10: Plant Community Monitoring

Session Objectives

- Distinguish univariate from multivariate datasets.
- Identify three alternatives to multivariate monitoring.
- Conceptually describe multivariate data analysis and appropriate tools.

Session Outline

Community definitions
Univariate *vs.* multivariate data
Surrogates for multivariate monitoring
Multivariate monitoring

In this section of the binder

10.1 What is a Community?
10.2 Univariate *vs.* Multivariate Data
10.3 Why is it Sometimes Hard to Monitor Communities?
10.4 Three Surrogates for True Multivariate Monitoring
10.5 Qualities of a Good Indicator
10.6 Multivariate Monitoring

Exercise *10a:* Applications for Community Monitoring

Related technical reference chapters and appendices

Chapter 8: Field Techniques for Measuring Vegetation, *Sections A-D*
BLM Technical Reference: "Interpreting Indicators of Rangeland Health," 2000
BLM Technical Reference: "Proper Functioning Condition for Streams," 1998

What is a Community?

Community:

The naturally occurring assemblage of populations living in the same general place and time. Community may refer to all species in the assemblage or a subset, such as the plant community (*e.g.*, spruce-fir forest) or the neotropical bird community.

- Noss *et al.* 1997 from The Science of Conservation Planning, Island Press

Community:

The ensemble of species in some area whose limits are determined by the practical extent of energy flow. The key to determining community limits is to identify boundaries, manifest as interspecific interactions broadly defined, by documenting where the population dynamics of a species in an ensemble (including indirect and cascading effects) are unaffected by each other.... Such a definition may include a large number of species, so much so that critics might plead unwieldy complexity. However, nature proceeds without regard to human logistical and analytical sophistication.

- Drake 1990, from *Communities as assembled structures: do rules govern pattern?* Trends in Ecological Evolution 5:159-164

Univariate *vs.* Multivariate Data

Univariate Example

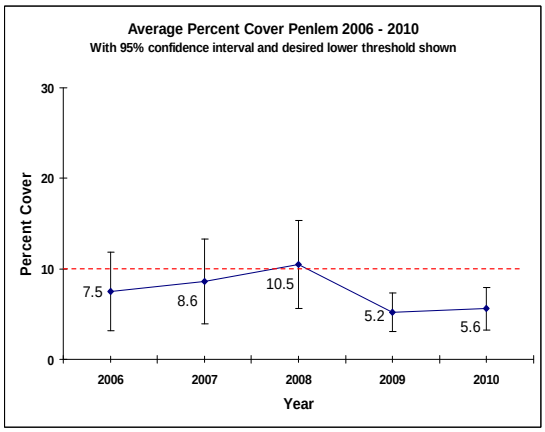
2006 Dataset:

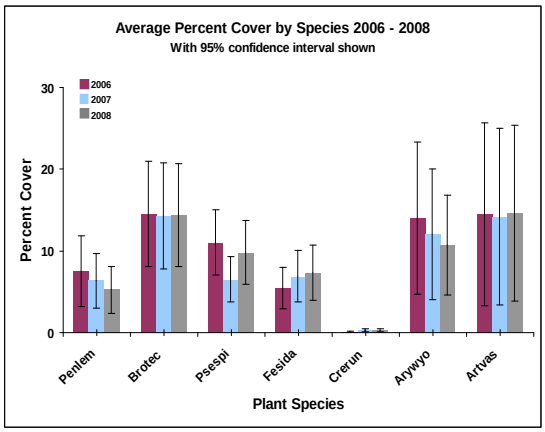
Sampling Unit	1	2	3	4	5	6	7	8	9	10
Penlem Cover (%)	0.5	10	3	15	5	20	15	0.5	3	3

Multivariate Example

2006 Dataset:

Sampling Unit	1	2	3	4	5	6	7	8	9	10
Plant Cover by Species										
Penlem Cover (%)	0.5	10	3	15	5	20	15	0.5	3	3
Brotec Cover	35	25	10	15	15	20	5	0	15	5
Psespi Cover	15	10	20	15	5	5	0.5	10	10	20
Fesida Cover	5	5	3	0.5	3	3	5	10	15	5
Crerun Cover	0.5	0	0	0	0	0	0.5	0	0	0
Arywyo Cover	15	5	45	5	0	0	35	15	15	5
Artvas Cover	0	15	15	0	0	15	0	10	35	55
Environmental Indices										
Shade	0	0	2	0	1	1	0	0	0	1
Soil Moisture	0	0	2	2	5	1	1	0	0	1





Why is it Sometimes Hard to Monitor Communities?

General:

- Identifying boundaries can be difficult
- Community classifications are heavily scale-dependent
- Community classification schemes are often based on subjective thresholds
- Developing a ecological model for an entire community is difficult-to-impossible

"All-species" (Multivariate) Monitoring Approaches:

- A monitoring design cannot be optimal for all species
- Observer bias in "all-species" monitoring efforts is very high
- Data collection and analysis are expensive
- Some species are extremely difficult to detect
- Management objectives are difficult to establish
- There's a lack of sampling design guidelines for multivariate monitoring
- Different measures (e.g., density, cover, frequency, biomass) will yield different results
- Results are often hard to interpret

Three Surrogates for True Multivariate Monitoring

I. Univariate

A. Proxies/indicators

B. Structural characteristics

C. Guilds and functional groups

D. Classification schema

II. Qualitative

A. Site condition assessment

B. Boundary mapping

C. Photomonitoring

D. Aerial photography / satellite imagery

E. Species checklists

III. Indices

A. Diversity indices

B. Special-interest indices

C. “Biotic Integrity” indices

Qualities of a Good Indicator

Sensitive to management

Corresponds to management goals

Large response to management

Convenient and inexpensive to monitor

Observer-bias resistant

Multivariate Monitoring

- **If at all possible, reframe the question as univariate, qualitative, or index**

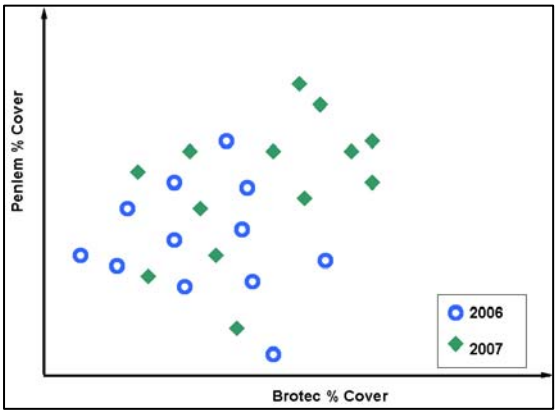
- **If you *must* track several taxa separately, the simplest analysis treatment is to analyze trends separately for each taxon**

- **Some monitoring questions truly are multivariate in nature**

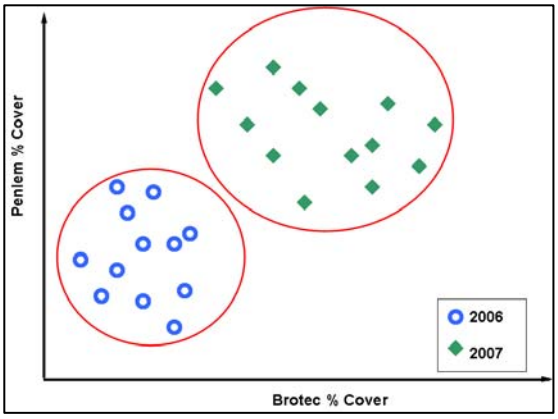
  First, define and measure the compositions of the species of interest, usually cover or biomass

  Then, compare composition at Time 1 and composition at Time 2

Ordination Example 1:



Ordination Example 2:



- **Cautions:**

  Different measurements (cover, frequency) yield different results

  Defining a "significant" threshold difficult

  Sampling design: you're on your own

  Interpretation difficult