

Data Analysis Approaches for developing ESD's

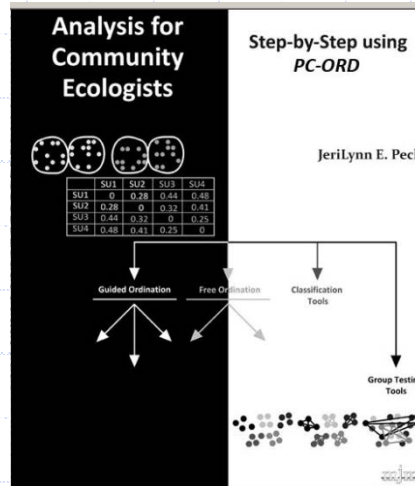
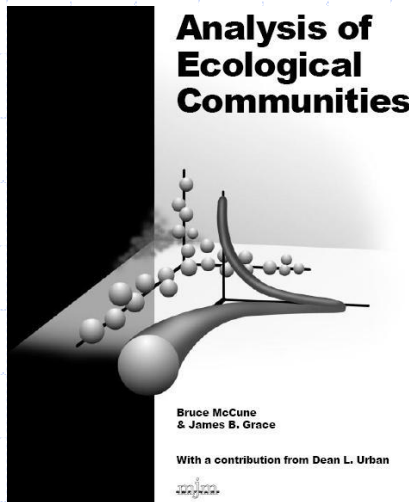
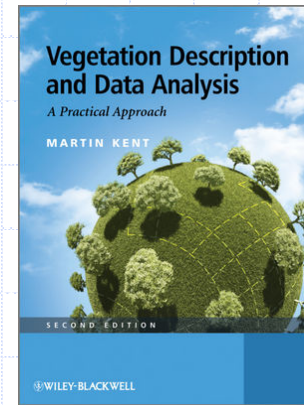
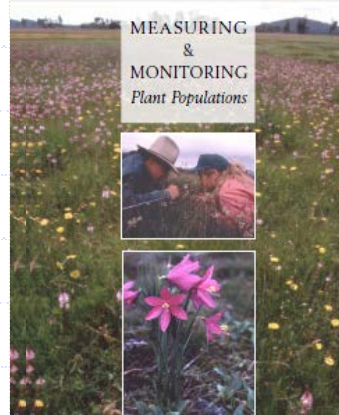
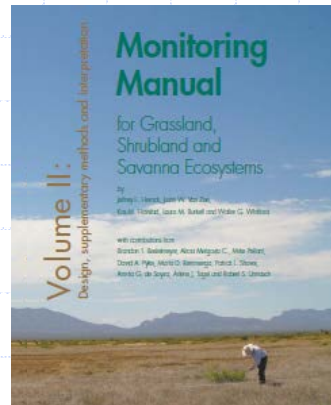
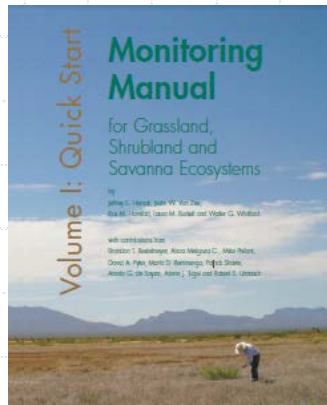
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Ecological Criteria: ESD's

- Grazingland landscapes are often a complex mosaic of geology, topography, soils, plants, and climate. Organizing this information into sites with some common ecological basis is the precursor to formulating ecological sites.
- The classification of rangeland Ecological Sites and pastureland Forage Suitability Groups are based on different criteria. Rangeland ESD's are a classification concept based on stands of native plants with similar climate, soils, and hydrology that occurs in a relatively repeated fashion across a landscape. In contrast, FSG's are based on landscape, soil, and environmental properties. Adaptable forage species are correlated with these groups.

Manuals and Knowledge



Sources of Data

- Old archived range 417 data
- New field data
- On-site NRI data
- Other sources

Analysis Approaches

- Univariate, examining one variable at a time.
- Central Tendency (means, median, ranges, standard deviations, confidence intervals).
- Multivariate analysis.

MLRA 53B Loamy ESD, North Dakota

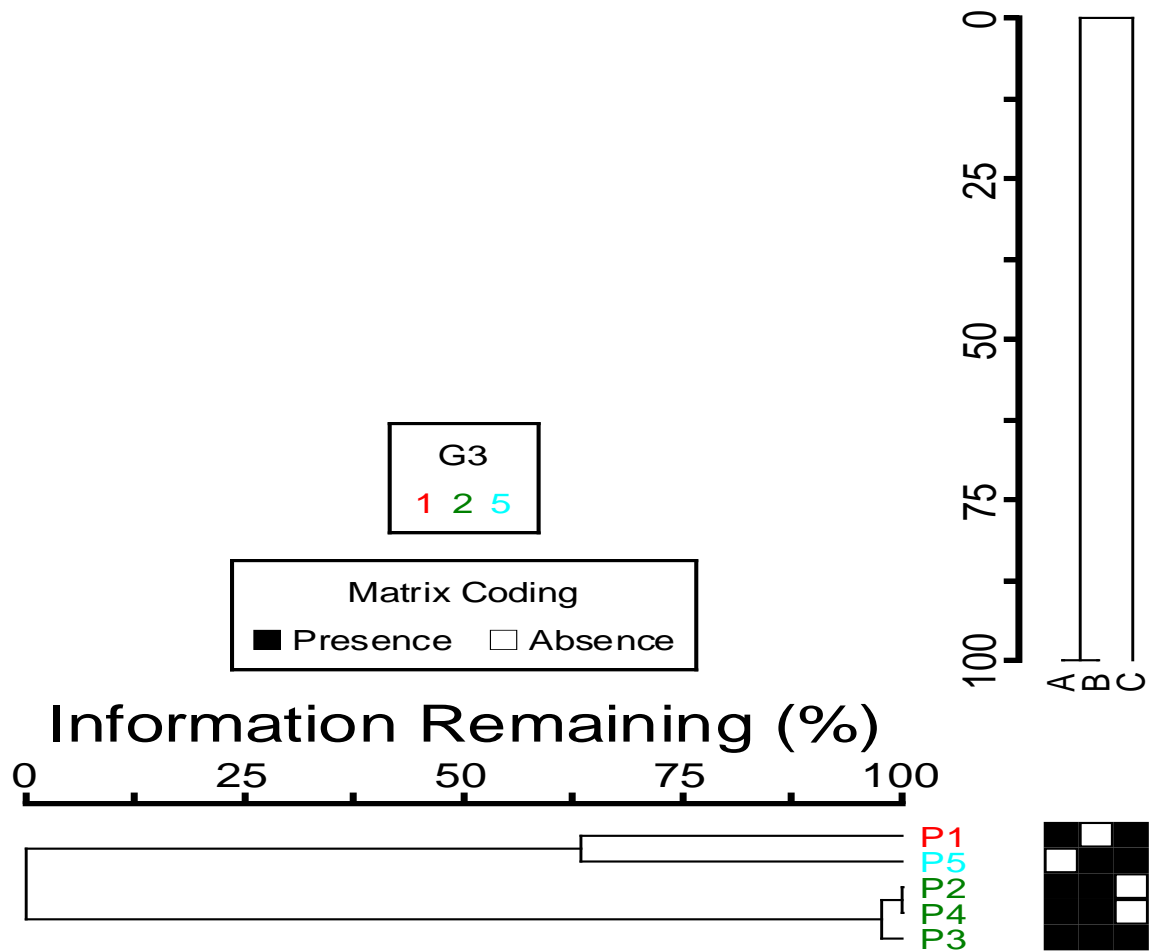
Variable	N	Min	Max	Range	Mean	Median	Std Dev
slope	68	0.8	22.0	21.2	7.1	6.0	4.8
similarity_index	68	1.0	75.1	74.1	31.9	30.3	17.3
cc_pct	68	0.6	1.0	0.4	0.9	0.9	0.1
bg_pct	68	0.0	0.3	0.3	0.1	0.1	0.1
richness_a	68	4.0	30.0	26.0	13.7	13.0	5.6
prod dry_wt	68	505.4	7233.5	6728.2	2341.4	1984.0	1284.6

Class I							
Variable	N	Min	Max	Range	Mean	Median	Std Dev
slope	28	0.8	15.0	14.2	5.9	5.5	3.7
similarity_index	28	1.0	24.6	23.6	15.4	15.0	7.0
cc_pct	28	0.7	1.0	0.3	0.9	0.9	0.1
bg_pct	23	0.0	0.3	0.3	0.1	0.1	0.1
richness_a	28	4.0	24.0	20.0	11.5	11.5	5.4
tot_spp_drywt	28	801.3	7233.5	6432.2	2657.2	2039.7	1537.6
Class II							
Variable	N	Min	Max	Range	Mean	Median	Std Dev
slope	31	1.0	22.0	21.0	7.9	6.0	5.4
similarity_index	31	25.5	49.3	23.8	38.6	38.4	7.8
cc_pct	31	0.6	1.0	0.4	0.9	0.9	0.1
bg_pct	23	0.0	0.3	0.3	0.1	0.1	0.1
richness_a	31	7.0	30.0	23.0	14.3	13.0	5.1
tot_spp_drywt	31	505.4	4037.0	3531.7	1893.8	1734.5	845.3
Class III							
Variable	N	Min	Max	Range	Mean	Median	Std Dev
slope	7	5.0	17.0	12.0	9.9	9.0	4.6
similarity_index	7	51.2	73.0	21.8	59.4	58.4	7.5
cc_pct	7	0.8	1.0	0.2	0.9	0.9	0.1
bg_pct	6	0.0	0.2	0.2	0.1	0.1	0.1
richness_a	7	13.0	28.0	15.0	17.7	17.0	5.0
tot_spp_drywt	7	1423.2	4098.2	2675.0	2574.7	2298.6	1047.1

Limy Upland 30-36		mlra 76		Bluestem Hills			
Variable	N	Min	Max	Range	Mean	Median	Std Dev
slope	10	3.0	23.0	20.0	9.9	6.5	7.3
similarity_index	10	8.0	22.7	14.7	17.5	18.3	4.9
cc_pct	10	0.7	1.0	0.3	0.9	0.9	0.1
bg_pct	9	0.0	0.3	0.3	0.1	0.1	0.1
richness_a	10	7.0	22.0	15.0	15.2	14.5	4.9
tot_spp_drywt	10	416.4	2244.9	1828.5	1033.1	991.9	488.4
Variable	N	Min	Max	Range	Mean	Median	Std Dev
slope	8	3.0	24.0	21.0	11.8	9.5	8.1
similarity_index	8	26.4	49.9	23.5	40.1	42.0	8.2
cc_pct	8	0.6	1.0	0.4	0.8	0.9	0.2
bg_pct	8	0.0	0.4	0.4	0.2	0.2	0.1
richness_a	8	11.0	26.0	15.0	18.5	18.0	5.0
tot_spp_drywt	8	829.1	5201.0	4372.0	1618.0	1095.9	1476.9
Variable	N	Min	Max	Range	Mean	Median	Std Dev
slope	4	4.0	12.0	8.0	7.3	6.5	3.4
similarity_index	4	50.9	63.1	12.2	58.4	59.8	5.2
cc_pct	4	0.8	1.0	0.2	0.9	0.9	0.1
bg_pct	3	0.0	0.2	0.2	0.1	0.1	0.1
richness_a	4	13.0	19.0	6.0	15.8	15.5	2.5
tot_spp_drywt	4	854.0	2064.0	1210.1	1534.2	1609.5	511.6

Multivariate Approach

- Classification (*Cluster Analysis*) and Ordination, are multivariate techniques that can quantify patterns and trends in ecological data.
- Community ecologists have a long tradition of using ordination and classification as complementary methods for depicting vegetation pattern. Ordination provides a continuous model of gradient response, while classification highlights discrete community types or discontinuities in the data.

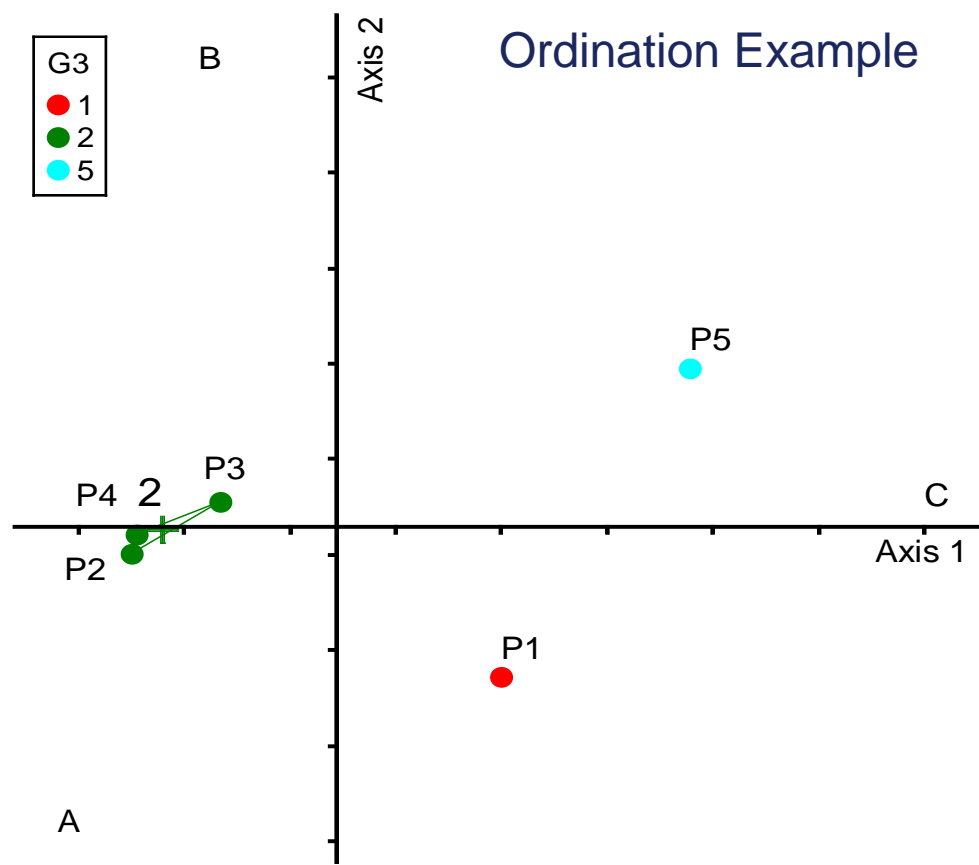


	Site 1	Site 2	Site 3	Site4	Site5
Spp A	2	5	5	3	0
Spp B	0	3	4	2	1
Spp C	2	0	1	0	2

Multivariate Analysis: Classification

Methods for Finding Groups

- ◆ 1) Vegetation and env. variables show endless variation in time and space (the continuum concept).
- ◆ 2) In order to study veg/env gradients, it is necessary to create order i.e., identify groups—Rangeland Ecological Sites, Pasture and Forage Suitability Groups, Habitat Types etc.
- ◆ In order to manage land effectively, some context of classification is necessary.
- ◆ Cluster analysis can be used to partition a data set into more homogeneous subsets, each of which can be studied in detail.



	Site 1	Site 2	Site 3	Site4	Site5
Spp A	2	5	5	3	0
Spp B	0	3	4	2	1
Spp C	2	0	1	0	2

Multivariate Approach: Ordination

- **Ordination** is the collective term for multivariate techniques that arrange data groups along axes on the basis of variables within the group.
- **The ordering** of a set of *data points* with respect to one or more axes. Displaying of a swarm of data points in a two or three-dimensional coordinate frame so as to make the relationships among the points in many-dimensional space visible on inspection.
- Ordination can be used to help generate hypotheses about the relationship between the groups.

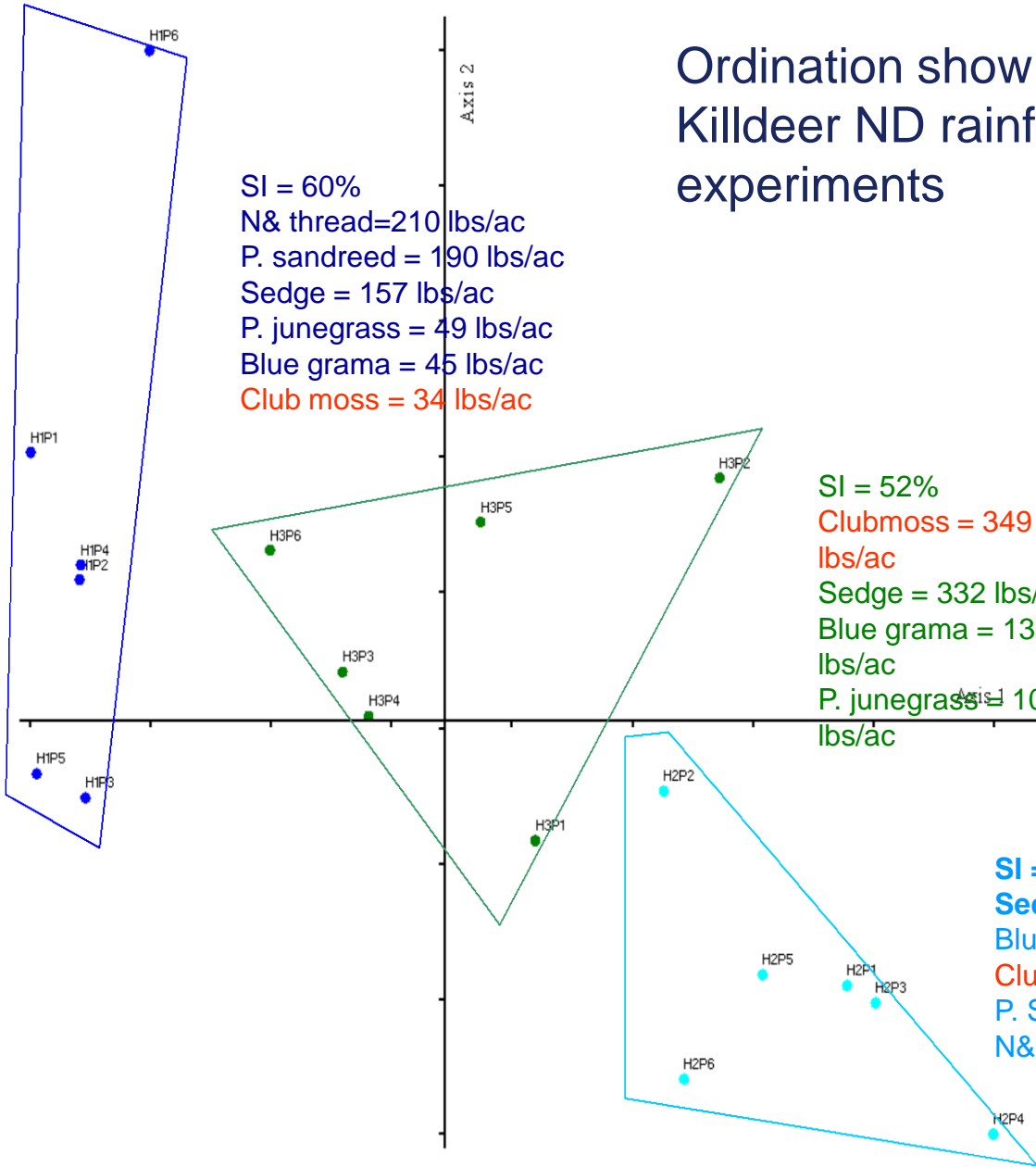
Ordination: Goals

- Show floristic relationships between stands of vegetation or between species. The distances between points on the ordination are measures of their floristic degree of similarity.
- Reduce noise (unexplained variation that masks the similarity relationships between species and/or plots)
- Discover the underlying structure of the vegetation data.



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Ordination showing 3 sites, 24 plots Killdeer ND rainfall simulation experiments

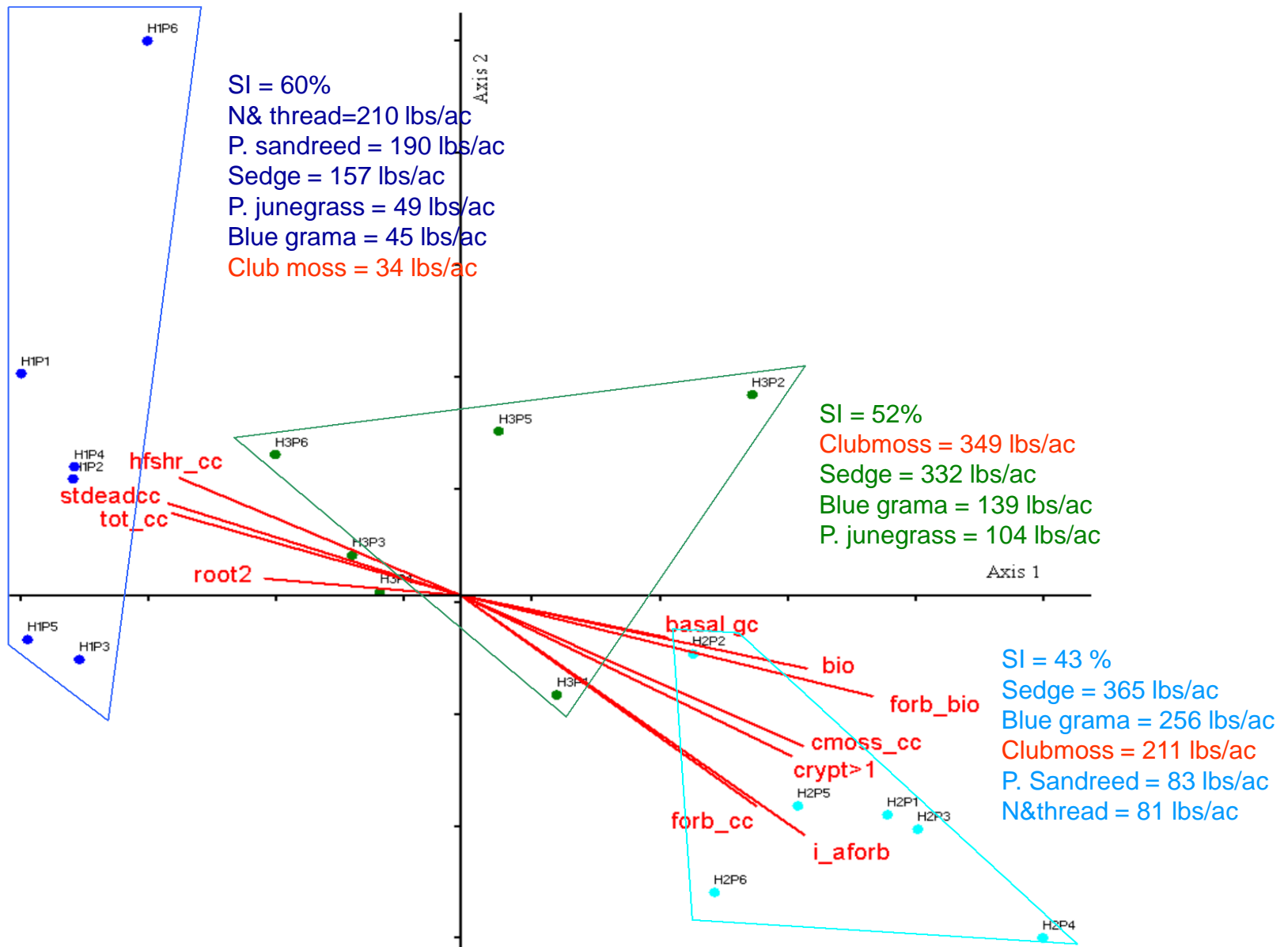


SI = 60%
 N& thread=210 lbs/ac
 P. sandreed = 190 lbs/ac
 Sedge = 157 lbs/ac
 P. junegrass = 49 lbs/ac
 Blue grama = 45 lbs/ac
 Club moss = 34 lbs/ac

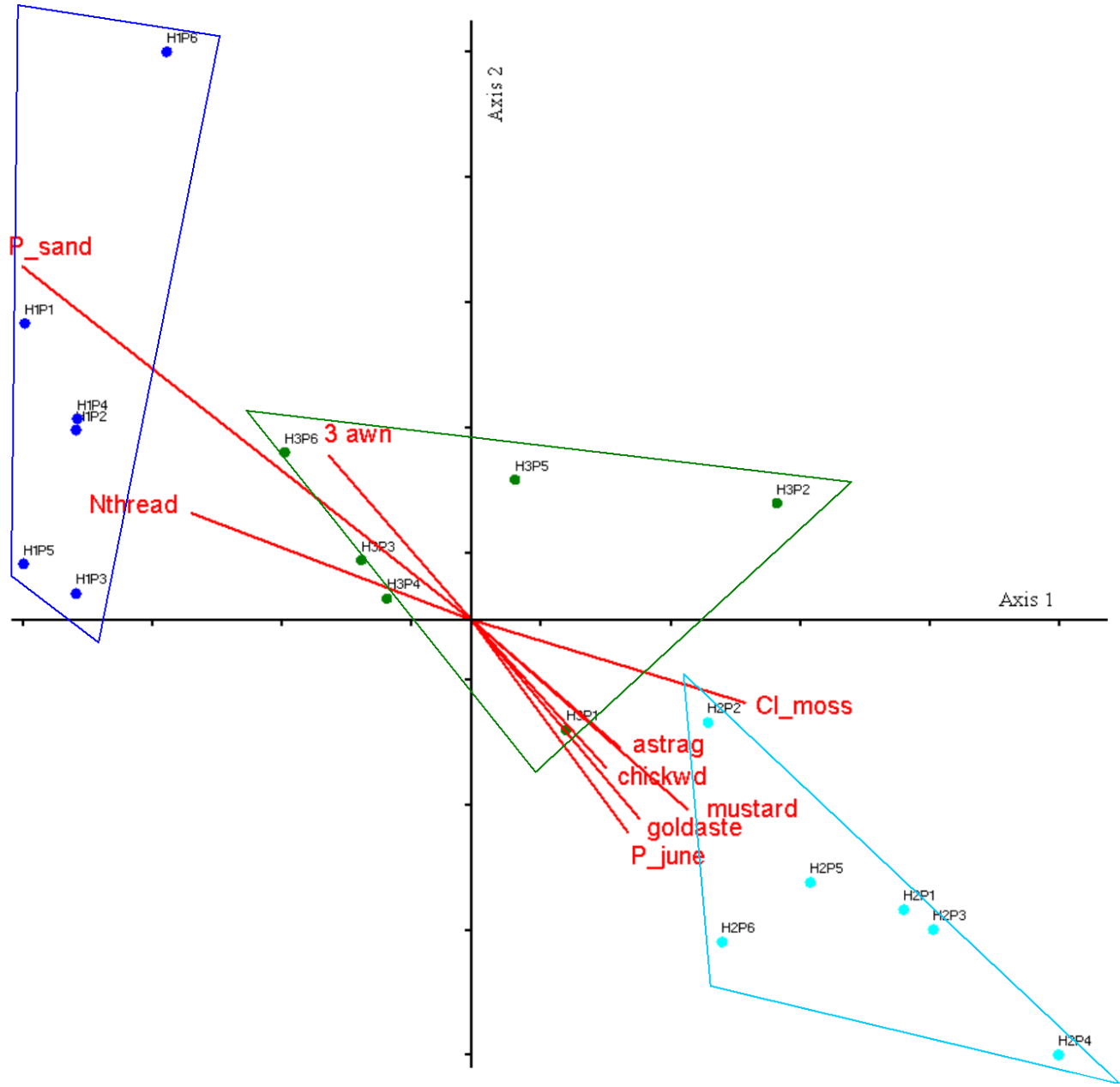
SI = 52%
 Clubmoss = 349 lbs/ac
 Sedge = 332 lbs/ac
 Blue grama = 139 lbs/ac
 P. junegrass = 104 lbs/ac

SI = 43 %
 Sedge = 365 lbs/ac
 Blue grama = 256 lbs/ac
 Clubmoss = 211 lbs/ac
 P. Sandreed = 83 lbs/ac
 N&thread = 81 lbs/ac

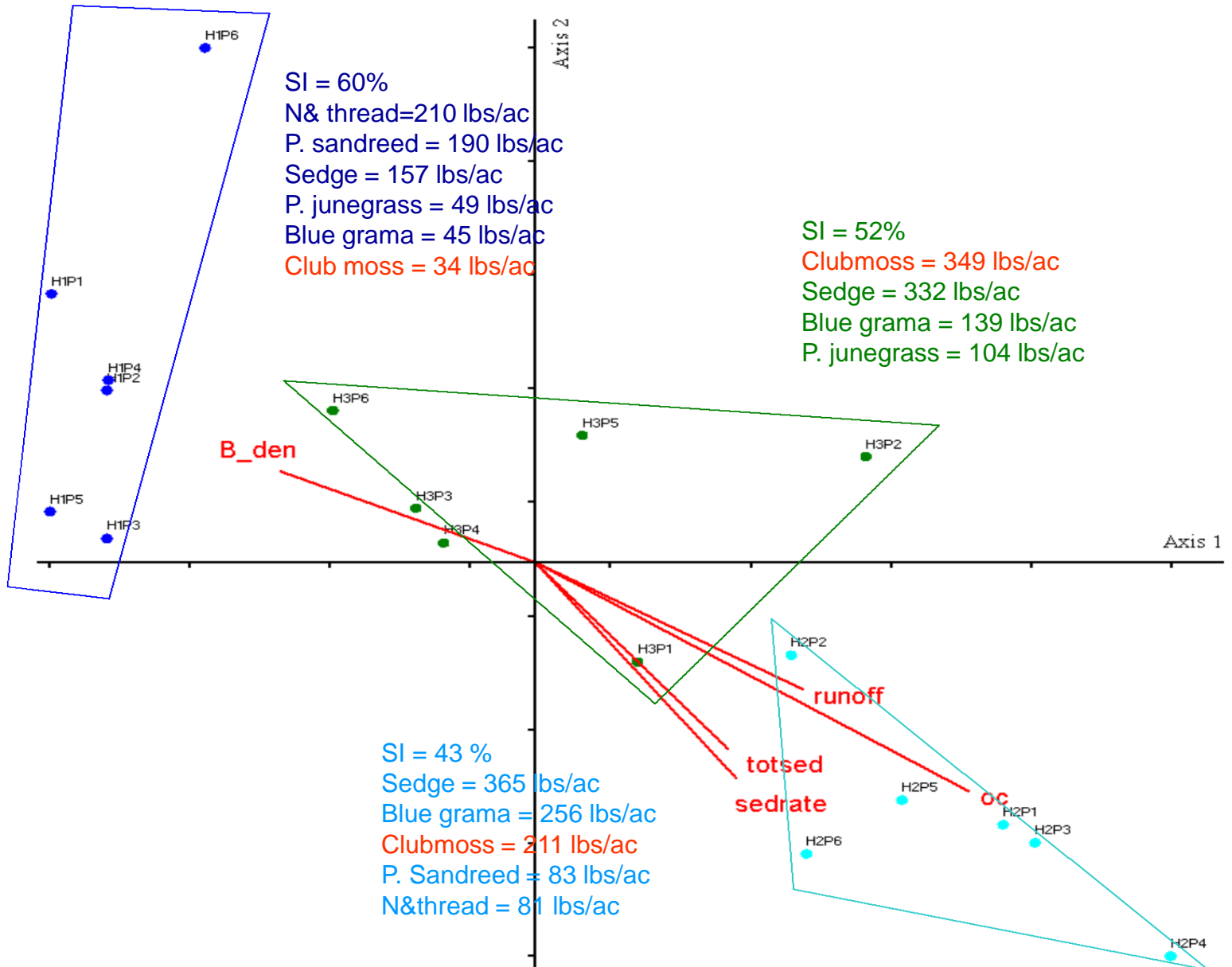
Ordination with sites and plant related data



Ordination with dominant plant species production correlations



Ordination with sites and hydrology and sediment yield



Interpreting the ordination diagram

- Where plant composition data (cover, production) are used, the axes of the ordination are *gradients of floristic similarity*.
- The results of ordination can be displayed one, two or three dimensions which define the *ordination space*.
- In general, the axes produced by ordination analysis come out in descending order of importance. The first axis is most important and describes the most variation in the floristic data.
- A powerful attribute of plot ordinations is that environmental data can be correlated with the floristic data and gradients can be overlain to portray environmental trends and gradients.

Interpreting the ordination

- We have formed an “ordination space” where the axes are of gradients of floristic similarity. Stands closest together are most similar.
- At this point, we have described a coenocline, but we have no idea what the axes mean ecologically.
- *The x and y axes can be correlated with environmental data for each plot with the x and y coordinates.*

Rank correlations. The variable with highest correlations with the *x values* best represent the *x axis*.

Biplot diagrams. A group of correlation arrows centrally located in the ordination space to show direction and strength of correlations between environmental variables and the ordination space.

- The analyst must interpret the data and “make sense” out of the results.

Example 2, MLRA 53B, Loamy

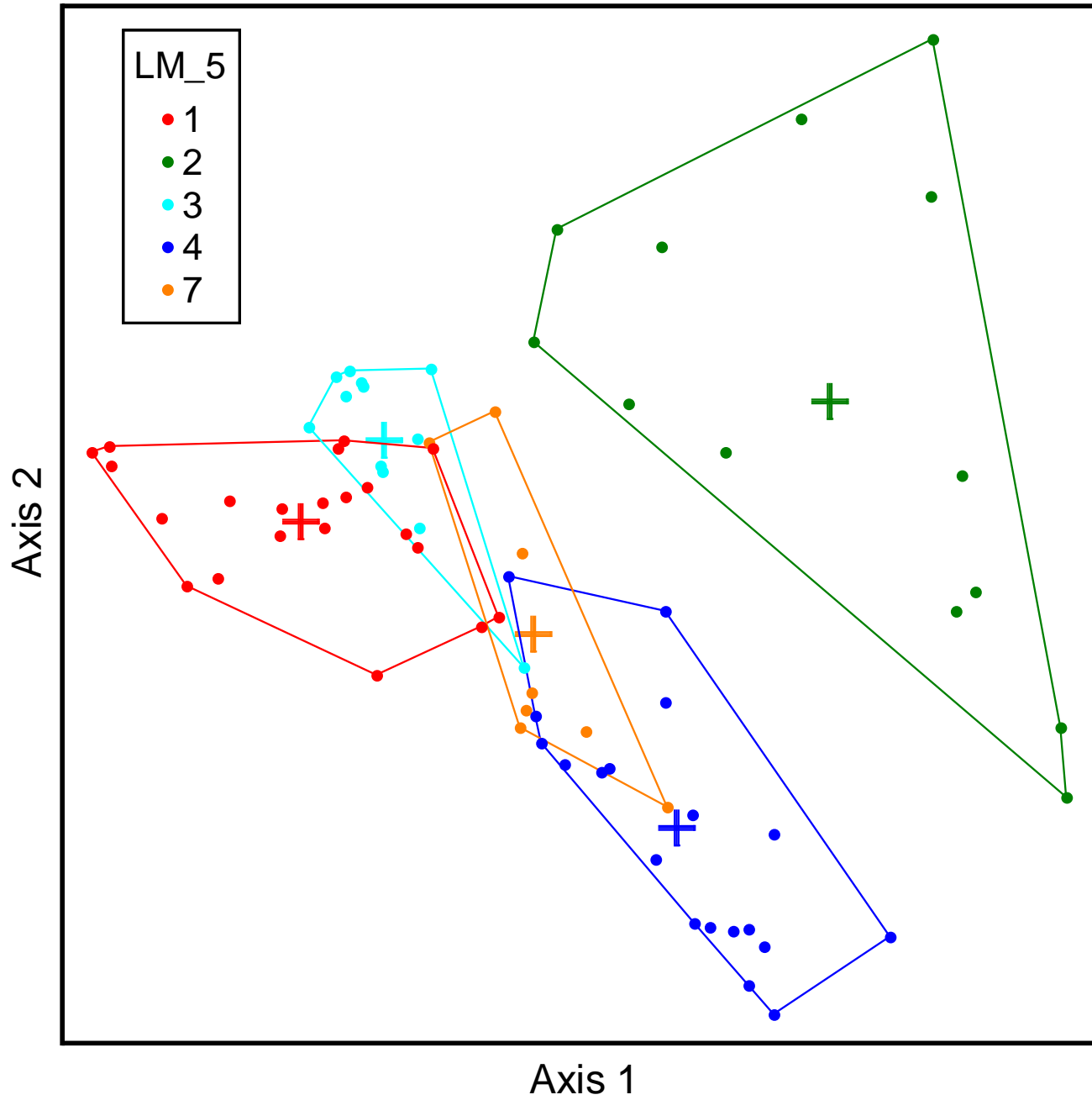
STEP I

- 73 NRI points
- Conduct Classification
- Conduct Ordination
- Overlay Ordination and Classification
- Determine Dominant and Influential plants within groups
- Evaluate Environmental gradients associated with Groups
- Identify groups that may represent various states (S&T)

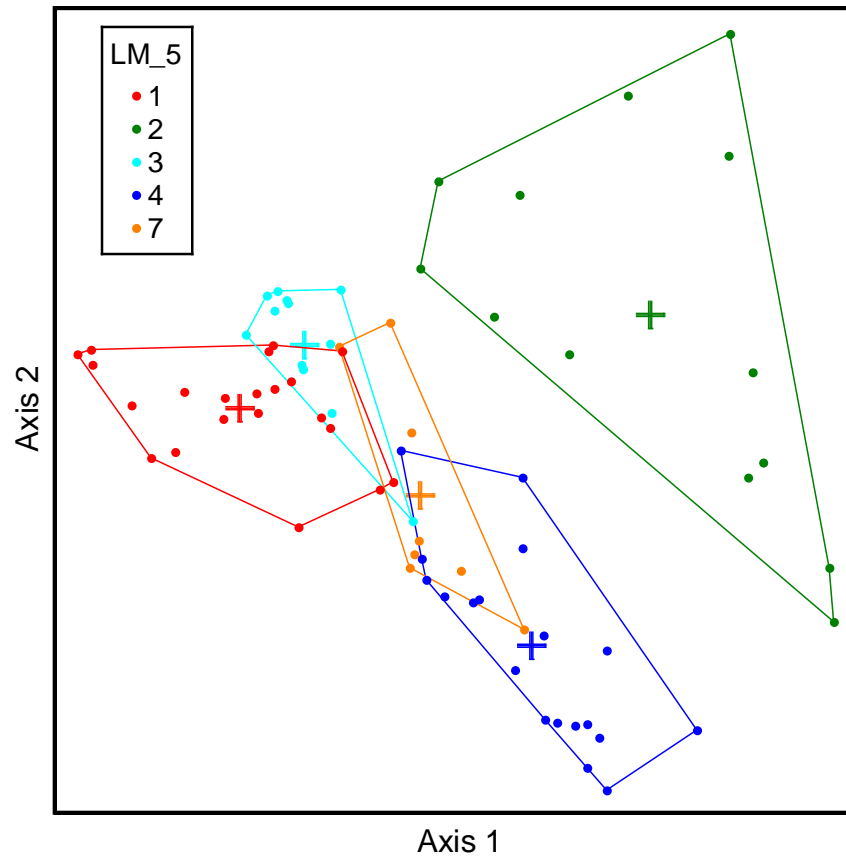
STEP II

- Study data within a specific group

Loamy Ecological Site MLRA 53B

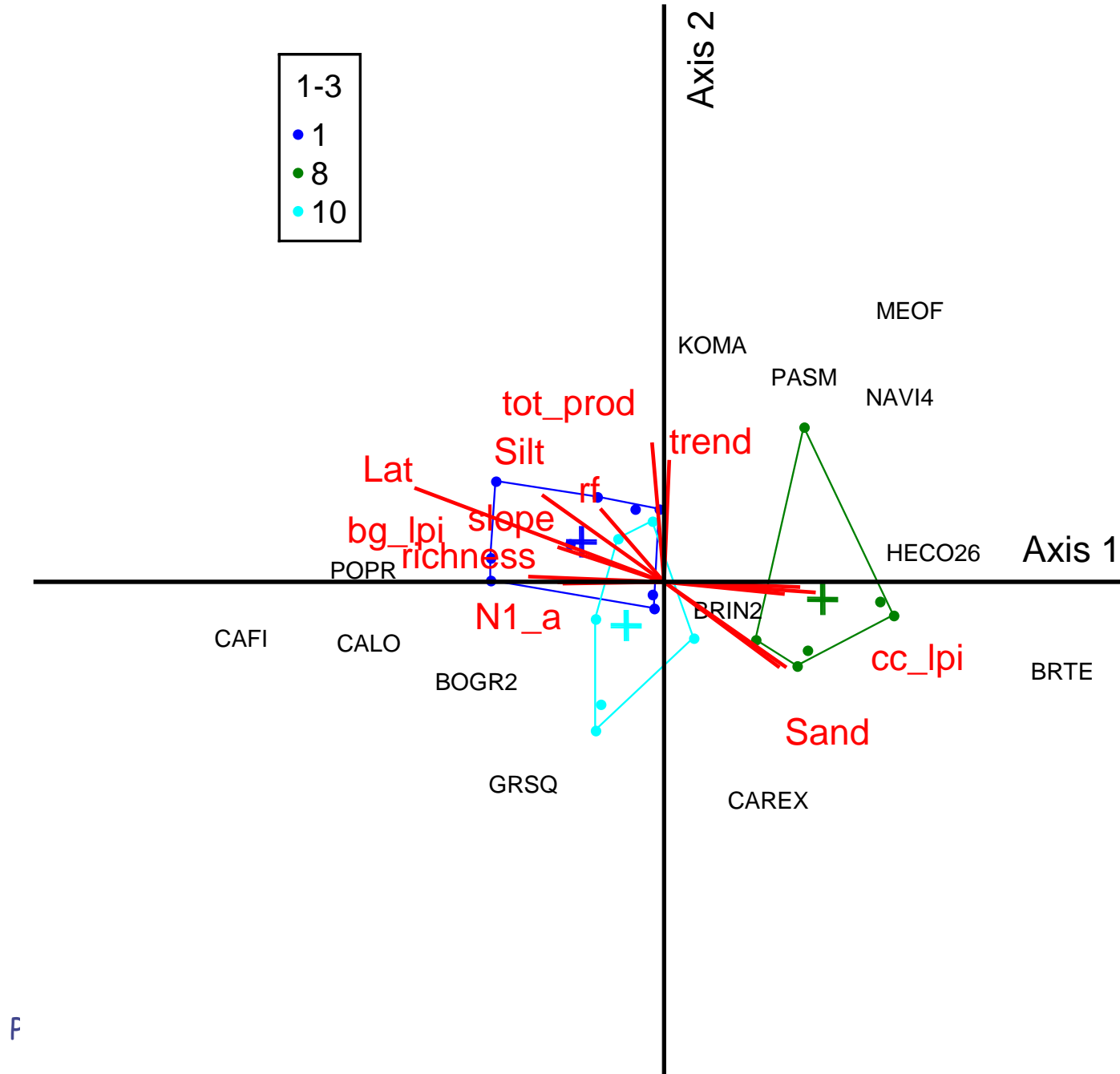


Loamy Ecological Site MLRA 53B

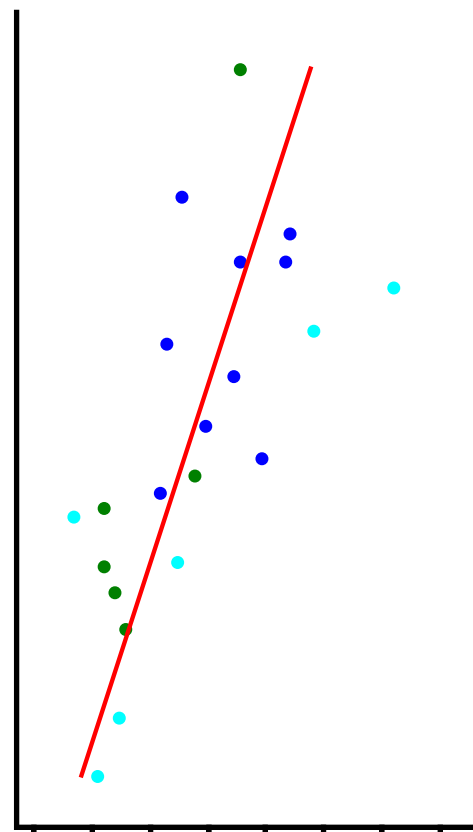


1	2	3	4	7
Carex	Agcr	Cafi	Popr	Bogr2
Pasm	Brin2	Heco26	Navi4	Cain9
Brte	Meof	Koma	Pasm	Grsq
Koma	Popr	Mucu3	Acmi2	Popr
Gogr2		Scsc	Cain9	Navi4

Loamy Ecological Site MLRA 53B: Group I

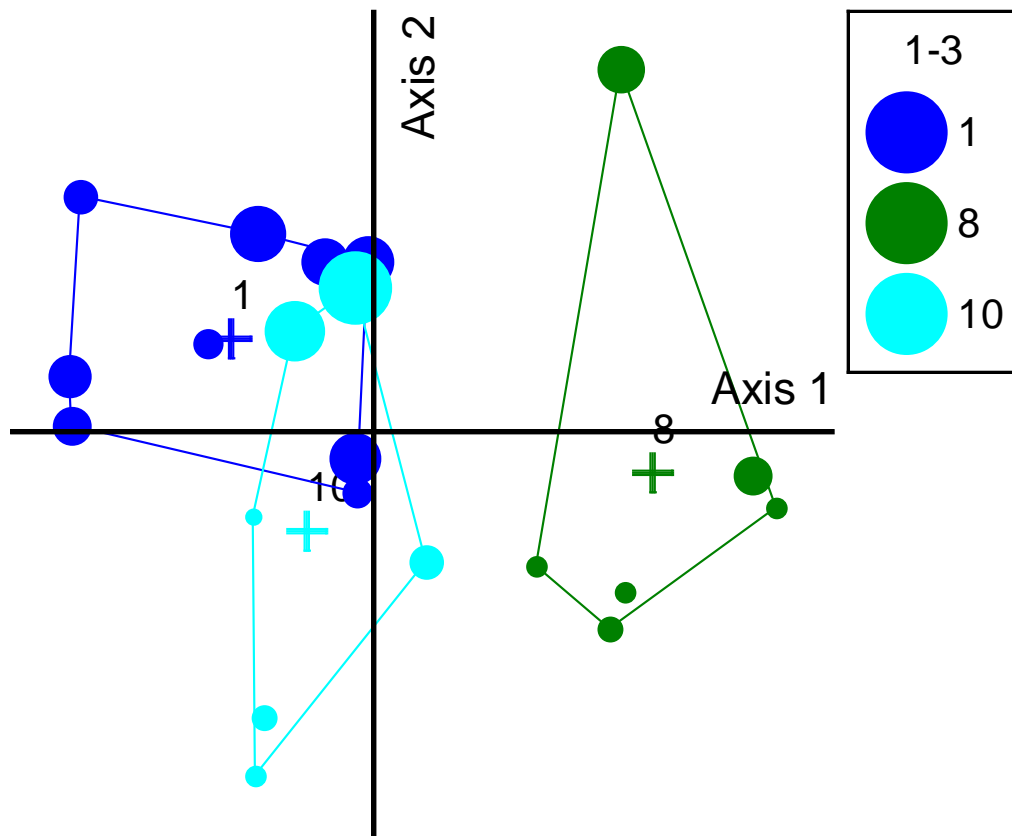


Loamy Ecological Site MLRA 53B

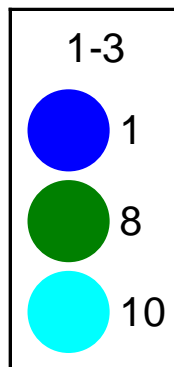
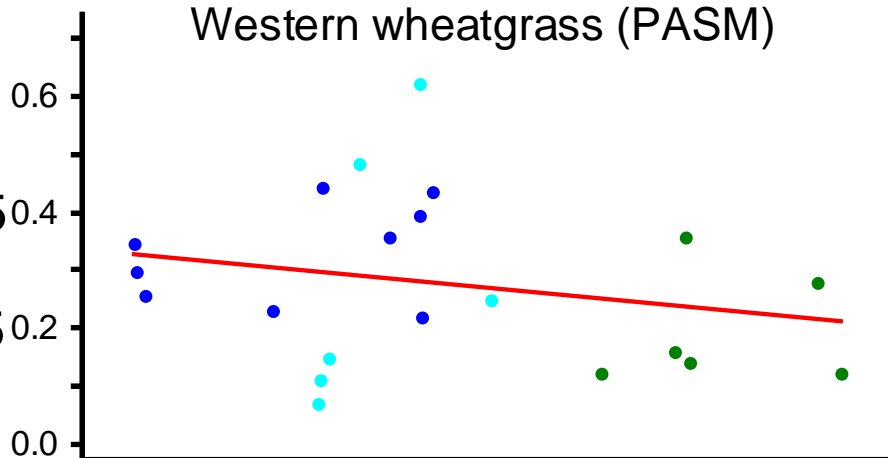


0.0 0.2 0.4 0.6
PASM

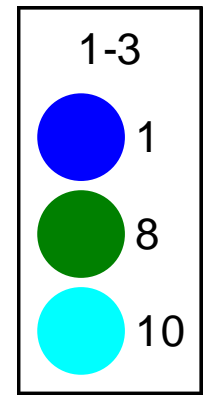
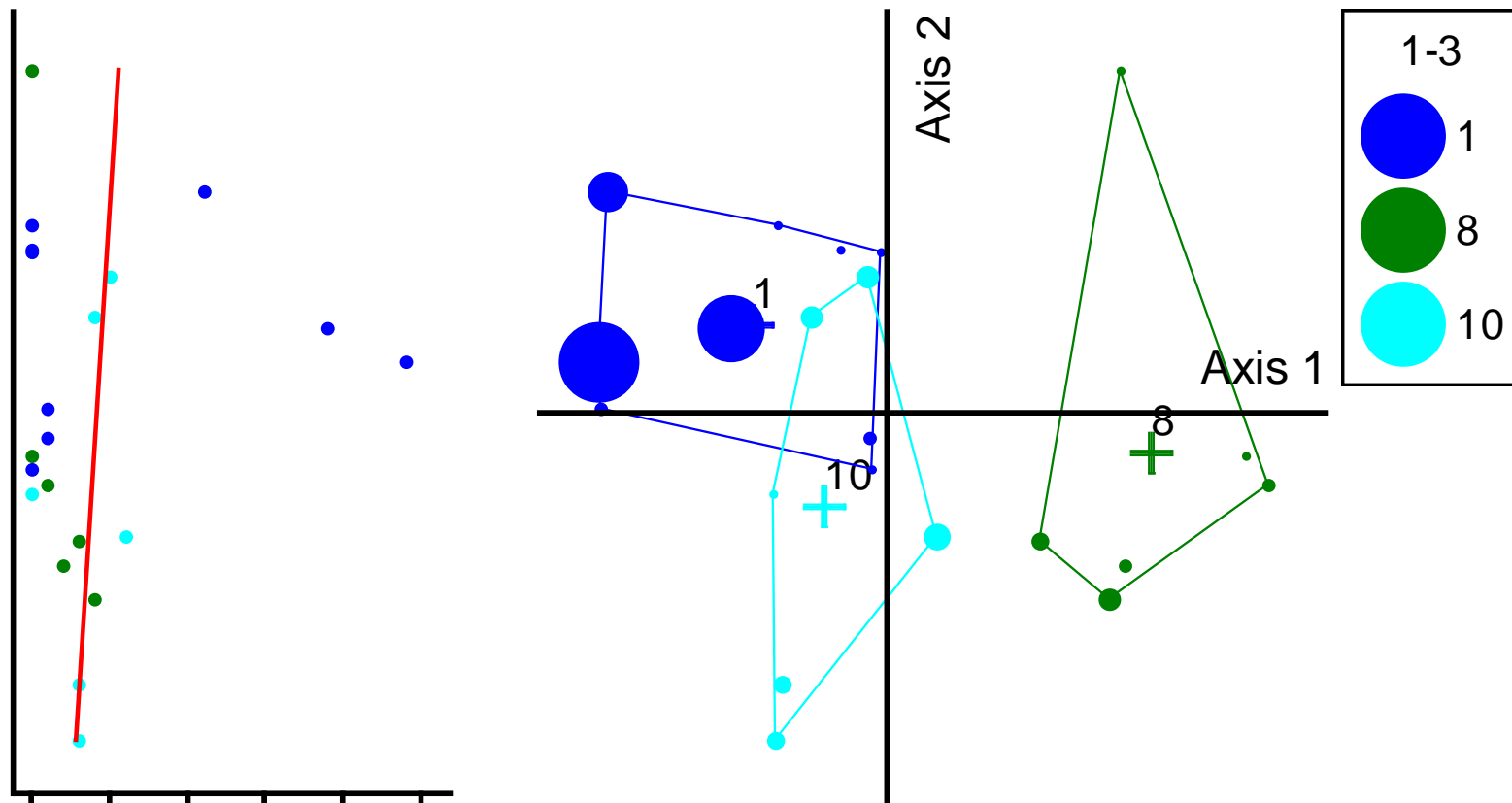
Axis 1
 $r = -.225$ $\tau = -.115$
 Axis 2
 $r = .693$ $\tau = .565$



Western wheatgrass (PASM)

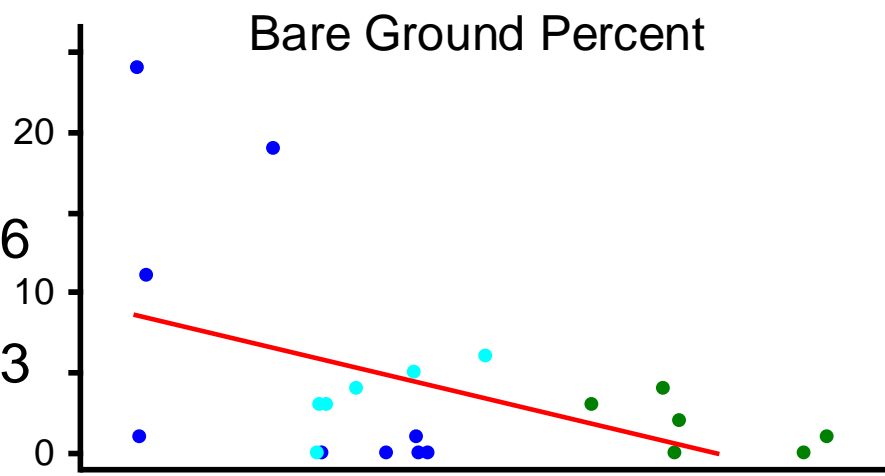


Loamy Ecological Site MLRA 53B



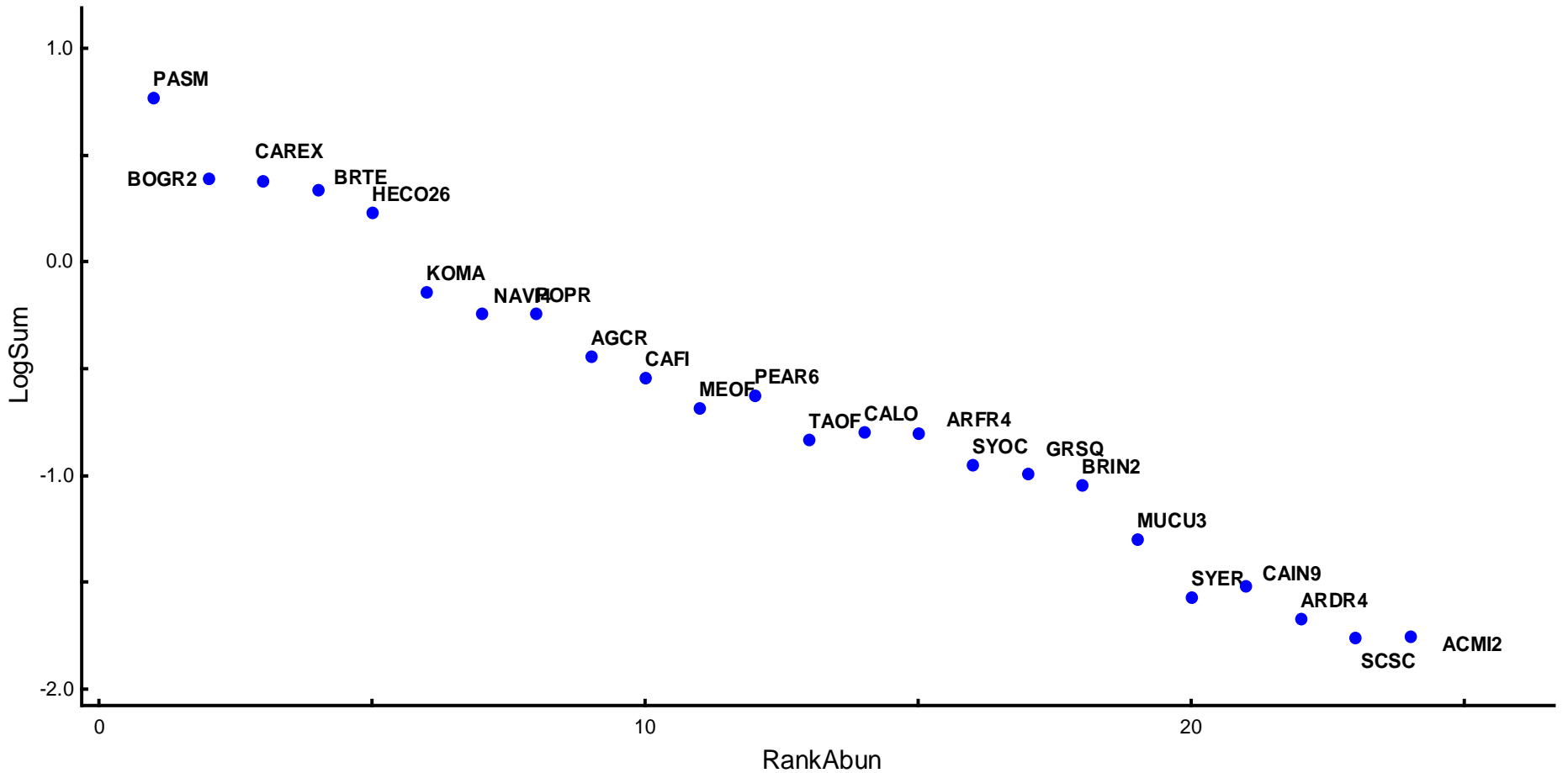
0 10 20
bg_lpi

Axis 1
 $r = -.464$ $\tau = -.256$
Axis 2
 $r = .108$ $\tau = -.133$



Dominance Diversity Curve for Group 1

Loamy Ecological Site MLRA 53B



Conclusions

- Environmental data analysis requires training and basic knowledge of statistical concepts.
- Ordination methods can provide a fast overview of plant, soil, and environmental data.
- Each analysis will be unique--key variables change from location-to-location.
- Multivariate methods are more informative for analysis of vegetation and corresponding environmental data.
- Interpretations require knowledge of plant communities and ecology. Decisions are required based on this knowledge.
- Modifications and data runs - instantaneous