Bio 112 Vegetation Analysis Lab Part 1
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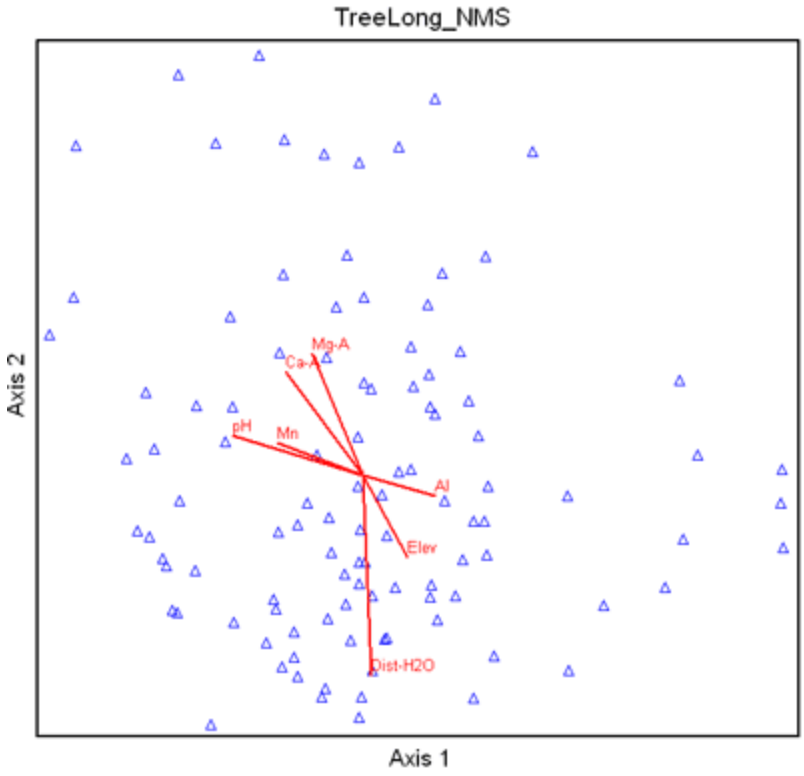
11/2/05

Summary: We did an NMS (nonmetric multidimensional scaling) ordination to group 106 samples/plots by the similarity of their species composition. From the scree plot, we found we could best reduce the number of dimensions from 68 (the number of species) to 3 without too much information loss. These 106 plots also expressed various quantities of 17 environmental variables. Plots that were more similar to each other were arranged closer together in the 3D ordination space than more dissimilar plots.

Interpretation of results from biplot with Treelong as both the main matrix and second matrix
Whatever the three axes were of our 3D ordination space, the following species responded most strongly to them (as determined by a strong correlation (long red line) on the biplot in the direction of that axis, as well as a high r-value (above 0.3) after doing Statistics > Correlations with Main Matrix):
Axis 1: QUPR, ACRU, OXAR; Axis 2: QUAL, LIST, CACR, ULAL, OXAR; Axis 3: QUST, JUVI, FAGR, LITU

Interpretation of results from biplot with Treelong as the main matrix, and Envlong as the second matrix
The following environmental variables had a strong correlation to the three axes (as shown graphically, and also from a high r-value from Statistics > Correlations with Second Matrix):
Axis 1: (-) correlations for pH, Mn, and Ca-A; (+) correlation for Al (see graphic below)
Axis 2: (-) correlation for Dist-H20 and Elev; (+) correlations for Ca-A and Mg-A (see graphic below)
Axis 3: none of the env. variables had very strong correlations with this axis. The closest were Elev (0.277), Solar (0.297), and K-A (-0.339), which were all around 0.3 (a decent level of correlation).



Right: Dist-H20 (distance to water) was the most significant env. variable, judging from its correlation of -0.737 (very close to -1). It lines up almost exactly with Axis 2, and did a better job than any other env. variable at explaining the ordination groupings of plots. This means that as distance from water increases, this has more of an effect than any other variable on the species that will be found in those plots. Since species QUAL, LIST, CACR, and ULAL also strongly corresponded with Axis 2, this suggests these 4 species were most sensitive to distance from water.

What the axes might mean
Axis 2 might involve factors in the soil (water and nutrients) that control plant growth. The Ca-A and Mg-A lines fall along Axis 2 just as Dist-H20 does, and both these nutrients are as essential as water for plant growth. The Elev line might be explained by its link to soil moisture if, as elevation increases, we have the same effect on plant growth as increasing the distance to water.

Axis 1 might involve soil pH. I read that low soil pH can increase Mn and Al availability to toxic levels, which would explain why Mn and Al are associated with this axis. Interestingly, low pH also lowers Ca and Mg availability—perhaps this is why the Ca and Mg lines are skewed in the direction of the pH line.

The K-A line had the only correlation above 0.3 for Axis 3. Like Ca and Mg for Axis 2, it is another important plant nutrient.

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Briefly describe the characteristics of each group—how do they correspond to the environmental variables? To species composition?

I originally started out with 6 groups, but then decided the relationships between groups of samples and environmental variables were better explained with 3 groups. Below are the 6 groups, with an explanation following for why 3 of those groups were later merged.

Red: this group has high Dist-H2O and Elev (found on high, dry sites). QUAL is a likely indicator species for this group, given its high abundance here and in surrounding areas of the graph (many individuals also in the dark blue and purple groups).

Purple: this group has an overall lower pH, Ca-A, Mg-A, Mn-A, and K-A than other groups, indicating high acid, nutrient-poor soils in these plots. Dist-H2O is also high here, so plots in this group must be dry. QUPR is a good indicator species for this group.

Green: this group is characterized by low Dist-H20 and Elev, and to a lesser extent (by only some plots in this group) by high Ca-A and Mg-A. These sites are likely low-lying areas near lakes or streams. LIST is a good indicator species for this group.

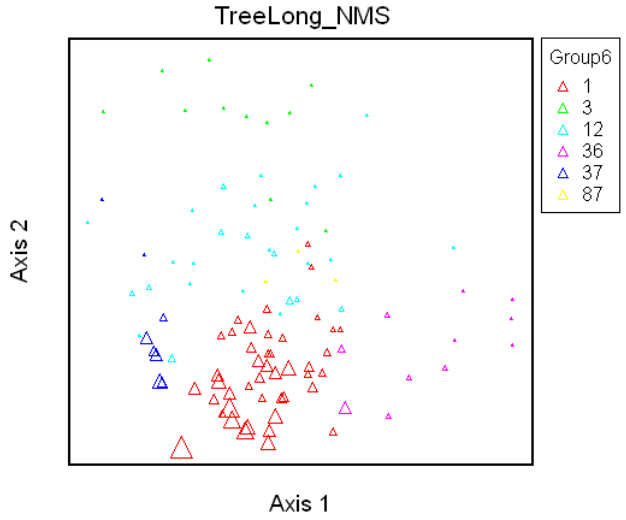
Light blue: this group is largely between the red and green groups, indicating that the plots are intermediate in elevation and distance to water.

Dark blue and **yellow** didn't match with any of the environmental variables very well, and were largely embedded inside other groups in the ordination space. So I thought 6 groups might be too many. It took a reduction to 3 grouping variables to merge both the dark blue and yellow groups with an existing group, which turned out to be the red group. Another result of this group reduction was that the light blue group (intermediate between the red and green groups in Elev and Dist-H2O) merged with the green group after only going from 6 groups to 5.

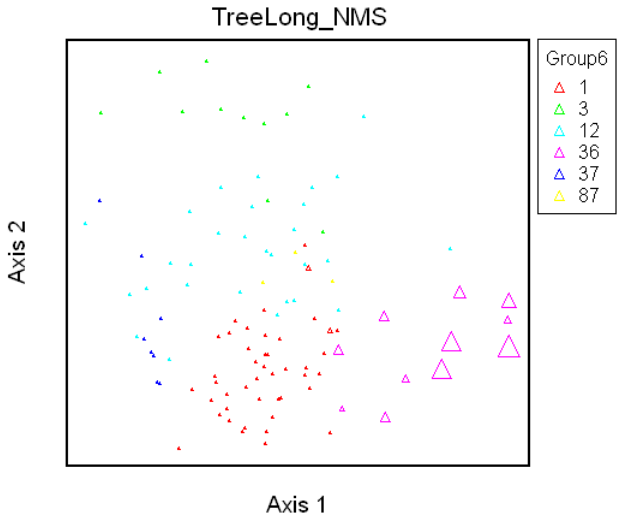
So to summarize my findings, what I ended up with were 3 groups with the following characteristics. You can see these groups labeled by hand on the dendrogram. In parentheses are which of the 6 groups were merged to create 3 groups.

- Group 1: high, dry sites where QUAL grows abundantly (red-dark blue-yellow),
- Group 2: acid, nutrient-poor soils where QUPR grows abundantly (purple), and
- Group 3: low to medium Dist-H20 and Elev where LIST grows abundantly (green-light blue)

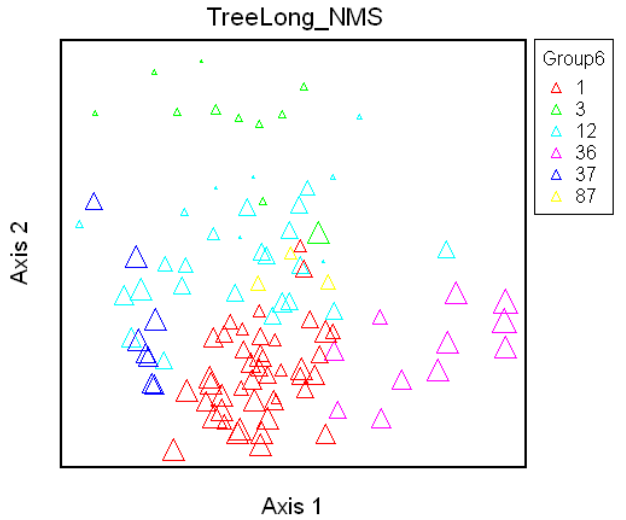
Graphs for 6 groups:



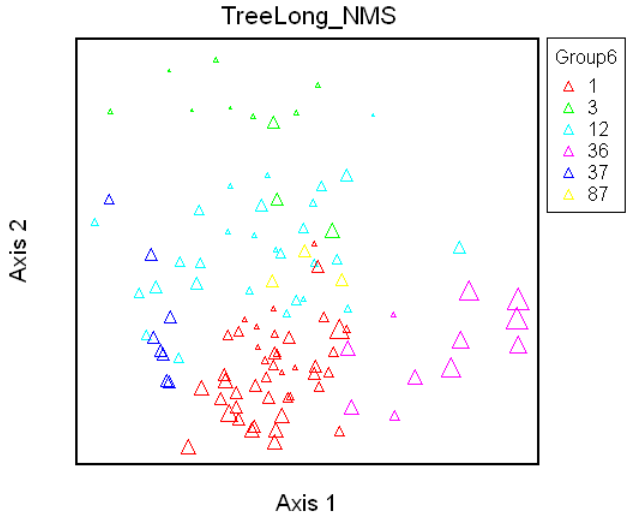
QUAL a indicator species for the red group (but some also in blue and purple).



QUPR a strong indicator species for the purple group than QUAL is for the red group.

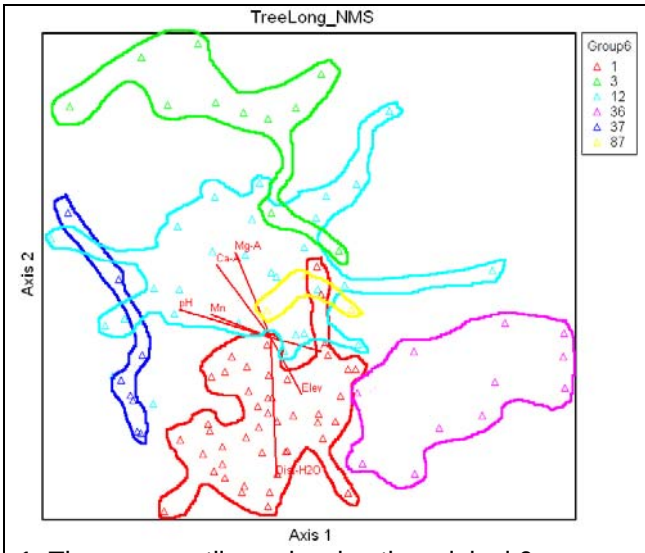


Dist-H2O is high for all groups except green, indicating that most plots in the green group are closer to lakes or streams.

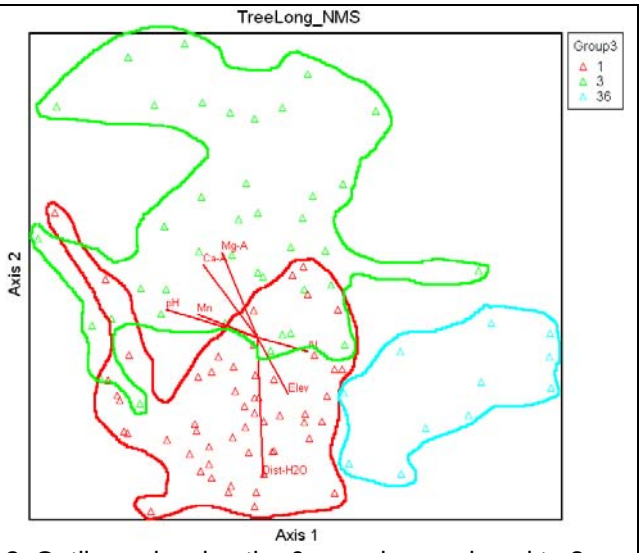


The same sites that had a high correlation for the Elev vector also had a high correlation with the Dist-H20 vector. This makes sense since higher-elevation sites are usually farther away from water.

After moving to 3 groups:

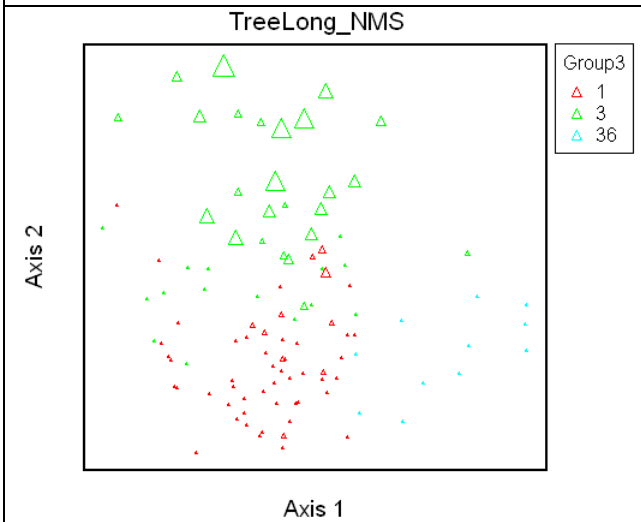


1. These are outlines showing the original 6 groupings. There is a lot of overlap between groups; the dark blue and yellow groups look like they could be part of a new group.



2. Outlines showing the 6 groupings reduced to 3. The protrusion on the right is caused by an outlier, and it looks like there are regions of overlap on the left between the two largest groups (red and green).

Dist-H2O is the environmental variable most strongly correlated with Axis 2. There is some overlap in red and green samples near the middle, but it is obvious that the two groups at the bottom of the graph lie in the direction of increasing Dist-H2O, while the large group at the top is found at lower distances to water.



When looking at just 3 groups vs. 6, LIST turned out to be an indicator species for Group 3.

Abundance (fidelity) – how “loyal” a species is to a particular group. A perfect indicator will occur in all the plots of that group.