Survey design

• Introduction
• Point transect designs
• Line transect designs
• Stratification

See
• Chapter 7 of Buckland et al. (2001) Introduction to Distance Sampling
• Chapter 2 of Buckland et al. (2015) Distance Sampling: Methods and Applications
Survey design – things to consider

• What are your objectives?
• What precision do you need?
• What resources are required?
• Are sufficient resources available?
• Include training in the costings.
• Cost for statistical advice!!
• Conduct a pilot survey.
Line or point placement

• Use randomly positioned lines or points, or a systematic grid of lines or points, randomly superimposed on the study area.

• **Do not** use roads, tracks, etc.

• Stratify the study area if strong differences in habitat or density are apparent.

• Aim to orientate lines perpendicular to density contours or to linear features (e.g. woodland edge).

• Many short lines are preferred to a few long lines.
Point transect survey design
Simple random sampling without overlapping plots: use a grid of squares of side $2w$
Points along lines:

Left-hand design: the lines should be taken as the sampling units,

Right-hand design: the individual points can be taken as the sampling units
Line transect survey design
Simple random sampling without overlapping strips: use a grid of rectangles width $2w$ and length $l$.
A systematic segment design

(See later lecture for strategies to deal with segments that intersect the study area boundaries ("edge effects").)
A circuit design

(Again, see later for how to deal with edge effects.)
Saw-tooth or zigzag designs
Corners in saw-tooth and circuit designs:

Animal X is detected in trapezium A, so is associated with line segment B.
Right-angle corners:
Designing an inshore survey
Iceland – aerial survey design, whale survey
Actual effort, Icelandic whale survey
Stratification (Geographic)

Why stratify?

- To improve precision.
  - *Estimate inter-stratum differences rather than have them contribute to variance.*
  - *Reduce overall variance by increasing effort in strata which contribute most to variance.*
- Because want estimates by sub-region/stratum.
- For logistic reasons
Stratification (Geographic)

What to stratify?

- Encounter rate: Density often varies spatially.

- Detection function: May vary spatially. There are often sample size limitations on stratified estimation (too few detections in some strata).

- Mean cluster size: May vary spatially. There may be sample size limitations on stratified estimation.

NB: If any of the above are estimated by pooling across strata, when in reality they differ between strata, within-stratum estimates are biased.
• Most animals between 200m and 2000m contours, so put more effort into a shelf-edge stratum?

• But:

• Sample size too low in other strata?

• Other species?
Most animals between 200m and 2000m contours, so put more effort into a shelf-edge stratum? But:
Sample size too low in other strata?
Other species?

Stratification (Spatial)
Optimal effort location for one species may be poor for another species.

Uniform effort across strata is often a good design for multi-species surveys. Pooling robustness is lost if coverage differs among spatial strata.