Approach to Field Research
Data Generation and Field Logistics
Part 1

Lecture 3
AEC 460

Road Map
How we do ecology
Part 1
- Recap
- Types of data
- Sampling – abundance and density methods
Part 2
- Sampling design
- Accuracy and precision

Observations, questions, hypothesis, predictions, models, oh my!
- Common ecological patterns includes spatial and/or temporal changes in a trait of interest (a variable)

- **Variable** – characteristic or parameter that differs among individuals or location

- Observed variation... what questions do you ask?

Observations to Hypothesis
- Generate a plausible explanation for the observed variation...

- Examples of questions and correct hypotheses from your work...

- Remember to make it more specific than general...

- Your hypothesis may describe a mechanism, but ideally it has an independent and dependent variable
Predictions

• If this hypothesis is true then...
• Many of your hypotheses were actually predictions
• Make sure it is specific to the hypothesis and not a list of outcomes
• Future tense...
• Examples from your work...

Home Ecology

Sampling...

Formal process...

• Perceive the problem
• Define the variable(s) to be studied
• Define the universe of interest
• Design the collection of data to address problem
• Obtain representative samples
• Objectively analyze the data
• Interpret and draw conclusions
• Report the findings
Data Collection and Analysis **Statistics**

- Statistics: numerical data assembled and classified so as to present significant information
- Statistics provide formal objective means to test models – hypothesis testing
- Statistical significance does not equal biological significance

**Sampling**

**Estimating Population Parameters**

- Usually interested in entire population (all elements of universe of interest)
- Can’t usually measure entire population
- Instead take a sample
  - Measure a small proportion of total population
- From the sample, we infer the population parameters

**Sampling and inference...**

To infer population characteristics, must have proper sampling

- Samples must represent the whole (make sure you define your sample and the whole)
- Need replicate samples – increases precision of estimate and better represents the whole – how many???
- Random sampling – a sample taken with no bias
- Systematic or planned sampling
- Controlling additional variables (similar sized samples, plots; stratified sampling)

**Random Sampling**

- *On average*, each individual has an equal and independent chance of being sampled
- Random samples are not always representative

*This sample is not representative of the population*
*This happens by chance*
Random Quadrat Selection

- Divide area into, say, 1X1m grid
- Select random \((x, y)\) coordinates from random number table
- Entire area has equal probability of being selected

Multistage Random Sampling

- If population or area very large
- Can’t number each individual or quadrat
- Divide into sub-groups or areas
- Randomly select some sub-groups or areas
- Randomly sample within each sub-group or sub-area

Stratified Random Sample

When the population consists of a mixture of more than one element type

Can assure that the sample is representative of the population

Stratified Random Sampling

Stratify random sampling in proportion to the size of each of the elements...
Systematic Sampling
Systematic sampling is the selection of samples from a population according to a set schedule or plan.

In this case, every third item is systematically selected.

Potential Problem
If habitat structure coincides with systematic sampling scheme – leads to sample bias...

Ecological Field Sampling Methods
- Ecological distribution and abundance
- **Abundance** – number of individuals within an area
  - Example: 100 individuals in the study area
  - May be *relative* abundance
- **Density** – abundance expressed per unit area or volume
  - Example: 100 individuals in the 2.5 hectare study area = 40 per hectare
- **Dispersion** – spatial arrangement of individuals, number of individuals at particular data points
- Important to define area as useable area

Habitat Characterization
- Where an organism lives – biotic and abiotic factors
- Important elements to define
  - Temporal
  - Spatial
  - Physical-chemical (Abiotic)
  - Biotic
- **DEFINE YOUR SCALES AND QUESTIONS WELL!!!!!!**
Biotic Elements
Abundance – what we measure!
• Density (abundance): numbers per unit area
• Index of density: used when difficult to get accurate count – requires standardized counting method
• Frequency: number of samples in which species occurs. Example: 7 out of 10 samples had species – 0.7
• Biomass: weight of individual per unit volume or area
• Coverage: proportion of ground covered by a perpendicular projection (clumped versus spread plant)

Sampling Methods for Abundance
• Quadrat Counts, Belt Transects
  – Mostly used with plants
  – Sampling within an area
• Line-intercept transects
  – Mostly used with plants
  – Measure of cover along a line
  – Relative measure
• Strip Census
  – Mostly used with animals
  – Census along a line
  – Usually a relative measure unless strip width known
• Line Transects and Distance Sampling
  – Mostly used with animals
  – Sampling along a line
  – May be absolute or relative

Quadrat Counts
Some Basic Considerations...
• Counts of all individuals within a quadrat of known area
• Provides an absolute density sample

Considerations
• The Edge Effect
• Shape of Quadrat – can minimize edge effect
  – Ratio of edge:area
• Size of Quadrat
• Consideration: practicality

More Quadrats and Such...
Belt Transects
• Belt transect
  – Long strip in which all individual organisms counted
  – Knowing length and width = density
  – Essentially a long skinny quadrat
Quadrats and Frequency Counts

- Can use quadrats to calculate frequency
- Frequency = proportion of quadrats that contained at least ONE individual of species
- Provides quick and dirty relative measure, not absolute density

Quadrats and Percent Cover Measurement

- Use quadrat with internal cross-grid
- Enumerate species at each cross
- Can also be used with photo plots

Line Intercept Method

- Line Intercept
  - Useful for common sessile species
  - Commonly used for plants
  - Line cut across habitat

Record species at each random point location
Line Intercept Method

Count only those individuals touching the line

Line Intercept Method
Can also be used to estimate percent cover
Estimate cover of plants or sessile species

Record distance along transect line covered by species of interest

Percent Cover = \frac{\text{Length covered by species of interest}}{\text{Length of sampling line}}

Line Intercept Method
How to deal with under/overstory
Line Intercept
To Estimate Density

- For grasses and clumps of small plants, measure the base of the clump near ground level

Transects
Strip Census and Line Transect

- Useful when plots not feasible
  - Species rare or plots need to be too large
- Strip Census and Line Transect
  - Useful for rare mobile species
  - Move along line and count individuals encountered
  - Provides relative count – number of individuals per distance censused
  - Difference in relative and absolute (if strip width is known or for line transects, see lecture notes for details)

Detection function

Small Critter Sampling
Relative Abundance Measures

- Pitfall traps
- Drop boards
- Sticky traps
- Pellet counts
- Track counts
- Point surveys
- Trapping – number caught/effort unit or mark & recapture
Mark/Recapture Assumptions

- Equal and independent chance of capture
- No change in ratio of marked to unmarked animals (immigration, emigration, death)
- Marked animal distribute themselves homogeneously with respect to marked ones

What’s due and what to do before Thursday...

Due Today:
- Proposal
- Map of YMP

For Thursday:
- Look at my comments and make revisions to your plan (if needed)
- Make any sampling sheets or data sheets you need in your note books or a separate sheet; have your random numbers, etc. etc.

Thursday Logistics

- Meet up at the lab, pick up your gear
- Leave for YMP at 8:45
- You will have only the time of the class to complete your study...
- Leave YMP at 12:30