

Describing Sub Community Structure in a Plant-Pollinator Network with Physical Traits

2014 Eco-Informatics Summer Institute Final Presentation
August 21, 2014

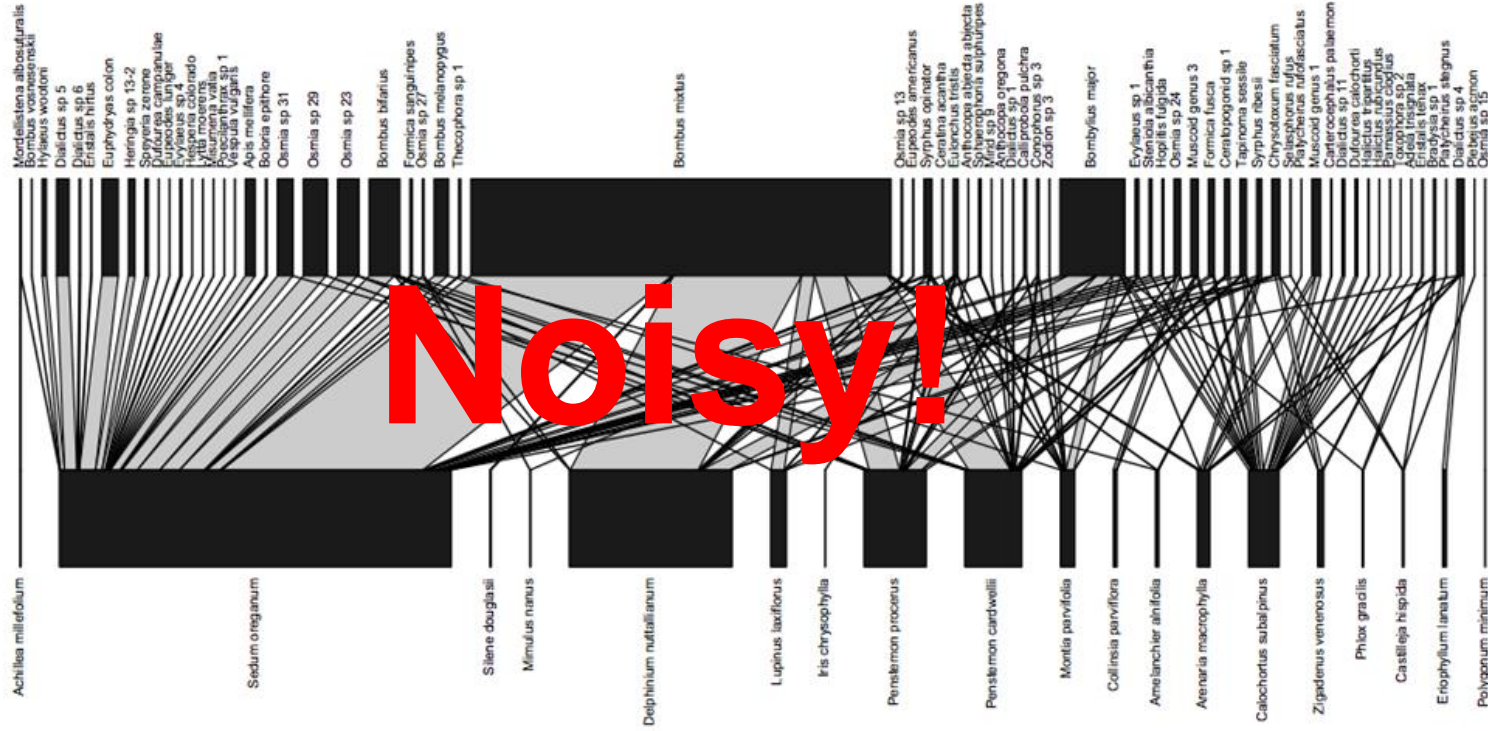
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Motivation



Research Questions

- Which physical traits can best predict module membership?
- Do the physical traits of plants and pollinators in a given module match up in a meaningful way?
- Objective: create a simplified version of the network

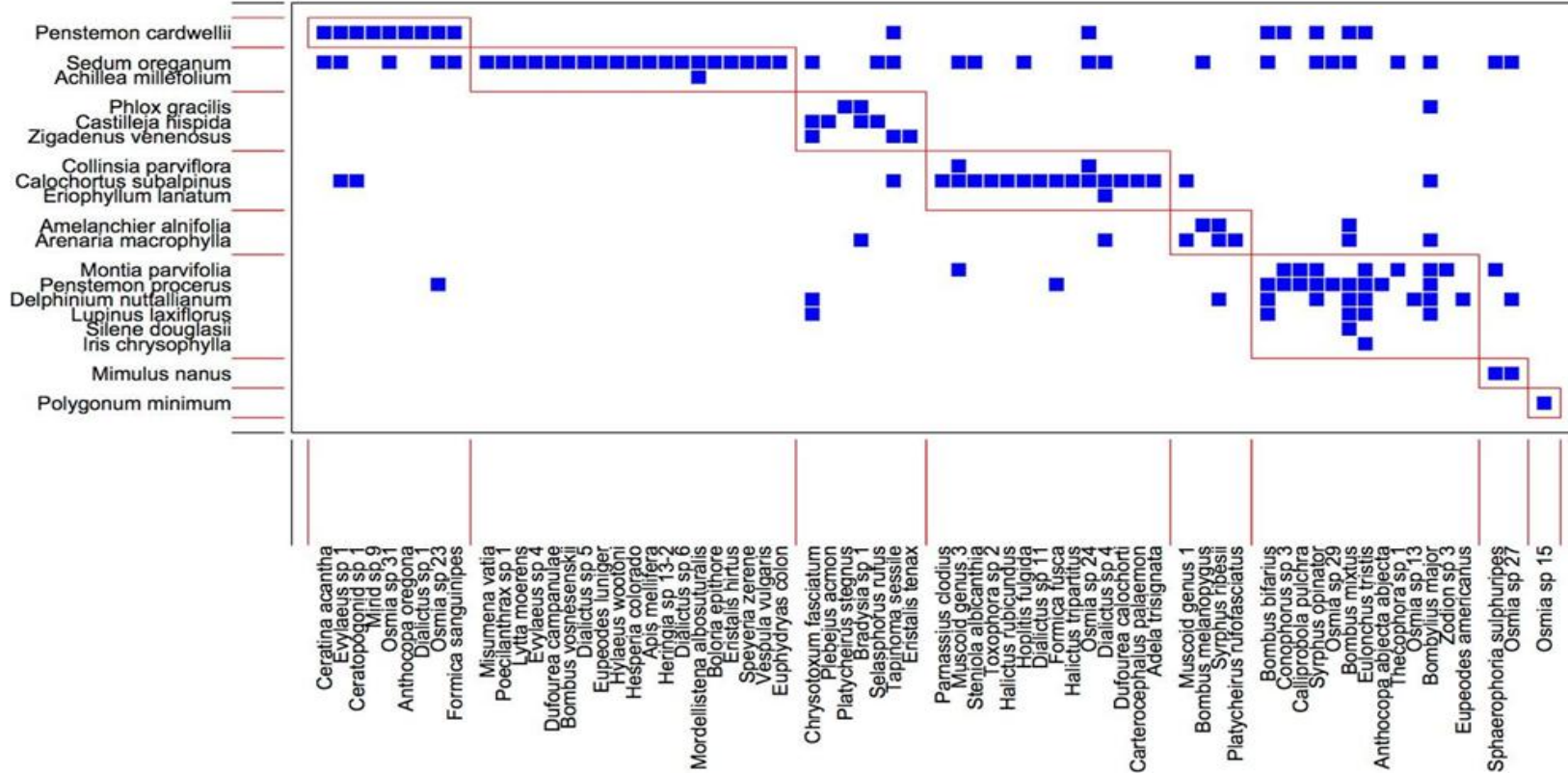
Data

- Interactions
 - 2011 to 2013 interactions data from Carpenter Ridge
- Plant and Insect Traits
 - Provided by Prof. Andrew Moldenke at Oregon State University
 - Included traits such as biomass, tongue length (insects), trophic guild (insects), taxon guild (insects), tube type (flowers), microhabitat (flowers), and lifeform (flowers)

Step 1: Detecting Sub Community Structure

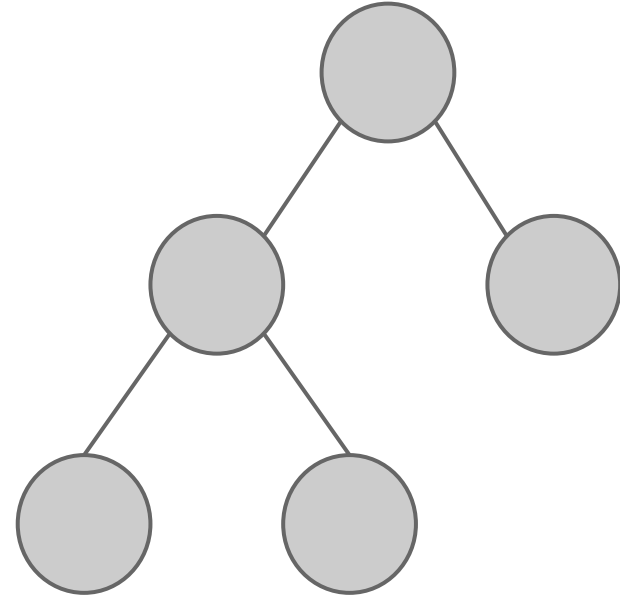
- Goal
 - Maximize connections within modules
 - Minimize connections outside of modules
- Algorithm
 - Starts with random modules
 - Swaps rows and columns in search of more modular arrangements

Carpenter Ridge Network Modules



Step 2: Fitting Classification Trees

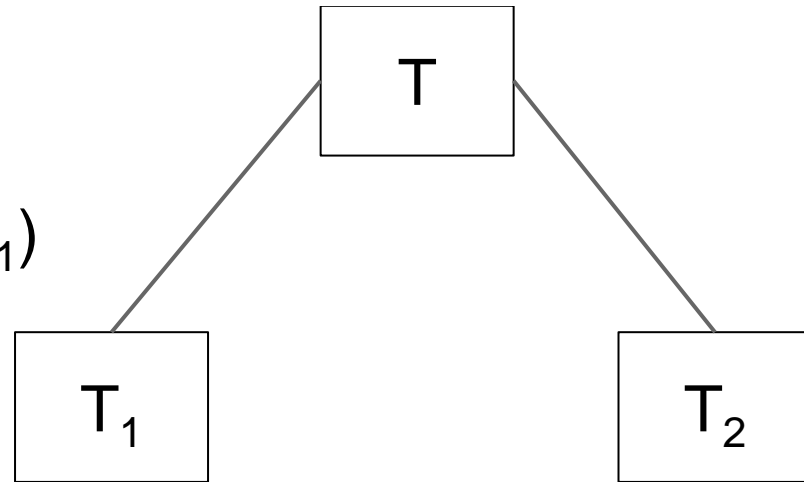
- What are classification trees?
 - Series of nodes and edges
 - Splits cases on a true/false basis
 - Predicts a class of outcome (module)
- Goal
 - Minimize residuals
 - Avoid complex trees



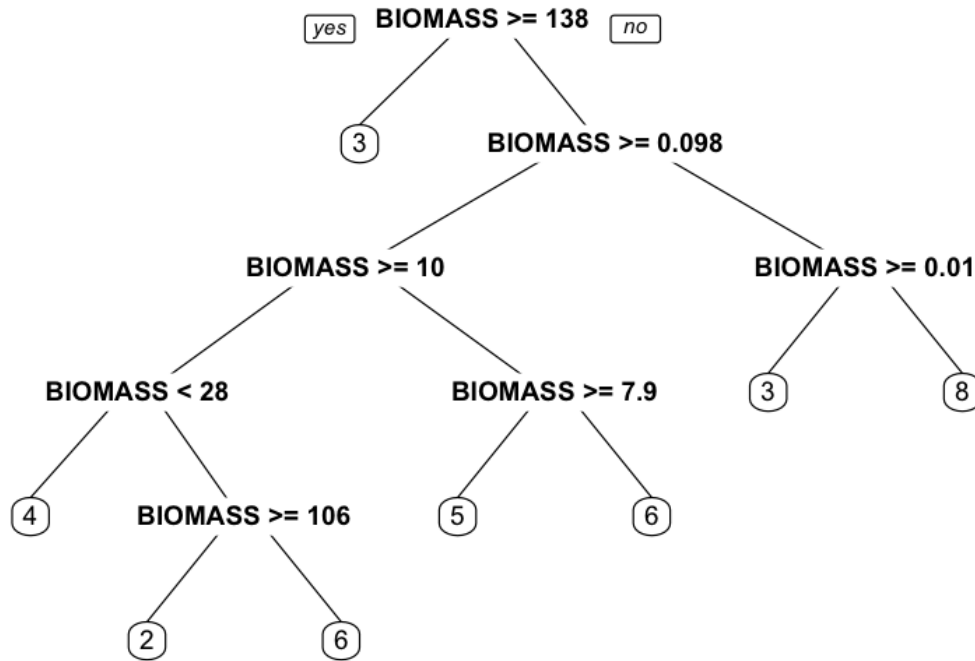
The Classification Tree Algorithm

- The algorithm tries to minimize impurity
 - measured by the Gini index
 - Chooses a split that minimizes the weighted average of $\text{gini}(T_1)$ and $\text{gini}(T_2)$

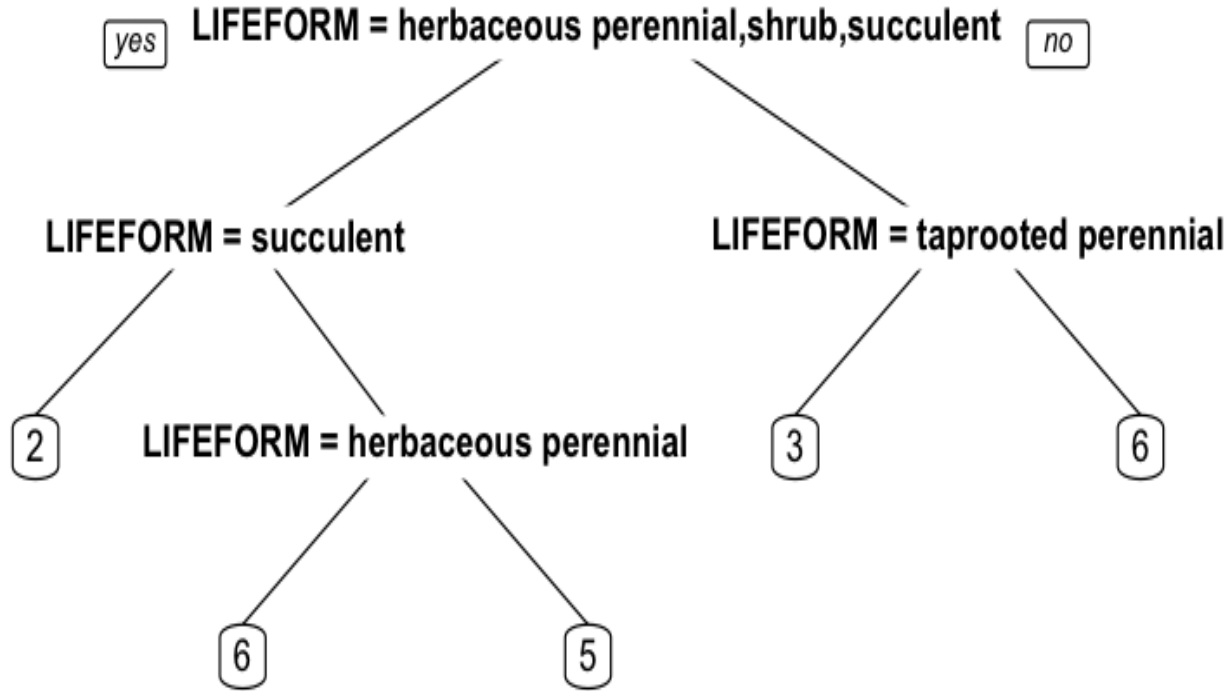
$$\text{gini}(T) = 1 - \sum_{i=1}^n p_i^2$$



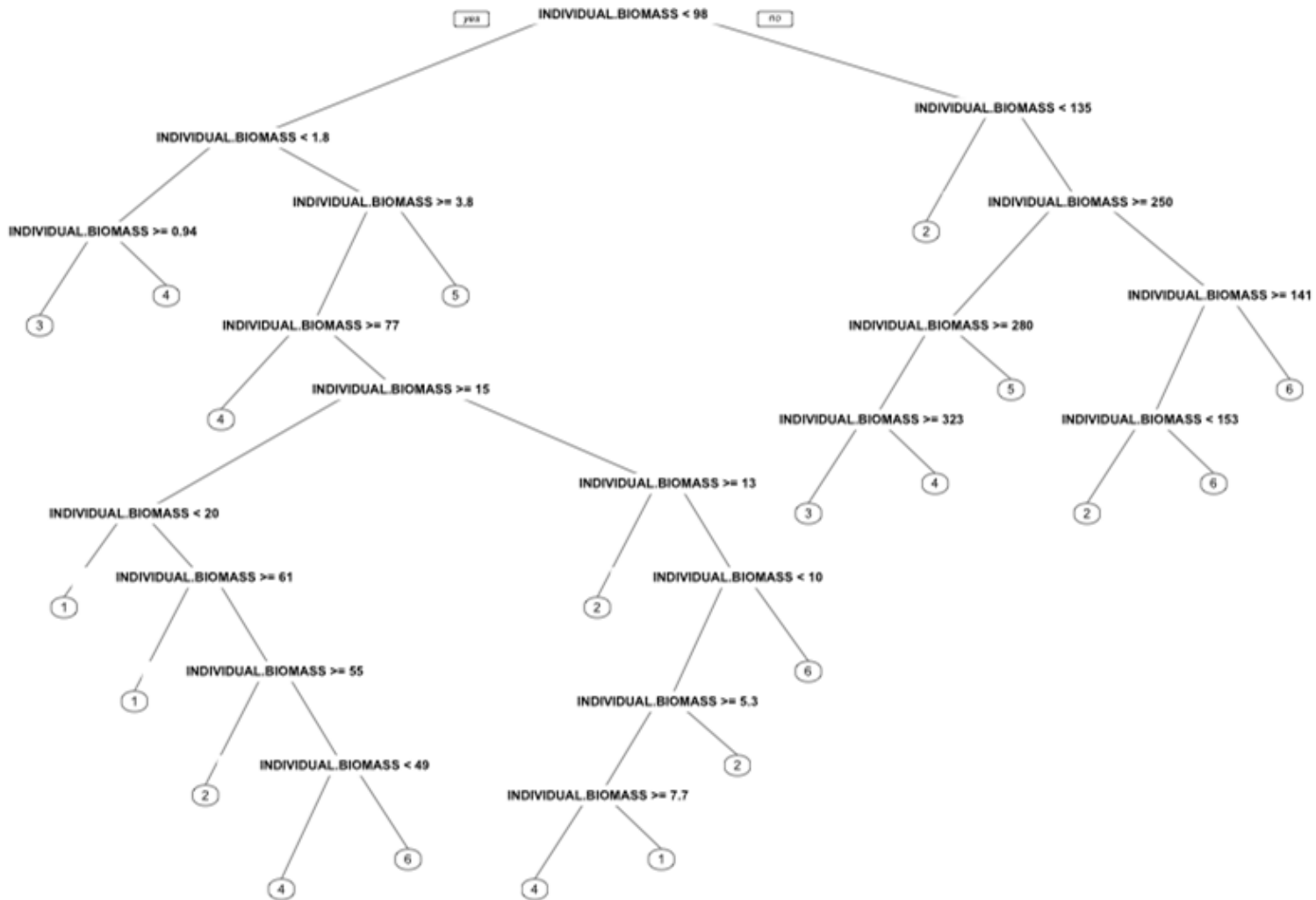
Some trees made by single covariates...



Placed 74%
of species
correctly.



Placed 47% of species correctly



Correctly placed
64% of
insect
species

TAXON.GUILD = Colletid bee, Halictid bee, Lepidopteran, long-lived social bee, Meloid beetle, Mordellid beetle, Muscoid fly, shorter-tongued beefly, Sphecoid wasp, spider, Vespid hornet

TAXON.GUILD = Colletid bee, Meloid beetle, Mordellid beetle, spider, Vespid hornet

TAXON.GUILD = Ant, Hover-fly, Hummingbird, Sciardid fly

TAXON.GUILD = Halictid bee, Lepidopteran, long-lived social bee, shorter-tongued beefly

TAXON.GUILD = Anthophorid bee, Ceratopogonid fly, True-bug

2

3

2

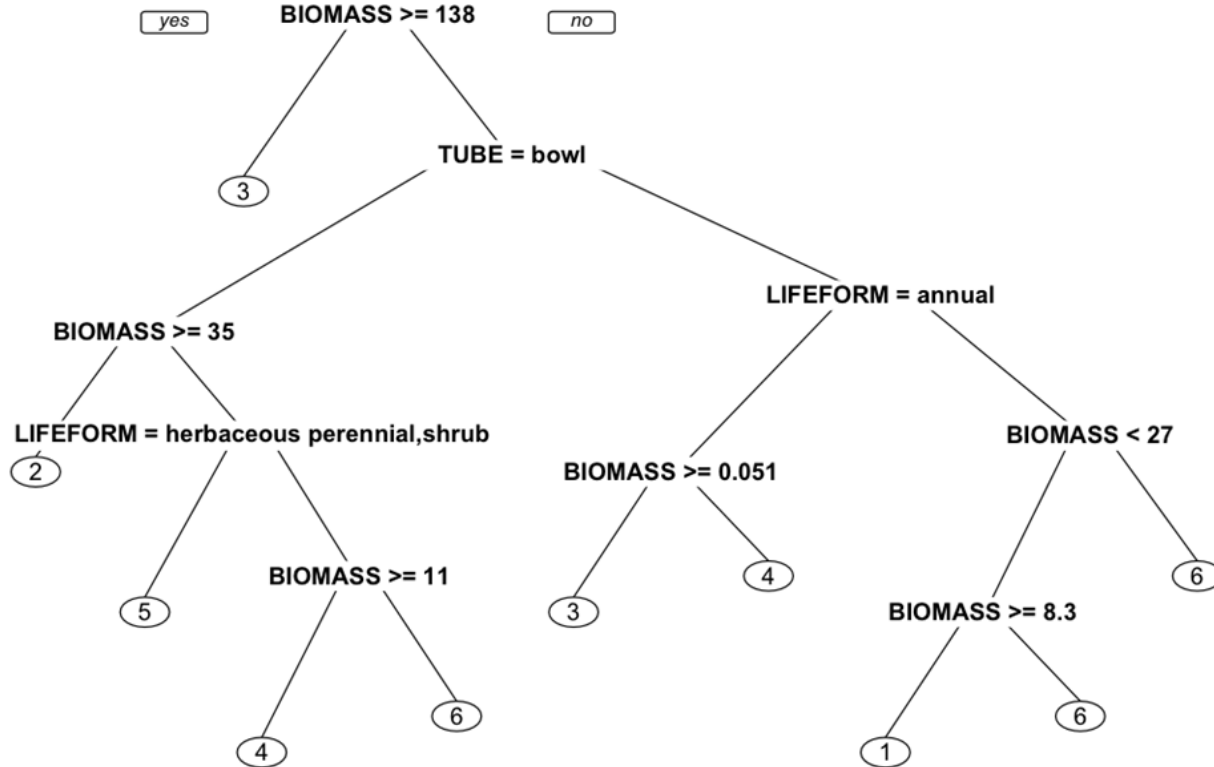
4

1

6

Correctly placed
51% of
insect
species

With multiple covariates, we could improve the trees



Correctly placed
84% of
plant
species

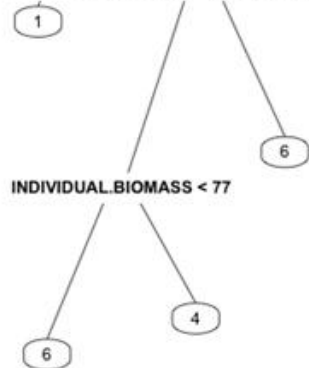
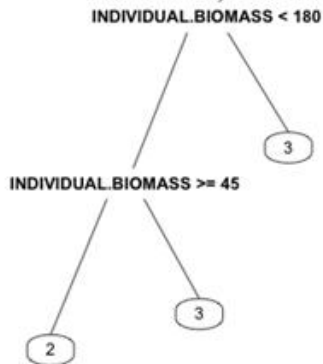
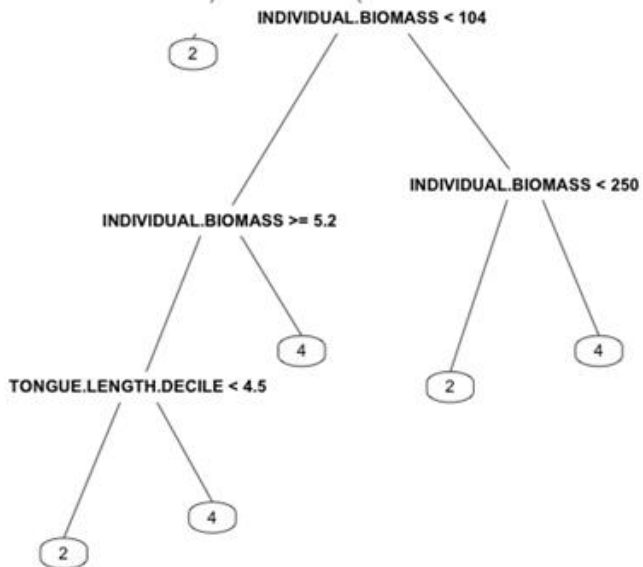
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TAXON.GUILD = , Megachilid bee



Correctly placed 64% of insect species.

Matching plant and pollinator traits by module

- Very few noticeable patterns
- Module 6
 - relatively small plants
 - long-tongued beeflies, conopid flies, and megachilid bees of biomass < 77
- Module 2
 - medium sized flowers with bowl-shaped tubes
 - poorly defined set of insects

Conclusions

- Multiple covariates vs. Single covariate
 - Multiple covariates → generally improved results
 - smaller tree size
 - higher percentage
- Are traits a good predictor of module membership?

Acknowledgments

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Questions?

