



Applying non-linear (fuzzy) classification rules for grouping streams with similar biological potential in Colorado

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Highlights

- In multimetric index development, we want to increase assessment accuracy
- Site classification is an important potential source of error
- Many sites are hybrid types
- Recognition of hybrid site characteristics will improve interpretation of multimetric assessments

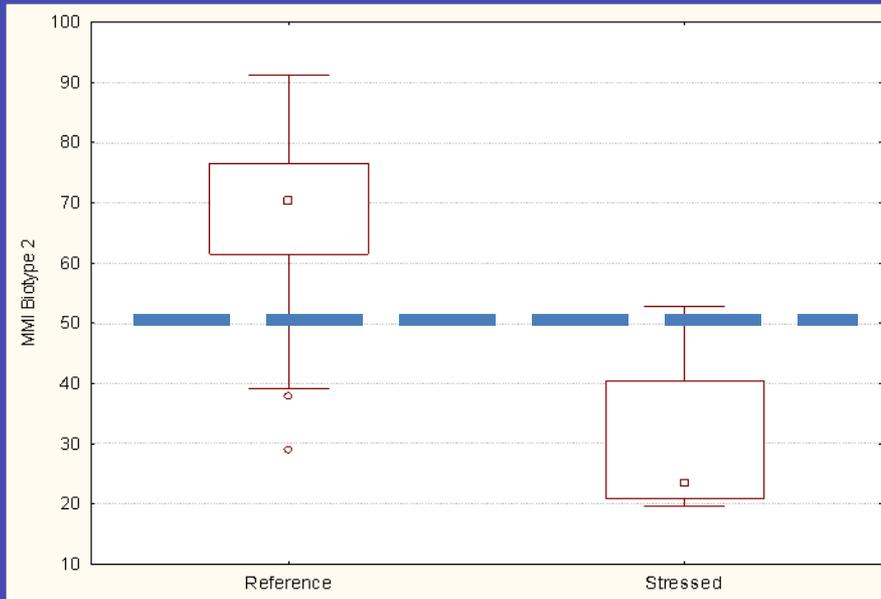


Error in Bioassessment

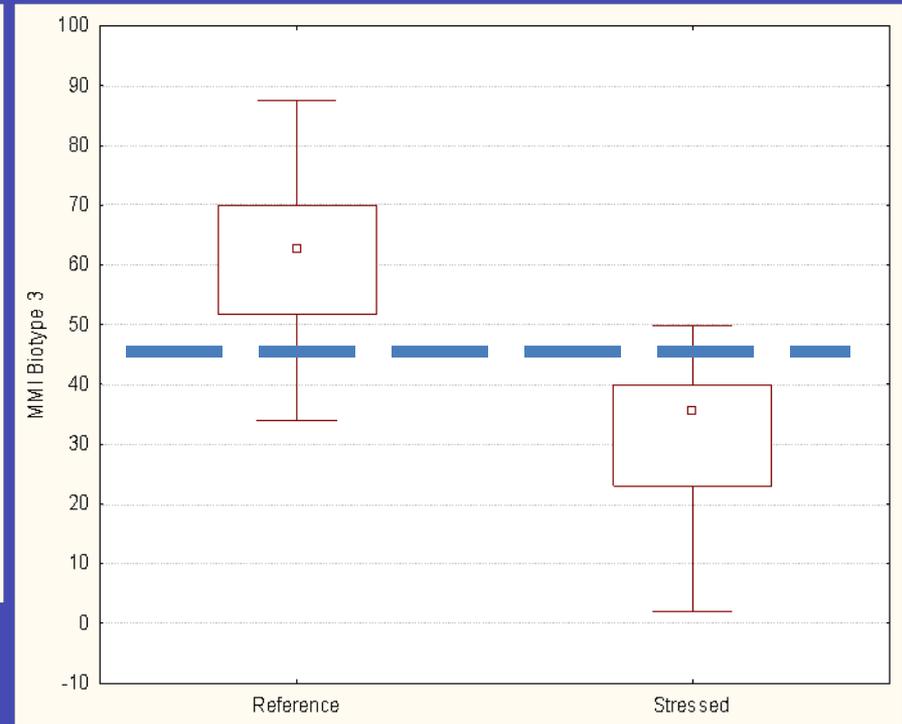
- Biological assessment with multimetric indices can be erred in 2 important ways
- We can get a score that is on the wrong side of the impairment threshold
- We can use an index that is inappropriate to the stream type



BioType 2 Mountain Regions



BioType 3 Plains Regions



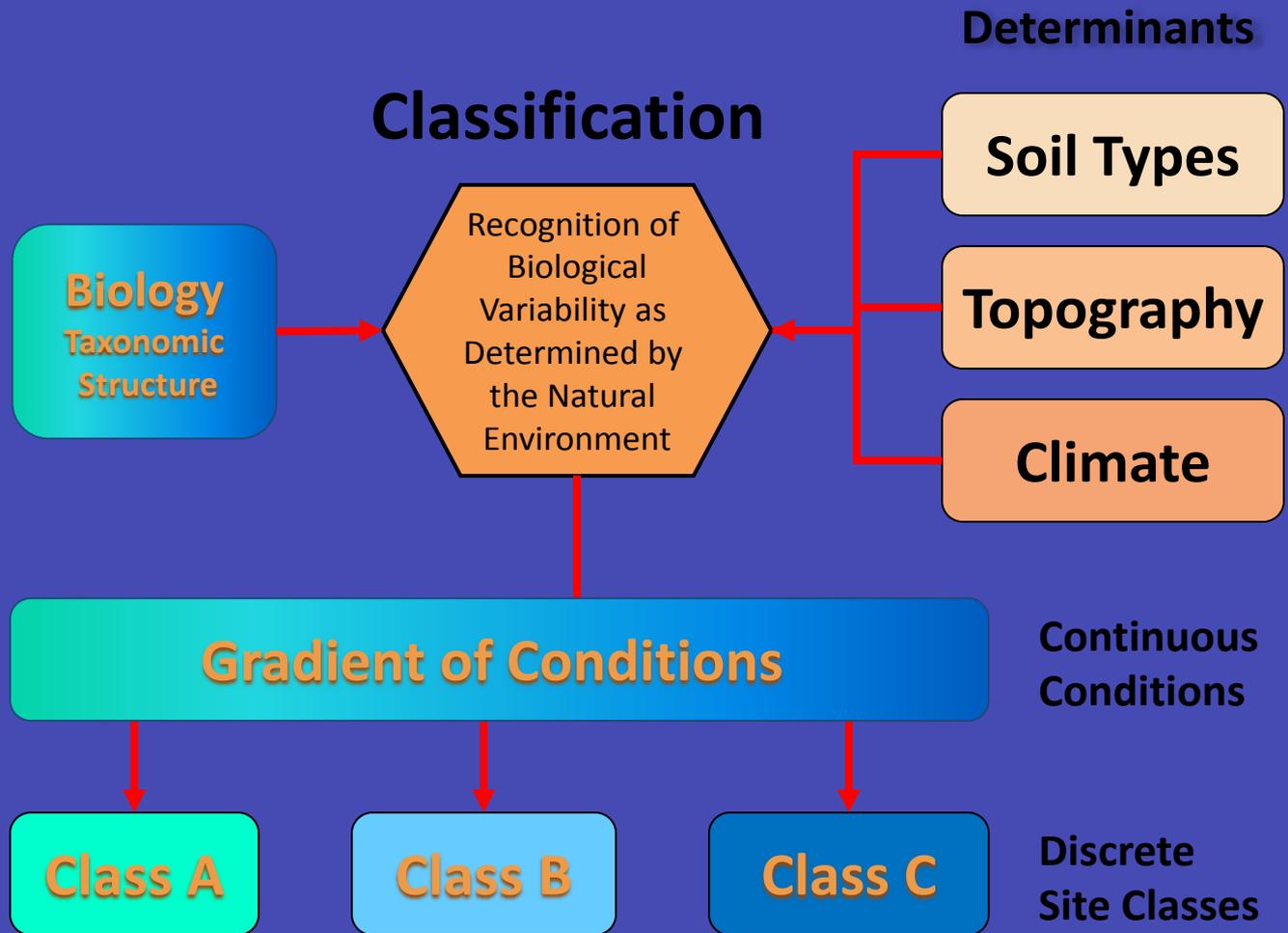
Total taxa
% Ephemeroptera
Predator, Shredder taxa
Beck's Biotic Index
Clinger taxa

Insect taxa
% non-insect taxa
% Sens. Fam. Plains
% dominant taxon
Predator, Shredder taxa
% sprawler



1.

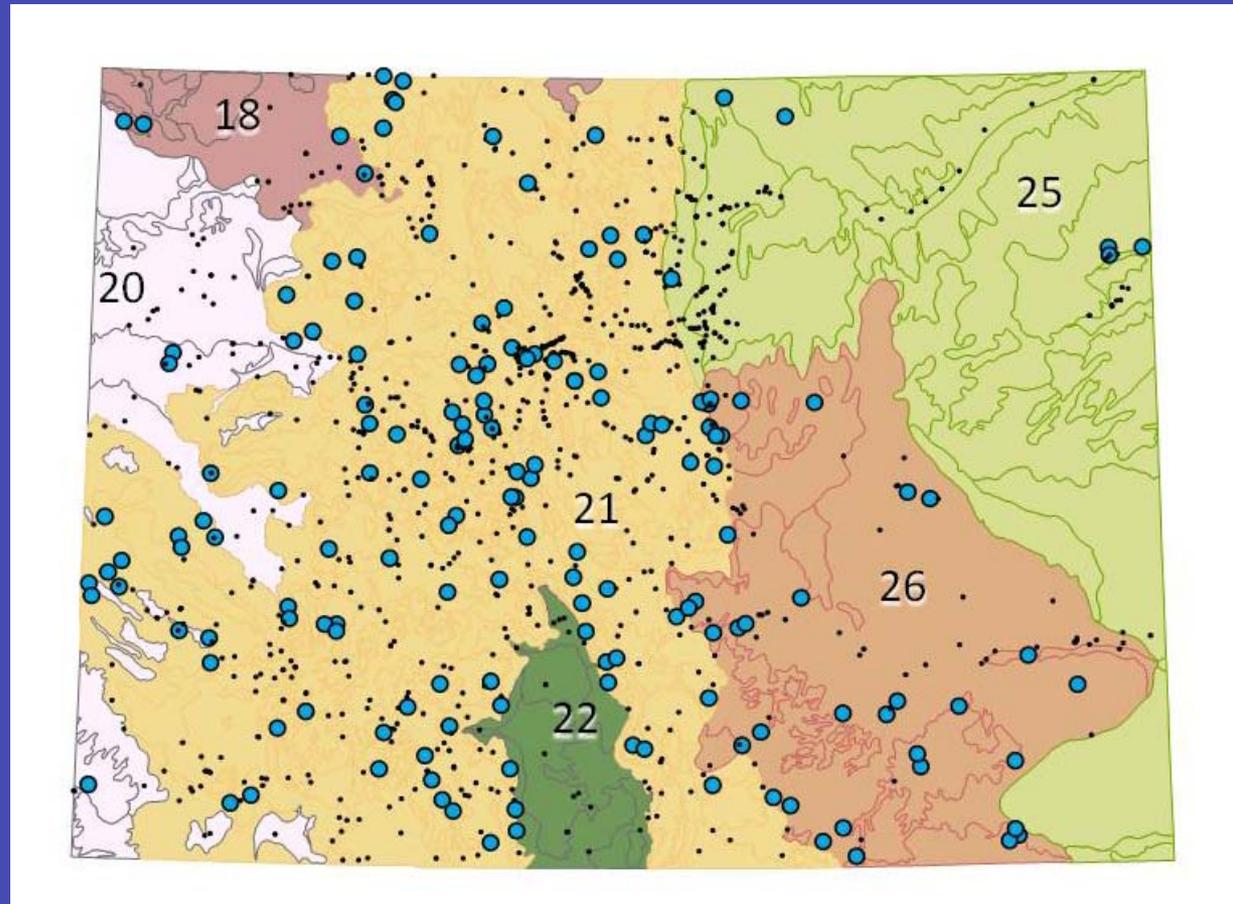
Classification Schematic



Why Use Fuzzy Sets?

- To recognize partial group membership
- To allow expert input
- To allow non-linear rules
- To communicate a transparent process
- To test a new application of a process that has worked well with BCG estimations





Colorado ecoregions and sample sites.

Large symbols are reference sites.

21 = Southern Rockies

20 = Colorado Plateaus

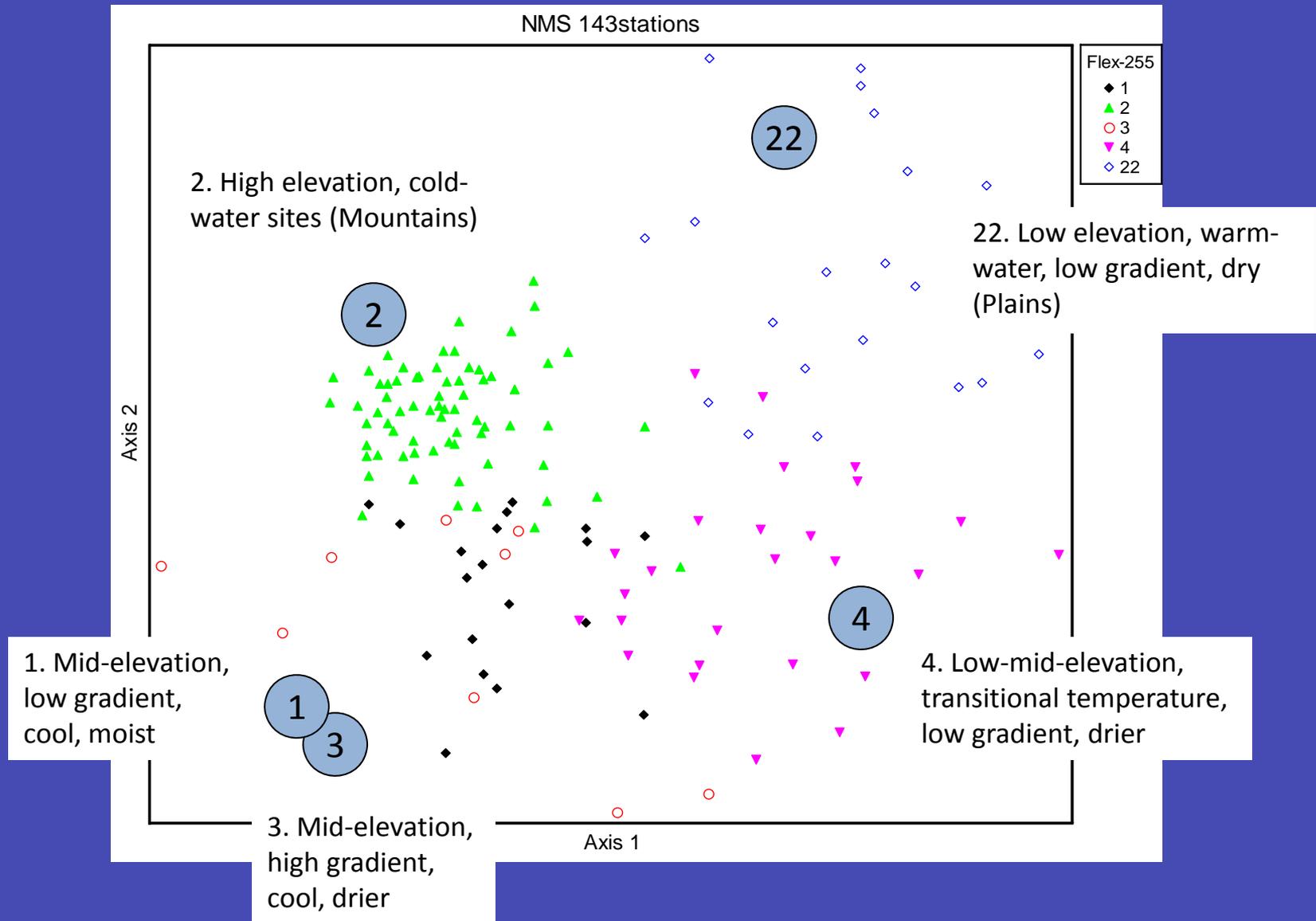
25 = High Plains

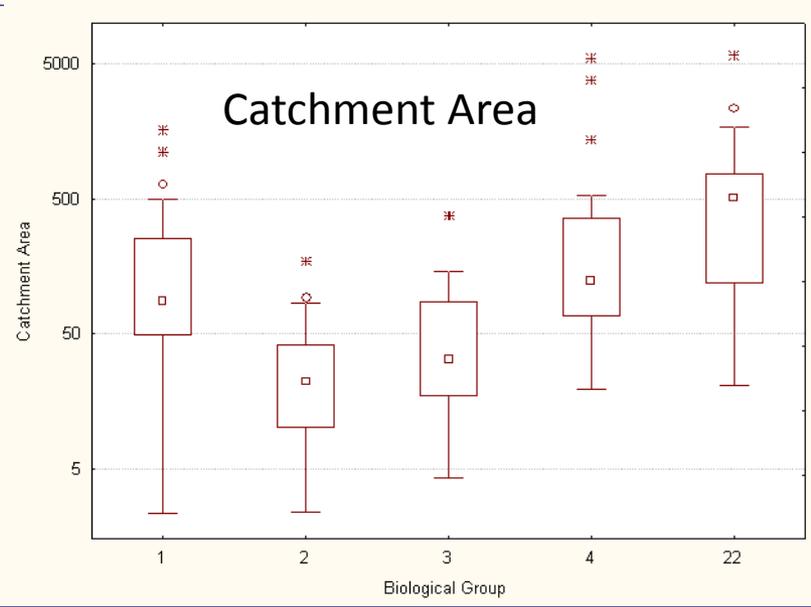
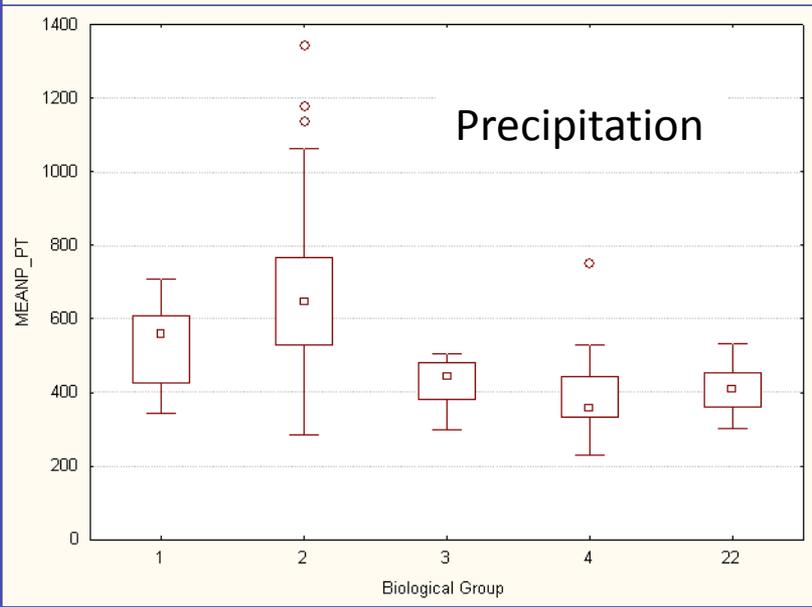
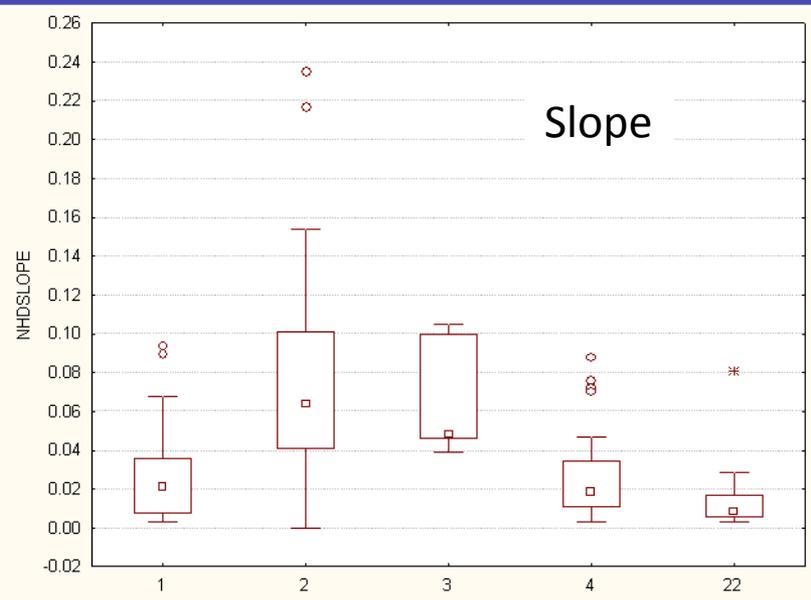
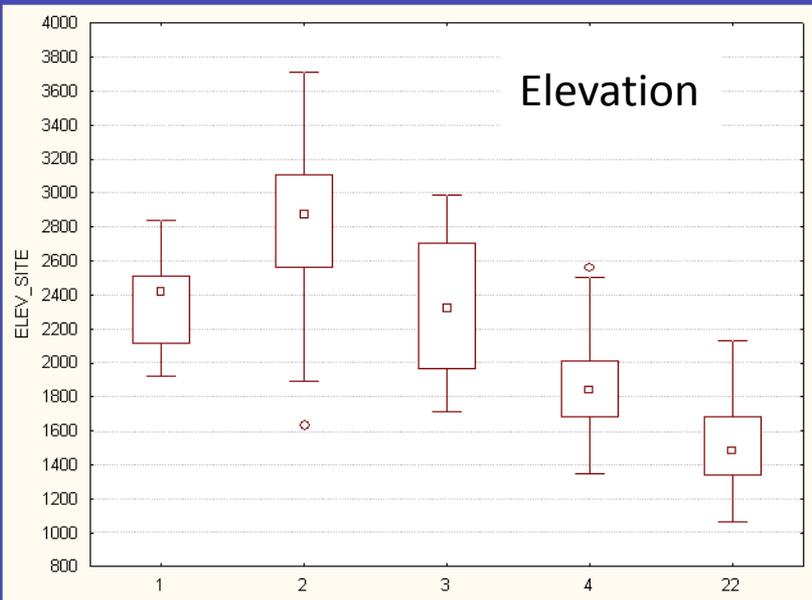
18 = Wyoming Basin

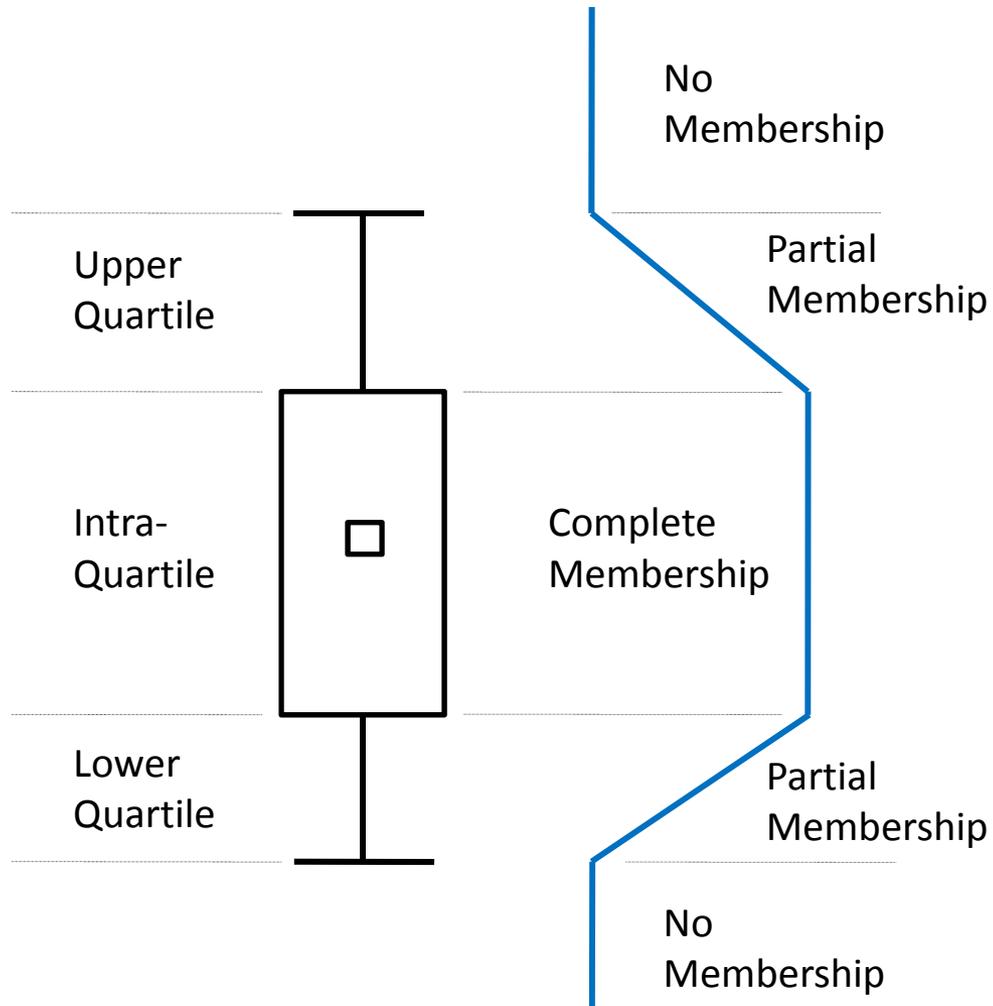
22 = Arizona/New Mexico Plateau

26 = Southwestern Tablelands.

Clustering and Ordination Suggest 5 BioTypes





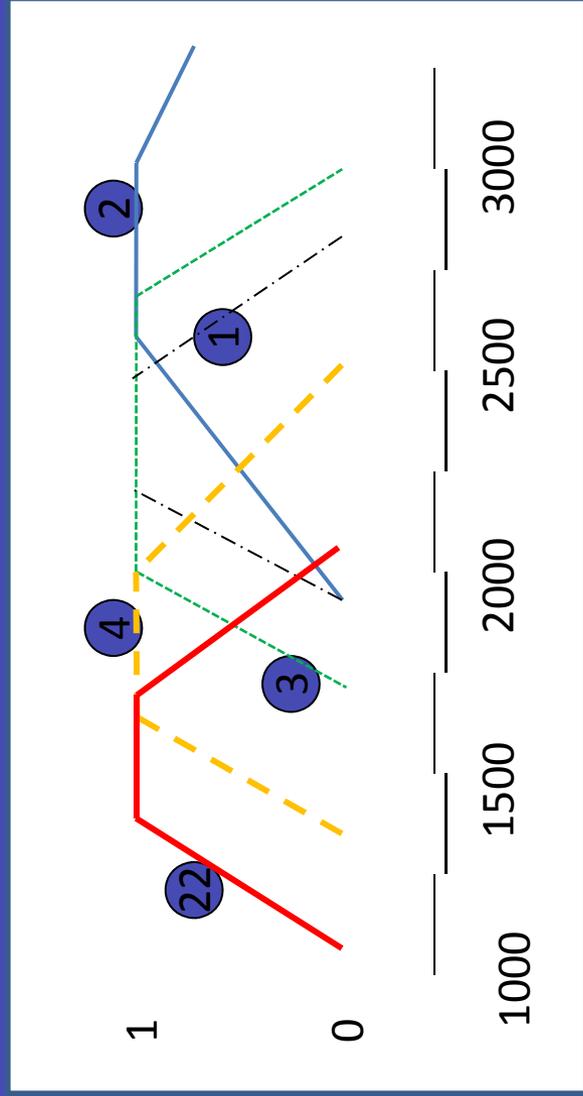
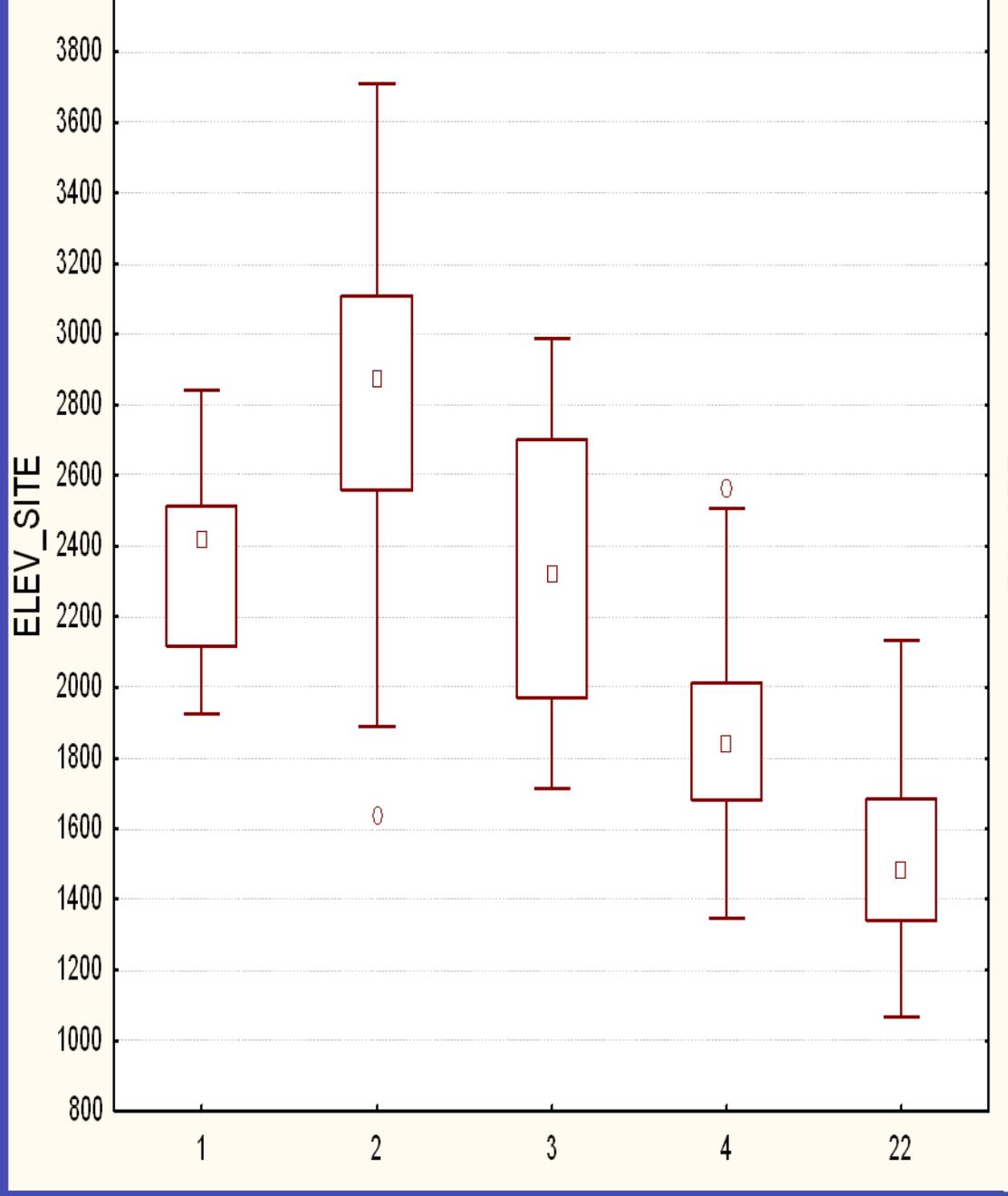


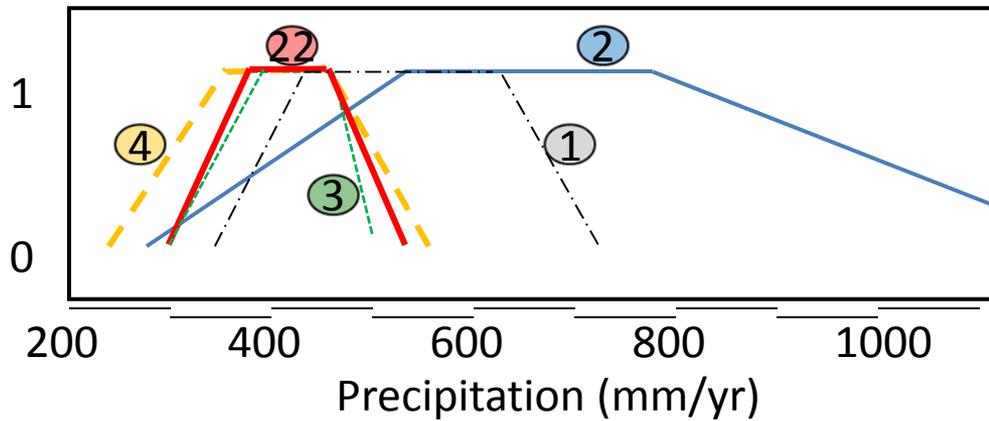
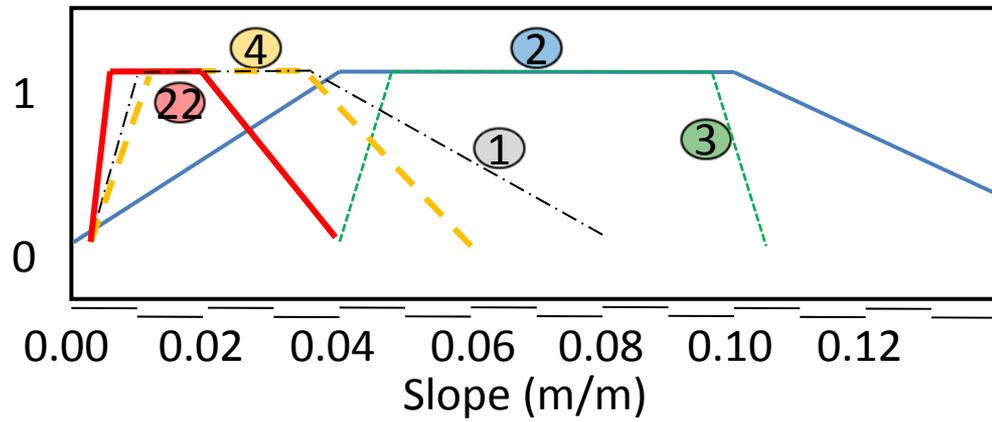
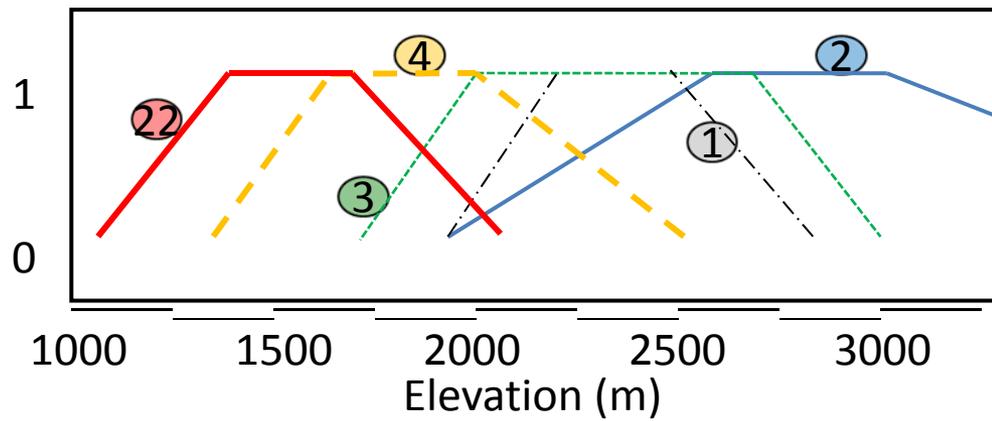
Box Plot

Defines Distribution

Rule Diagram

Predicts Membership







Boulder Creek



Boulder Creek Site Classification:

Cluster	1	2	3	4	22
Degree of membership	0.87	0.31	0.43	0.12	0.0

This site is similar to sites in cluster 1.
It has some characteristics of clusters 3, 2, and 4.
Assess it as BioType 1.

Application Consideration

- Confusing to establish impairment thresholds for hybrid sites
 - Especially when metrics respond differently across core classes
- Not ultimately adopted in Colorado
- May be a valuable tool for interpretation of index results from distinctly classified sites
- Successful application in New Hampshire



Membership Rules - Example

Class	Variable	μ	μ (class)
Acidity	pH = 6.72	0, pH > 6.0	0
Mountains	Location (Ecoregion) = White Mtns –Blue Mtns	1, in the White Mountains/Blue Mountains	0.5
	Elevation = 815.4	0, elevation < 1000 ft.	
	Catchment Size = 17.1 sq mi	1, catchment size is less than 30 sq mi.	
Plains	Location (Lat/Long) = 44.029158 / 71.711912	0, 2.5641*((0.5884 * Long + 85.456) - Lat) < 0	0
	Elevation = 815.4 ft	0, Elev > 600 ft	
Hills			0.5



NH Threshold Determination

$$\text{Threshold} = (0.5 * 72) + (0.5 * 64.5) + (0.0 * 59) = \mathbf{68.25}$$

(mountains) (hills) (plains)

