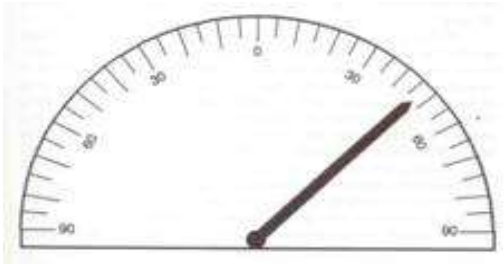
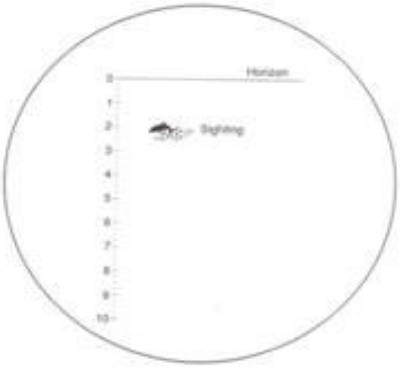
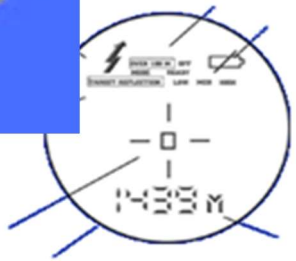
Get accurate and precise distances



Technological aids can be invaluable - use whenever possible

Avoid introducing more uncertainty by guessing





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Get accurate and precise distances

If possible, mark the transect line

A clear definition of what you are measuring distance to helps to guard against spiked data and bias

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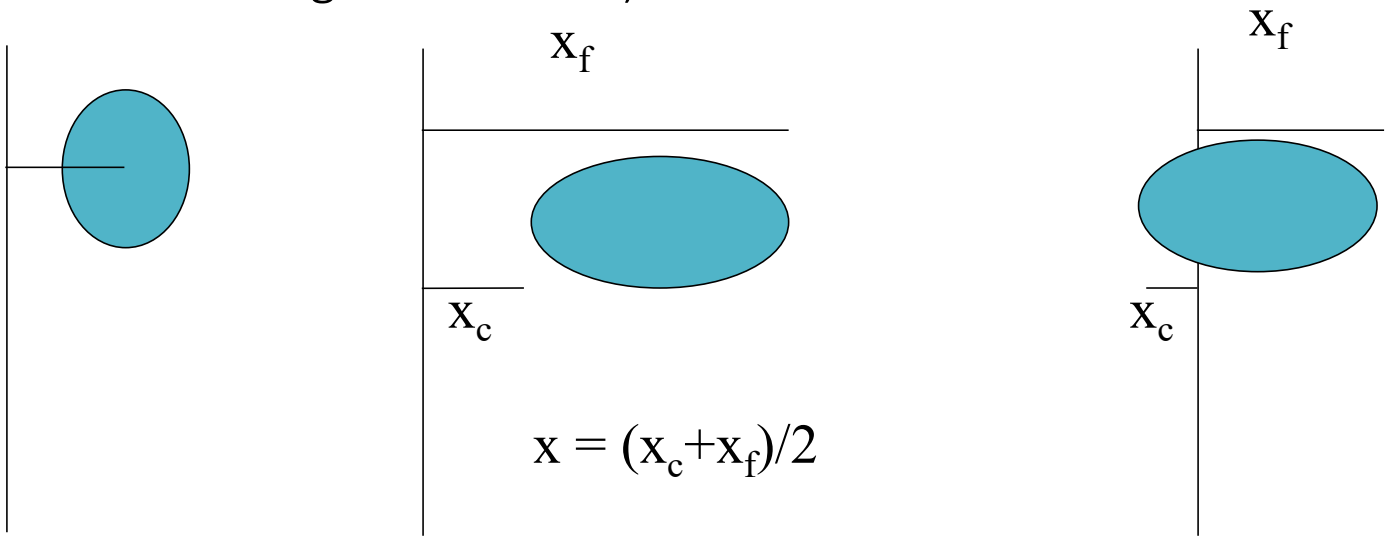
Get accurate and precise distances

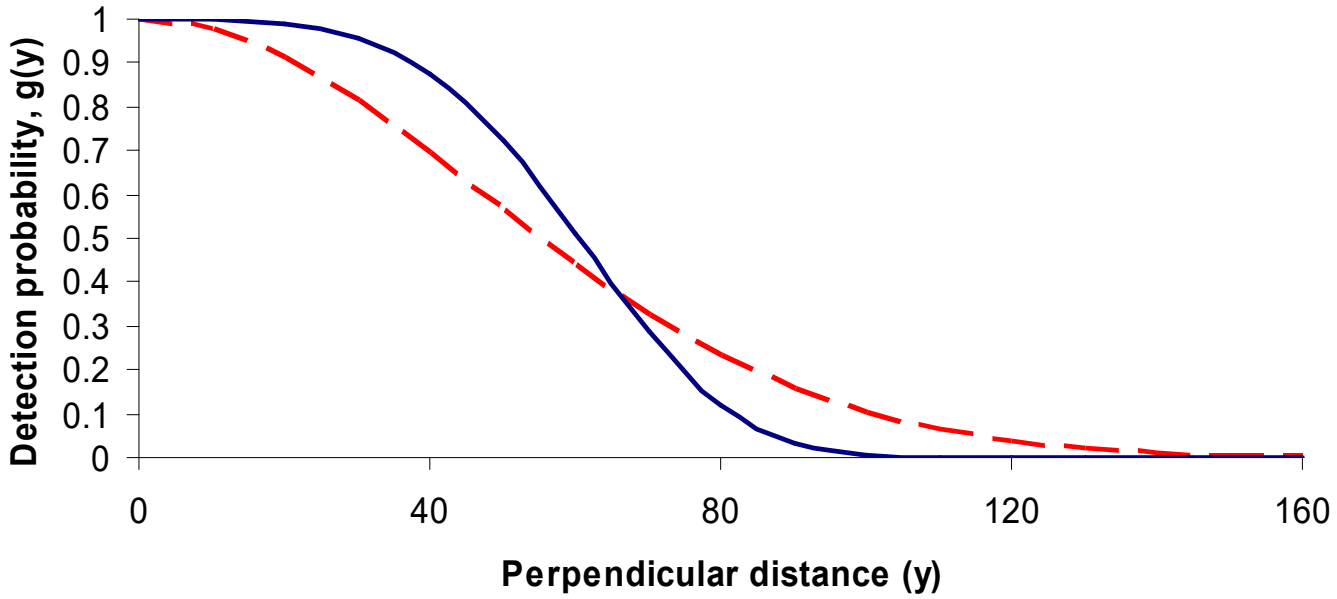
- If size of animal/object is large compared to scale of measurements, define what measurement is to be made (e.g. from line to centre, tallest part, flower, etc)
- If measuring distances to clusters, get the distance to the “centre of the cluster”
- In practice, the mean between closest and furthest away distance might be enough (remember to collect signed distance)



General recommendations

General recommendations

- Strive for wide shoulder in detection function



- Think about optimal effort allocation (ensure g(0) while distributing effort)
- More than one observer?

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General recommendations

- If possible, review data during survey

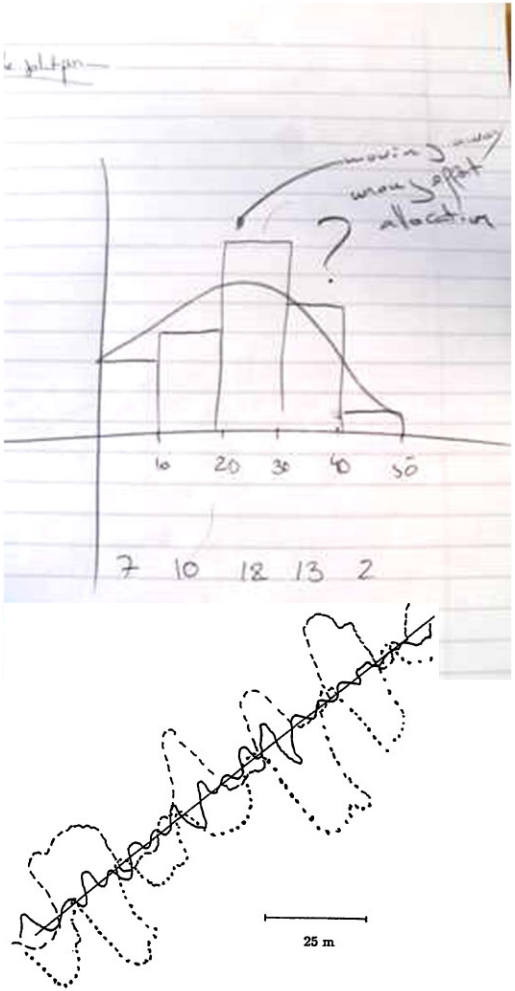

Fig. 6. Search strategy suggested by the distance data collected where a 3-person team is used to detect desert tortoise. This is only 1 part of the field protocol.

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General recommendations

- Collect only relevant data
  - Perpendicular distance or distance and angle? (Angles for point transects?)
  - Cluster size
  - Effort (line length; no. of points); line or point ID
  - Observer name, survey block, date, start time, end time, weather, environmental conditions, habitat, sex, species, age, etc…

General recommendations

Make data recording as easy as possible:

- dedicated field sheets
- distance intervals for aerial surveys
- tape recorder + voice activated microphone
- separate person to record data
- automated data entry (ship's GPS, etc.)
- video

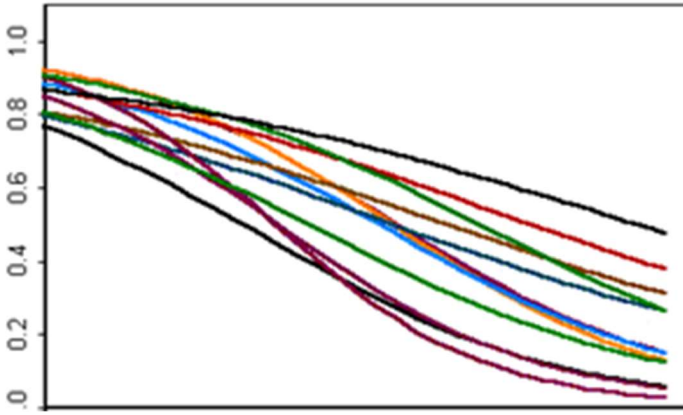
Have a backup

- backup recording method
- backup of field data

General recommendations

(most…) OBSERVERS ARE HUMAN…

- Observing for long hours can be boring – plan breaks /rotations
- Want to count what they see
- have a “>w” category
- for one-sided transects, have a category for negative values
- Teach observers how to search
- Emphasize effort on and near line
- Look ahead
- Look back if necessary
- Do not assume observers know what to do
- Go with observers to the field
- Test and train observers



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Special circumstances: Multi-species surveys

Problems

- Species differences in detection
- Identification of similar species
- High density situations

Solutions

- Multiple observers
- Training
- Focus on key species

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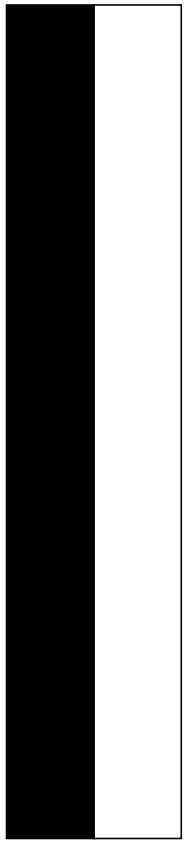
Animals at high density

- Consider strip transects
- Reduce truncation width
- Increase observation time (move more slowly)
- Multiple observers
- Streamline data collection

One-sided transects

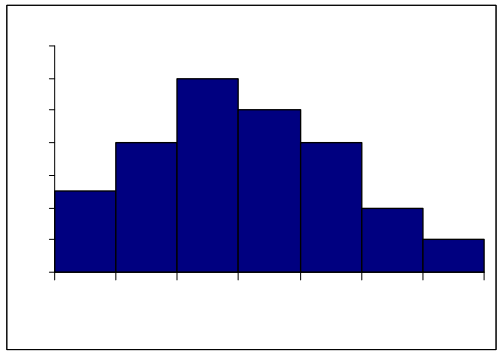
- Avoid!
- Problems:
  - accurate line determination
  - movement into or out of survey strip
- Leads to heaping at zero distance



Some of what can go wrong, will likely go wrong

I spent all my money and have no data!

What do I do with this?



Situation

- Hi tech breakdown
- No planning
- Haven't thought about assumptions

Problems

- Data are lost
- Poor quality data

Solutions

- Sometimes low-tech is better
- Backups
- Conduct a pilot survey
- Train observers
- Examine data during survey

Survey checklist

Which method when?

Strip transects

- Populations that occur in large, loose clusters (e.g. walruses)
- Stationary objects, at high density, and easily detected

Line transects

- Sparsely distributed populations for which sampling needs to be efficient (e.g. whales, deer)
- Populations that occur in well-defined clusters, and at low or medium cluster density (e.g. dolphin or fish schools)
- Populations that are detected through a flushing response (e.g. grouse, hares)

Point transects

- Populations at high density, especially if surveys are multi-species (e.g. songbirds)
- Populations that occur in patchy habitat
- Populations that occur in difficult terrain, or on land where access to walk predetermined lines is problematic (e.g. bird populations in rain forest or on arable farmland)

Checklist for a good survey

- Is distance sampling appropriate for your study; if so which type?
  - *Do study animals occur at high density?*
  - *Is terrain difficult to traverse or is estimation of distances difficult because it is being done by calls?*
  - *Do animals exhibit responsive movement?*
    - Do animals move much faster than observers?
  - Are animal densities so low that sufficient detections is impractical?
- How do animals distribute themselves?
  - Is there an animal gradient across study area?
  - Do animals exhibit habitat preferences?
  - Are preferred habitats in distinct patches or gradually changing habitat?
  - Small-scale animal gradients with respect to the transects?
- Does the study organism travel in groups?

Checklist continued

- Other potential assumption failures
  - Imperfect detection on the transect
  - Measurement error in detection distances
- Final points to consider
  - Are you considering use of roads or tracks?
  - How will randomisation be used to distribute transects within the study area?
  - What was learned from the pilot study?

Analysis hints

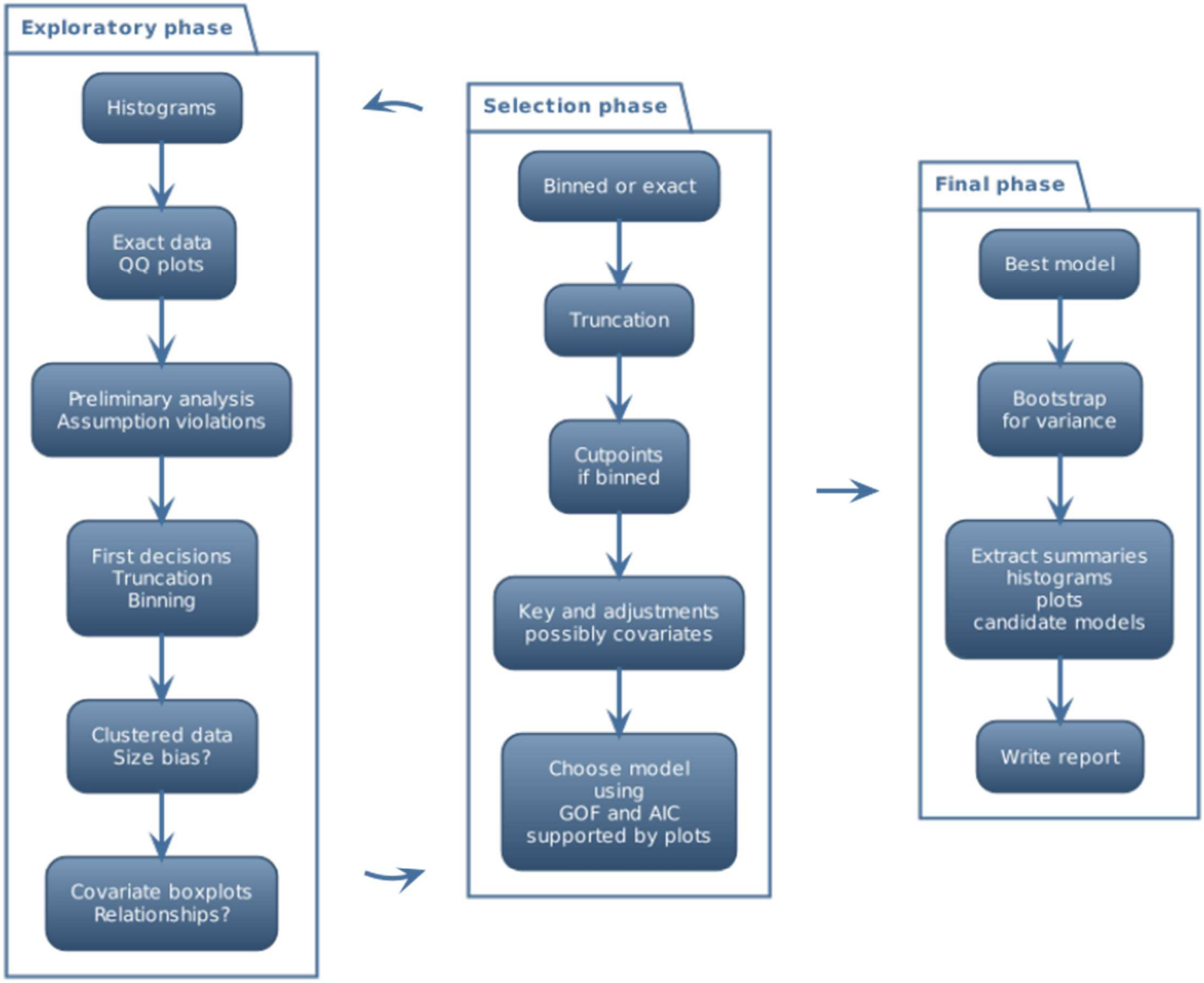
- Section 2.5 of Buckland et al. (2001) Introduction to Distance Sampling
- Thomas et al. (2010) Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology 47:5-14.

Analysis hints

This is not a cookbook

Do not simply use the function defaults in the software

The art of model selection



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