

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*

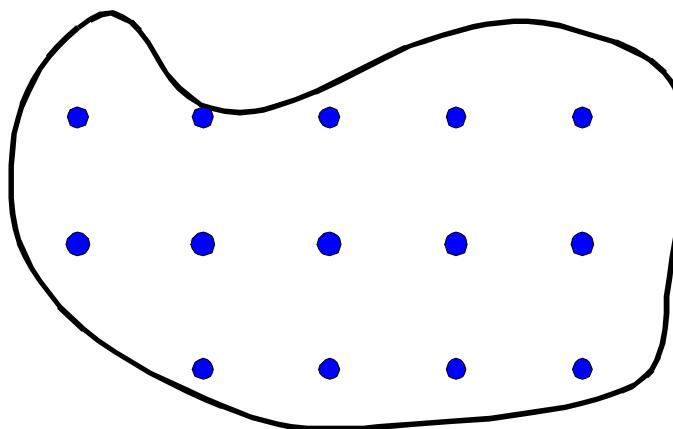
Survey design – things to consider

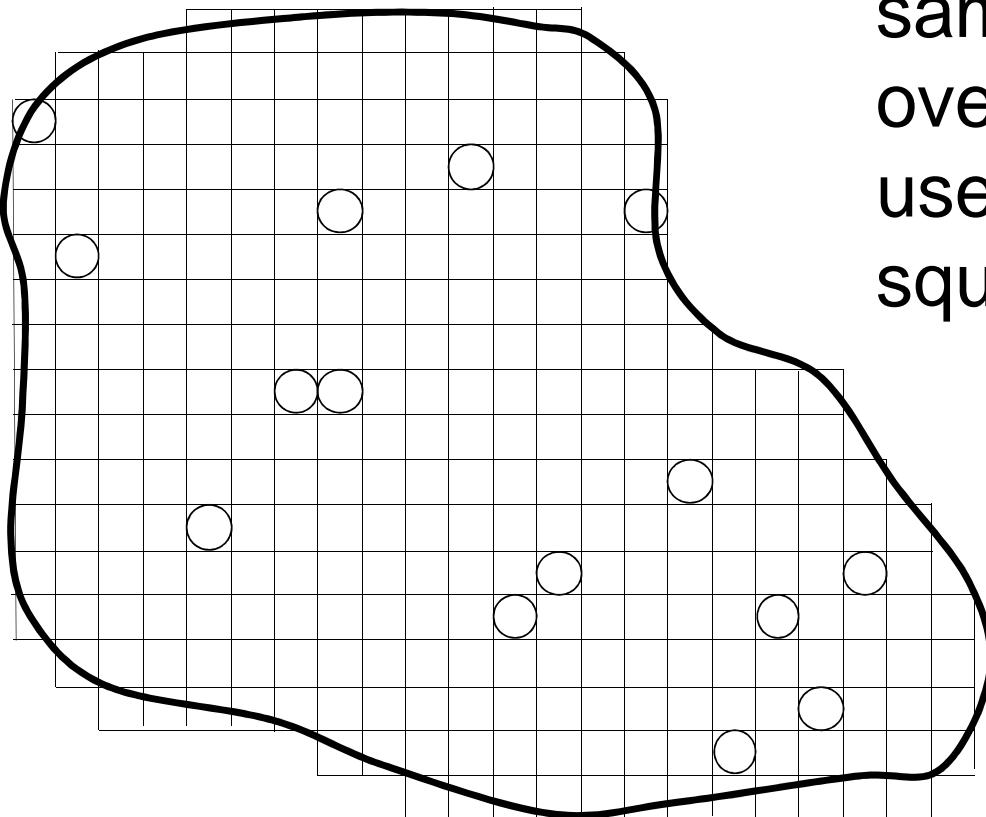
- What are your objectives?
- What precision do you need?
- What resources are required?
- Are sufficient resources available?
- Include training in the costings.
- Cost for statistical advice!!
- Conduct a pilot survey.

Line or point placement

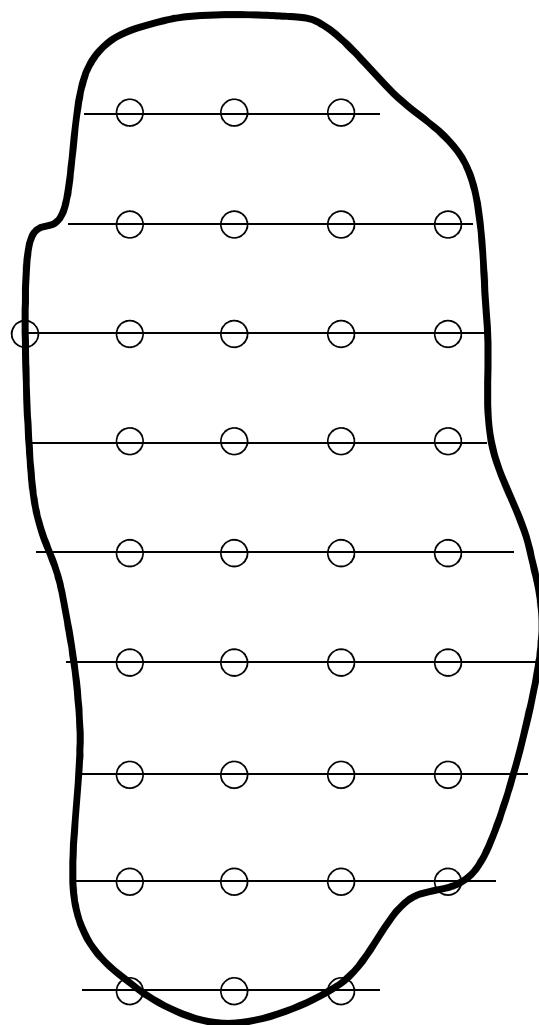
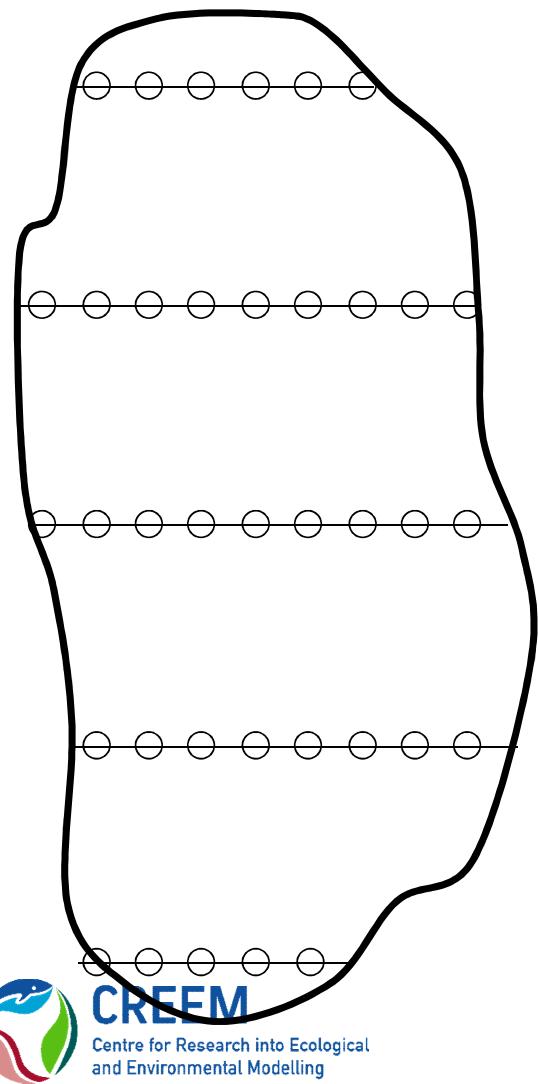
- Use randomly positioned lines or points, or a systematic grid of lines or points, randomly superimposed on the study area
- **Do not** use roads, tracks, etc.
- Stratify the study area if strong differences in habitat or density are apparent
- Aim to orientate lines perpendicular to density contours 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 $2w$

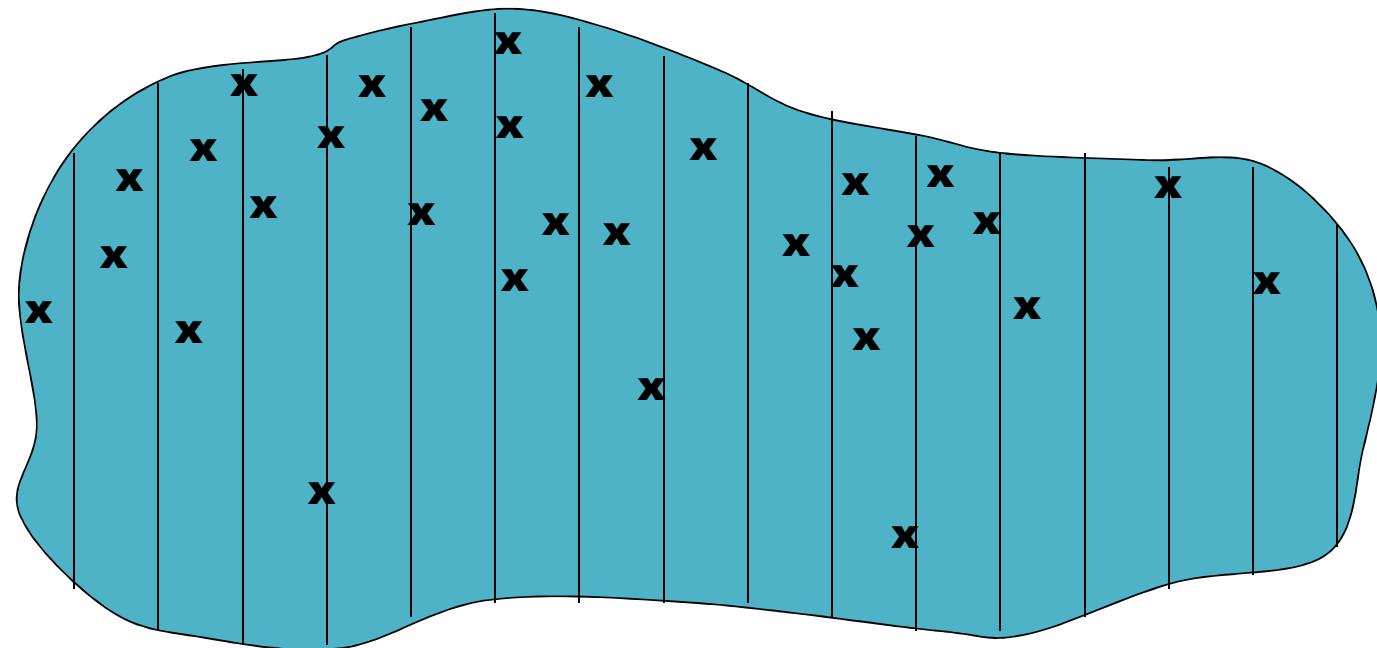


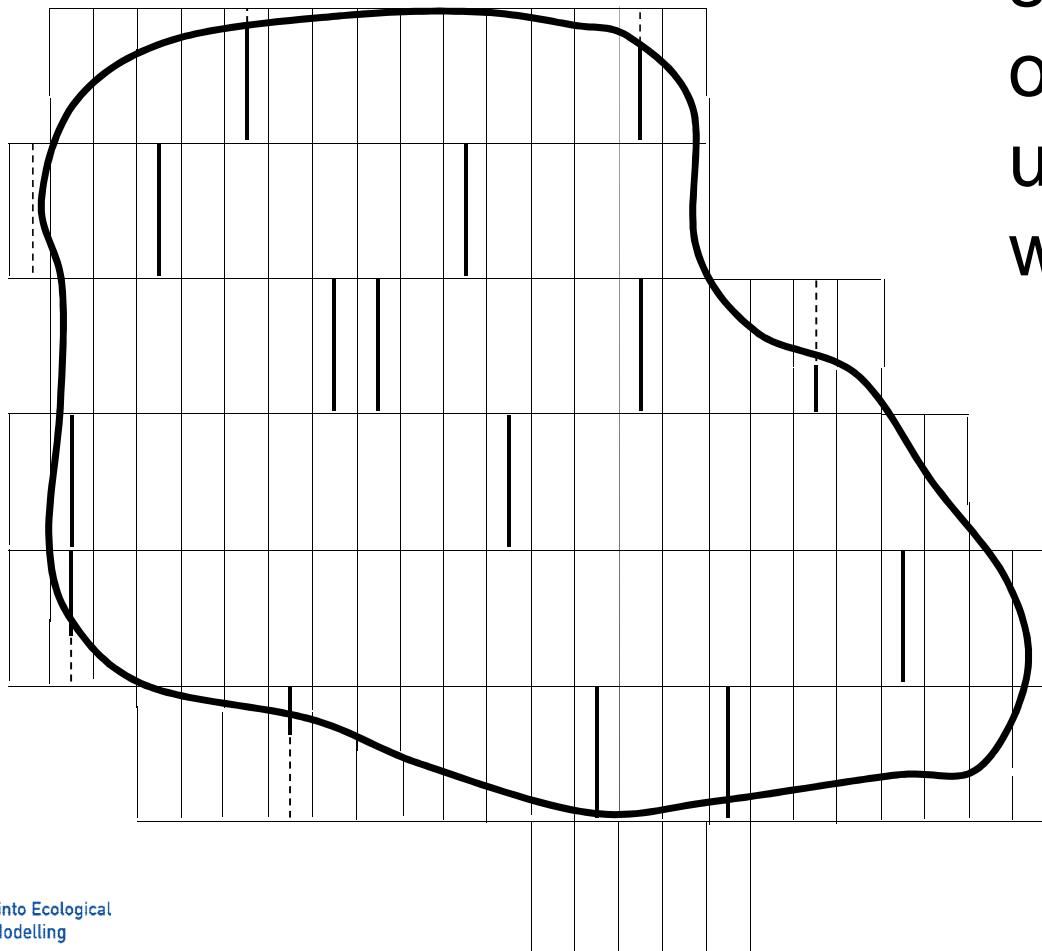
Points along lines:

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

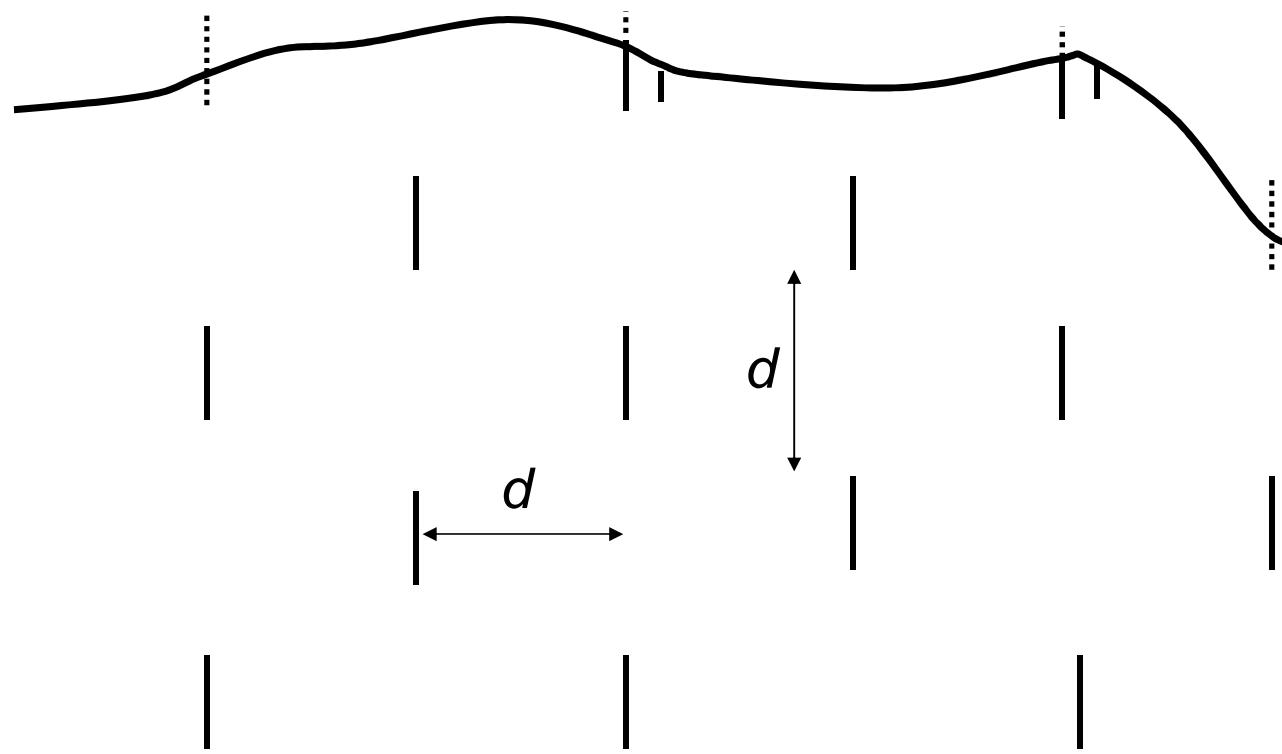
Line transect survey design





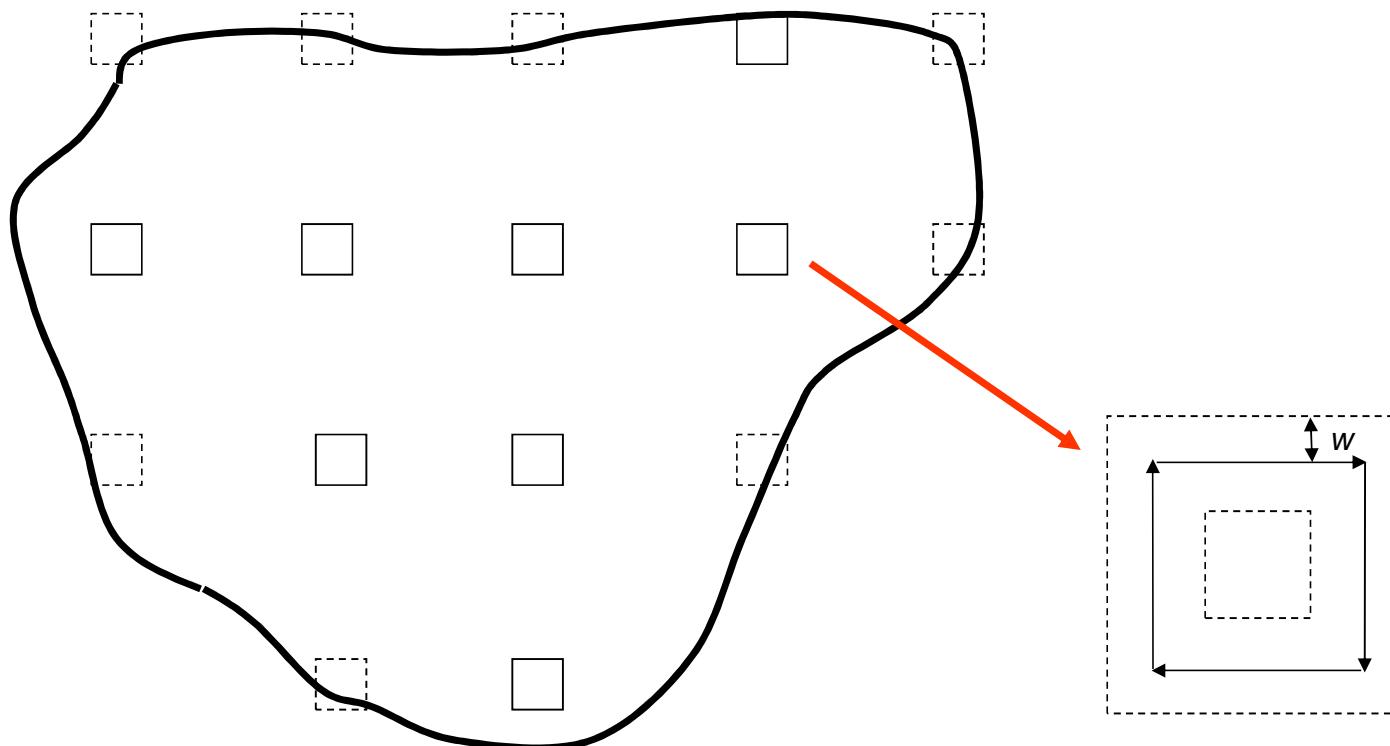
Simple random sampling without overlapping strips:
use a grid of rectangles width $2w$ and length l

A systematic segment design



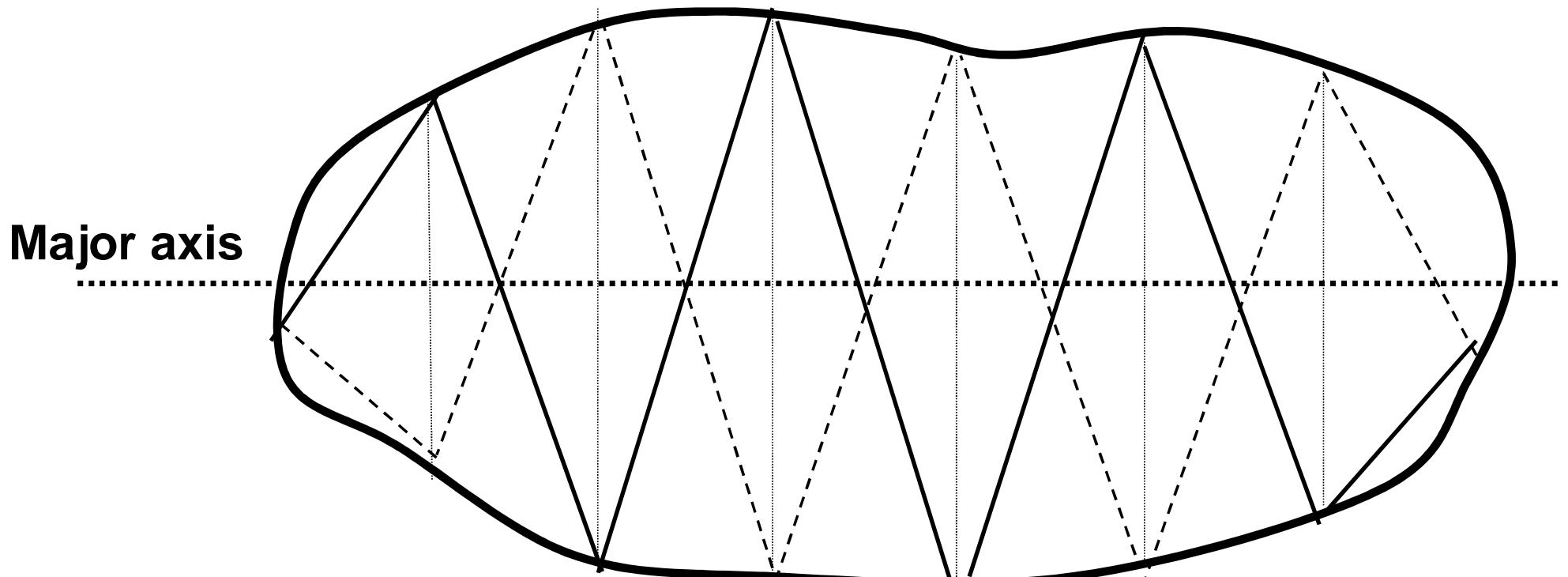
(See later lecture for strategies to deal with segments that intersect the study area boundaries (“edge effects”).)

A circuit design



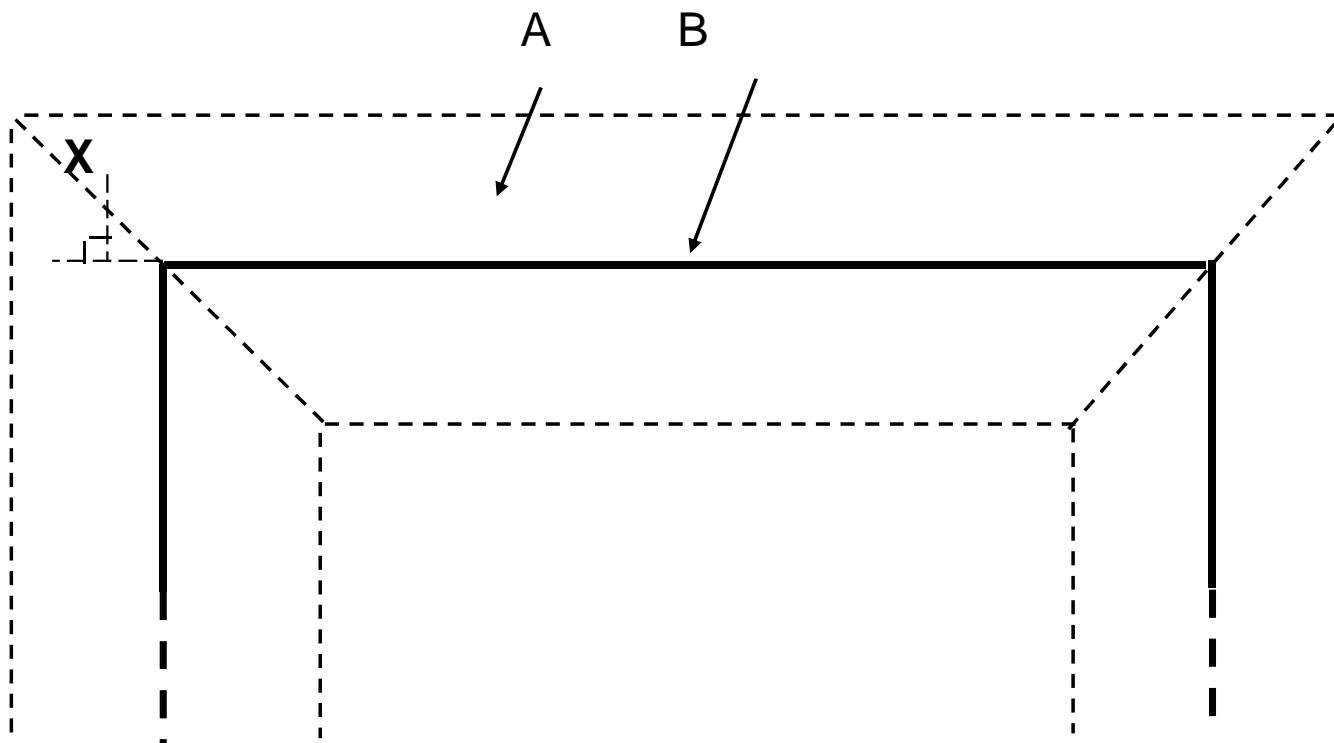
(Again, see later for how to deal with edge effects.)

Saw-tooth or zigzag designs

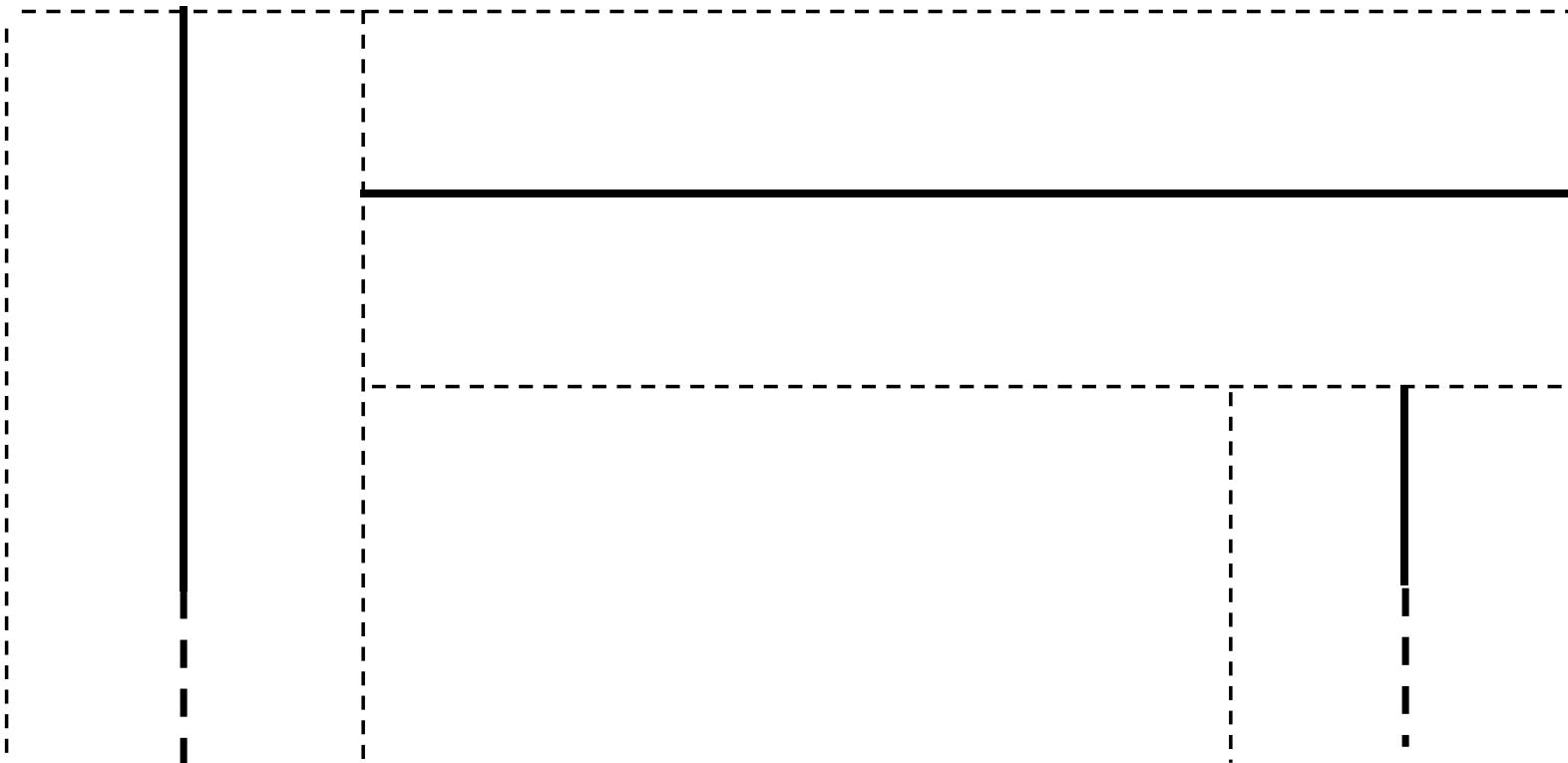


Corners in saw-tooth and circuit designs:

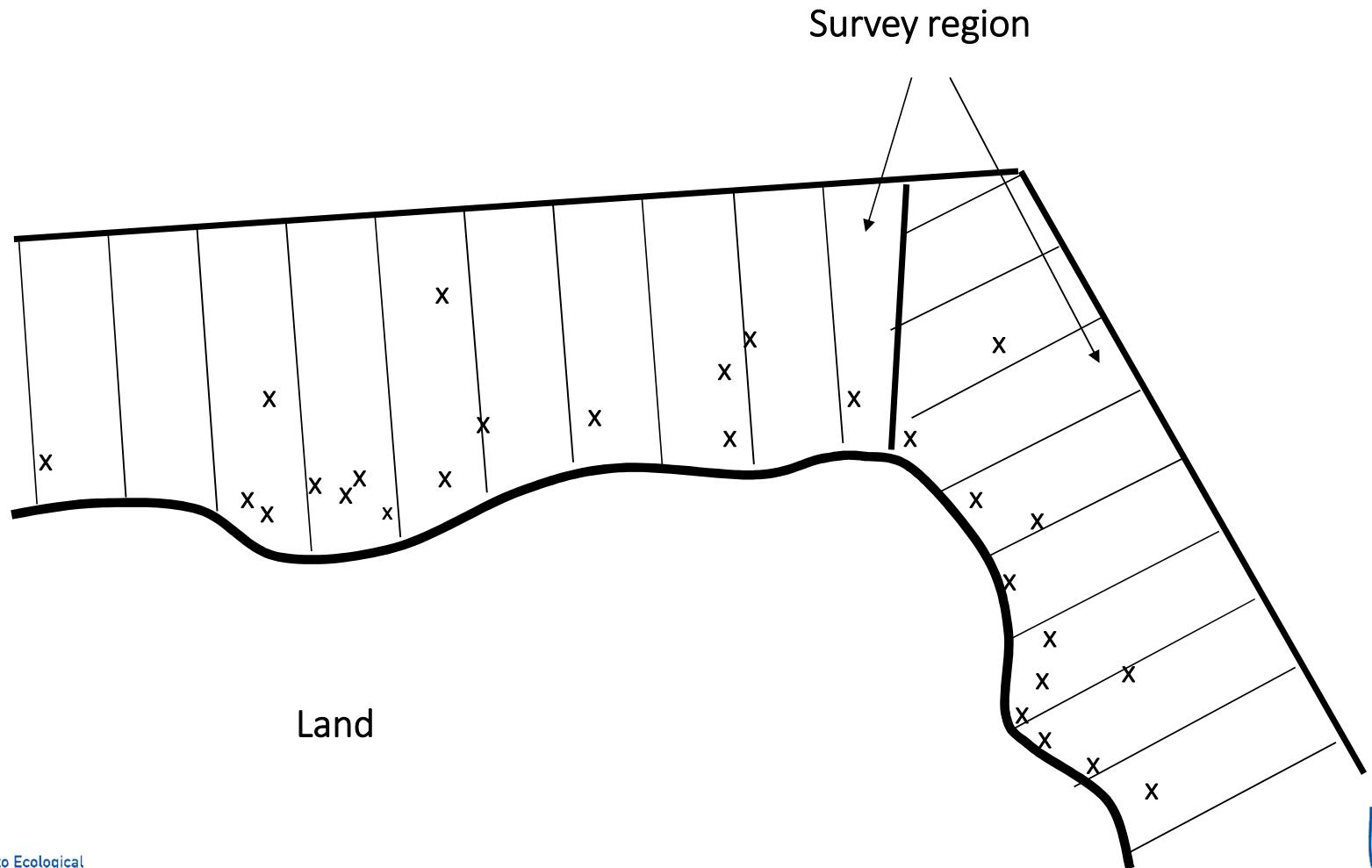
Animal X is detected in trapezium A, so is associated with line segment B



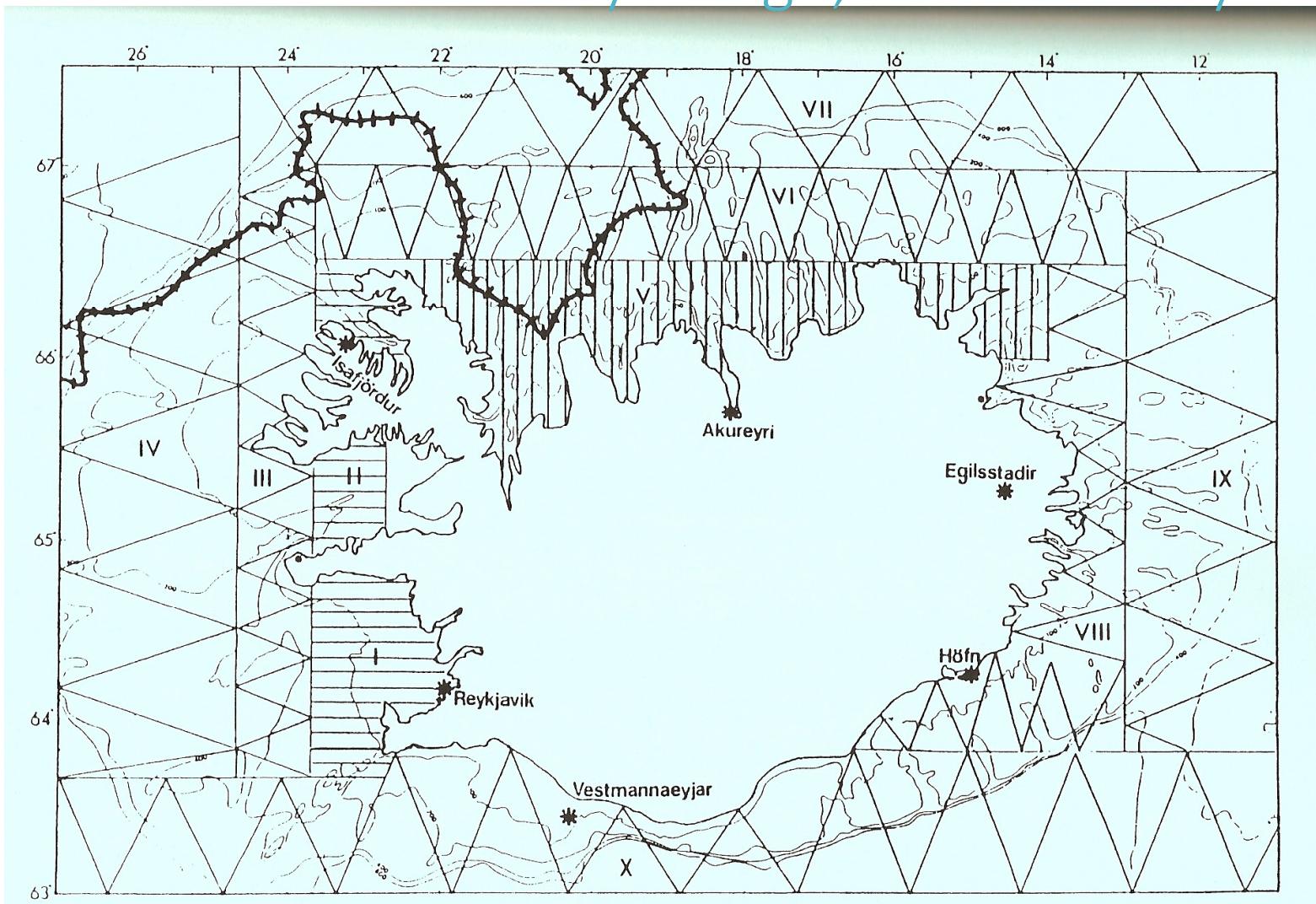
Right-angle corners:



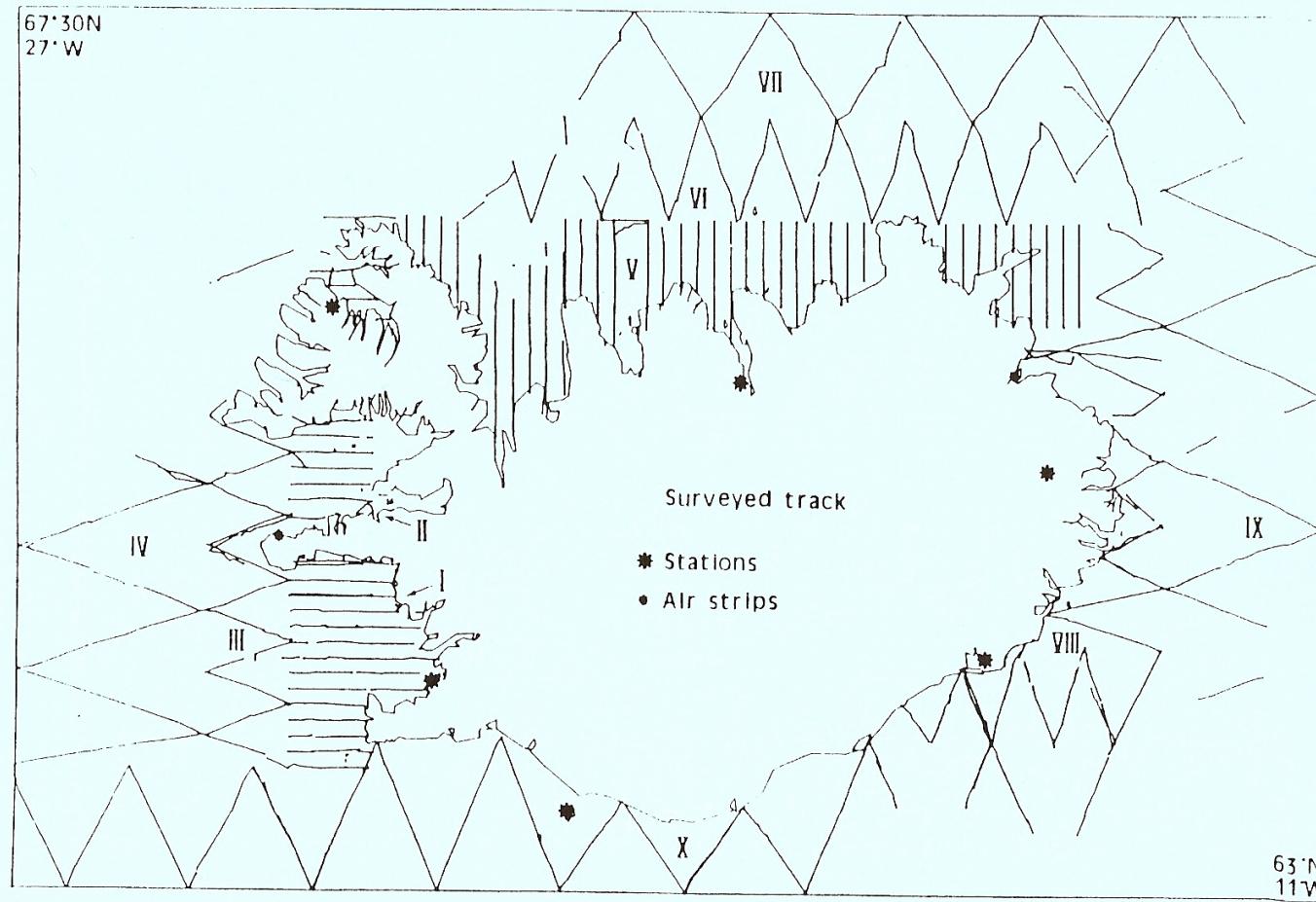
Designing an inshore survey



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

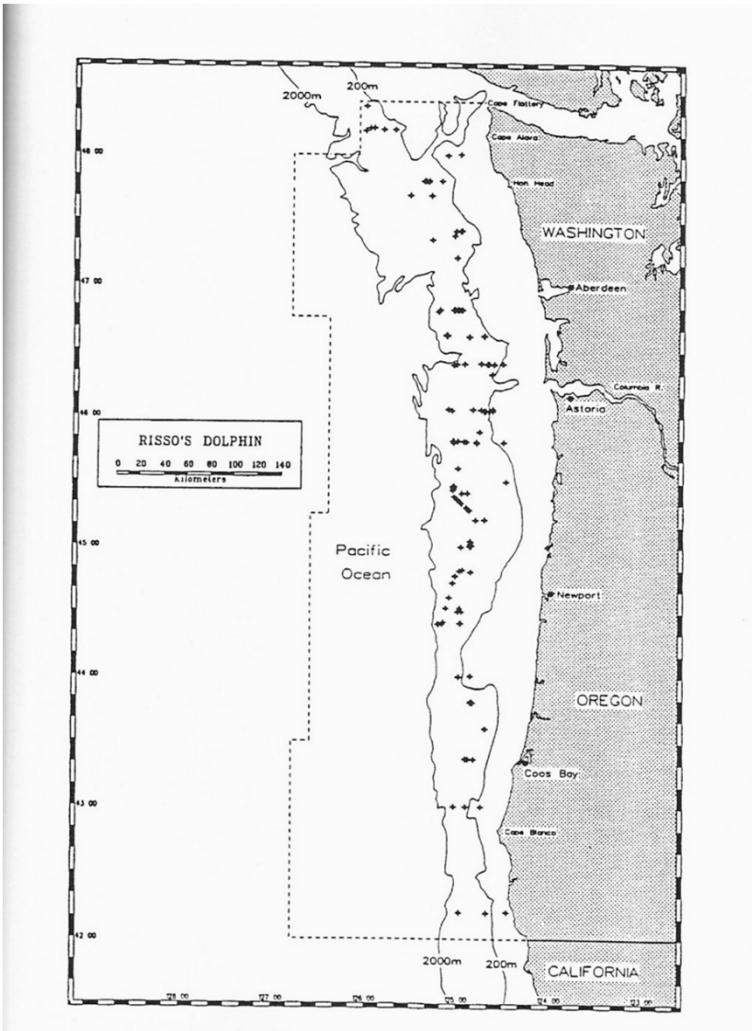
Stratification (Geographic)

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.

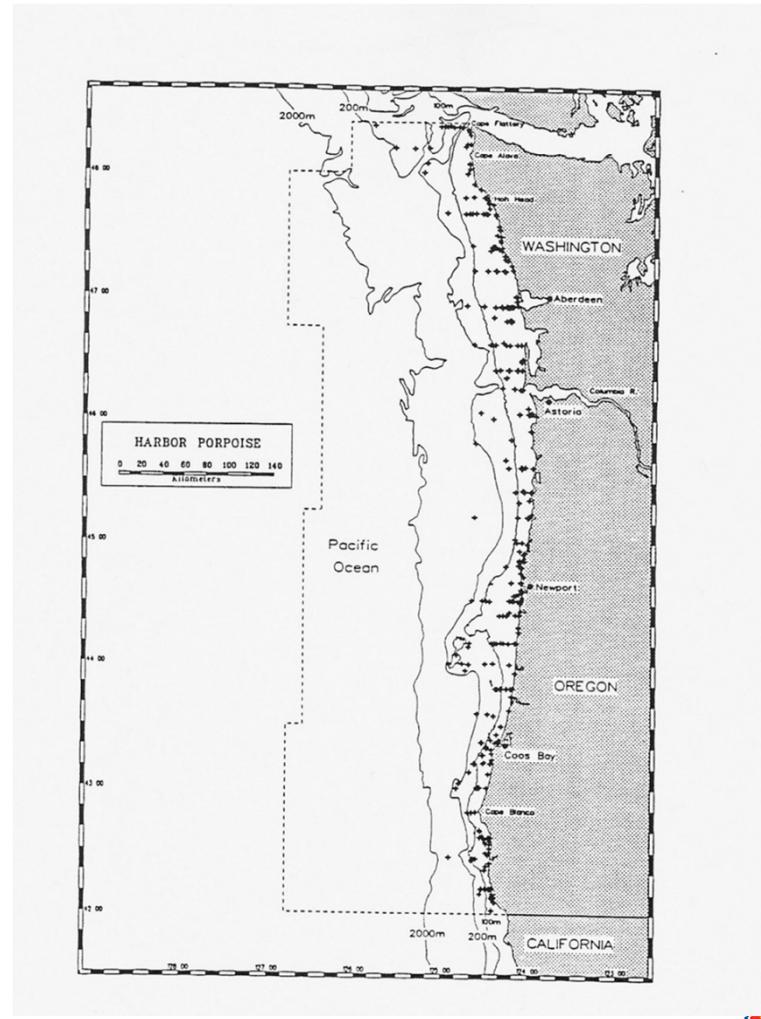
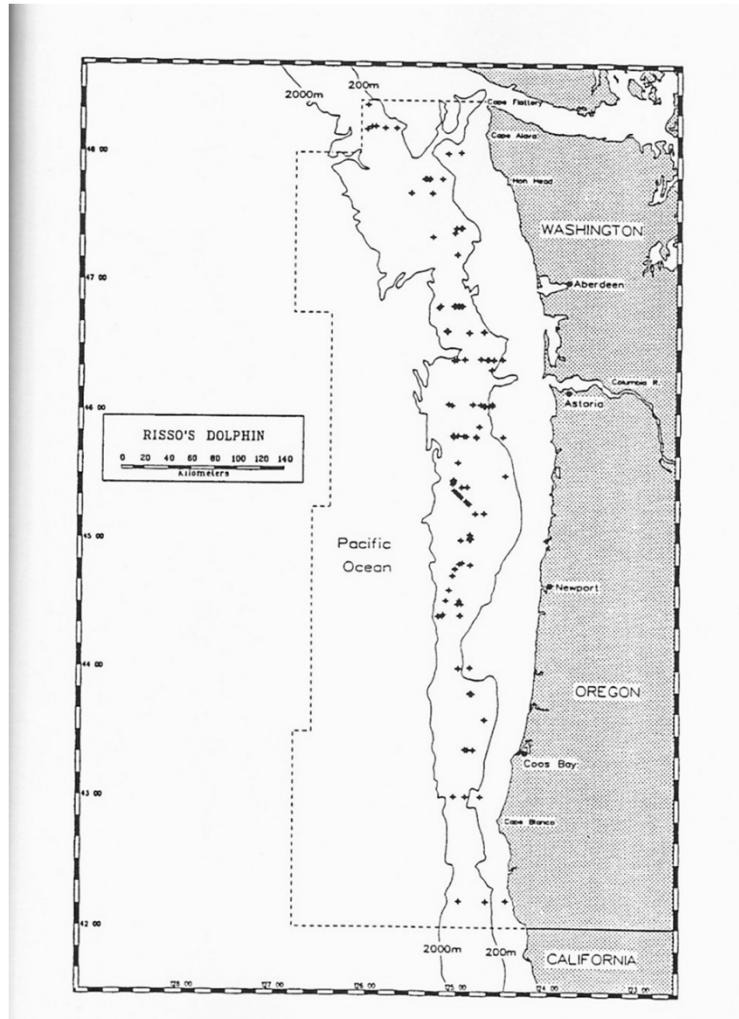
NB: If any of the above are estimated by pooling across strata, when in reality they differ between strata, within-stratum estimates are biased.

Stratification (Spatial)



- 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)



Stratification (Spatial)

