

Introduction

- Specialization is a widespread but ambiguous and context dependent concept.
- Specialists are thought to be at a greater extinction risk
- Attempts to classify and define specialization are numerous but often lack context
- Here, specialization is quantified for 141 *Quercus* species using a metric-based framework
- Metrics were chosen based on their ability to represent specialization and their significance in previous literature

The main questions we addressed:

- Can specialization be quantified in an objective, practical, and metric-based manner reliably?
- How does assessment of specialization from experts compare to metric-based rankings of specialization? How do both compare to species threat level?
- How do specialization and generalization emerge at the phylogenetic and geographic level?

Method

Ranking Generation:

Five main metrics were collected for 141 oak species. Points were assigned towards specialization based on where a species' value fell compared to the others in the study. Scores were summed to create a final **Metric-Based Specialization Ranking (MBSR)**.

Model Validation:

Metric-Based Specialization Rankings were statistically tested for correlations against two groups; **Average specialization score as assessed by *Quercus* scientists and experts**, and against **IUCN Red List designations**.

Geographic and Phylogenetic Analyses:

Geographic distributions were tested using Moran's I on mean **MBSR**, Variance, and Species Count by **Ecoregion**.

Phylogenetic Generalized Least Squares (PGLS), Blomberg's *K* and Pagel's λ , and Ancestral Character State Reconstruction were used to test phylogenetic hypotheses.

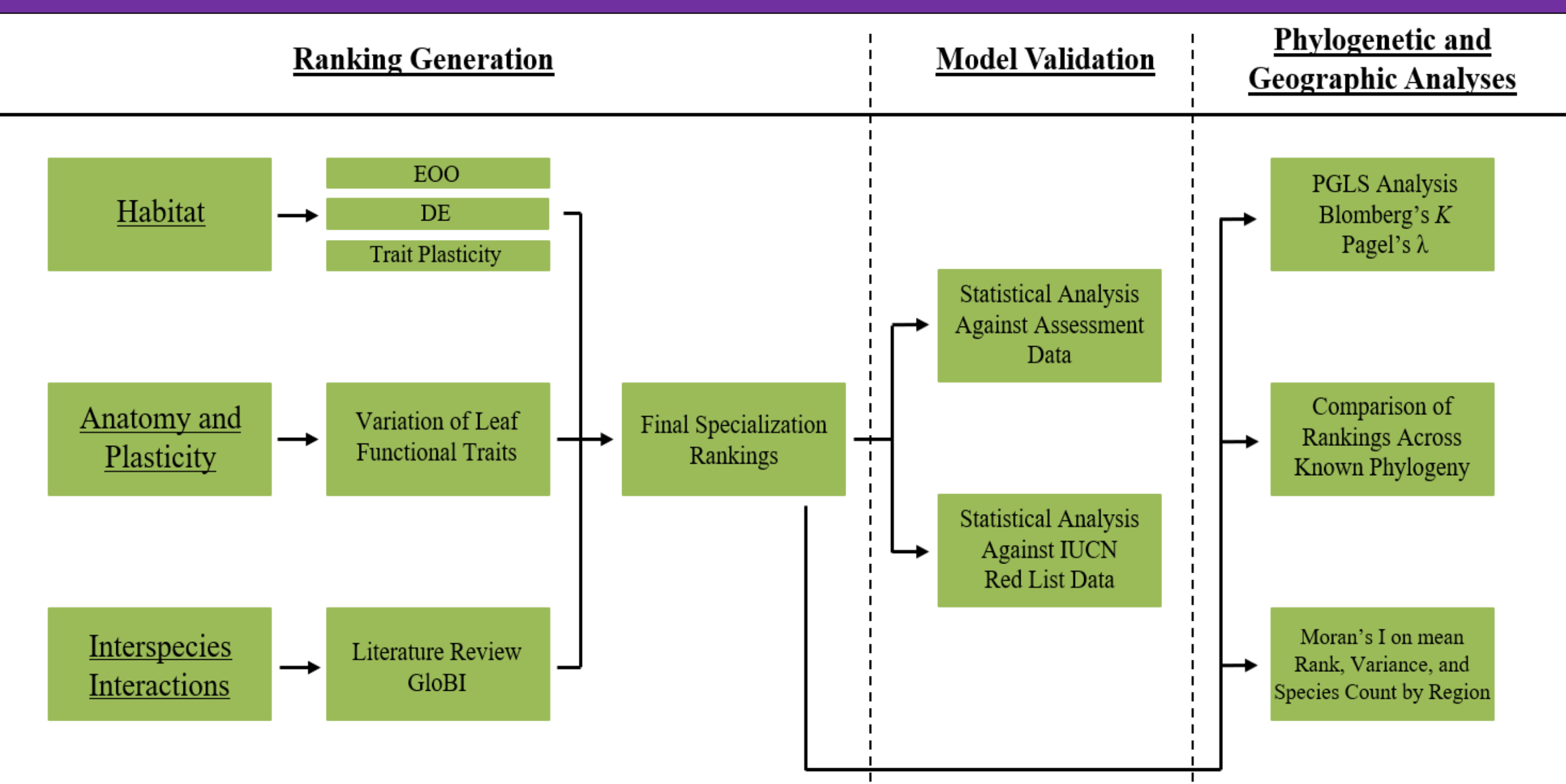


Figure 1. Flowchart of overall methodology. Concepts related to specialization were identified, and metrics representative of them were gathered for all 141 *Quercus* species. These data were used to create **Metric-Based Specialization Rankings**, which were then used in a variety of analyses.

Results

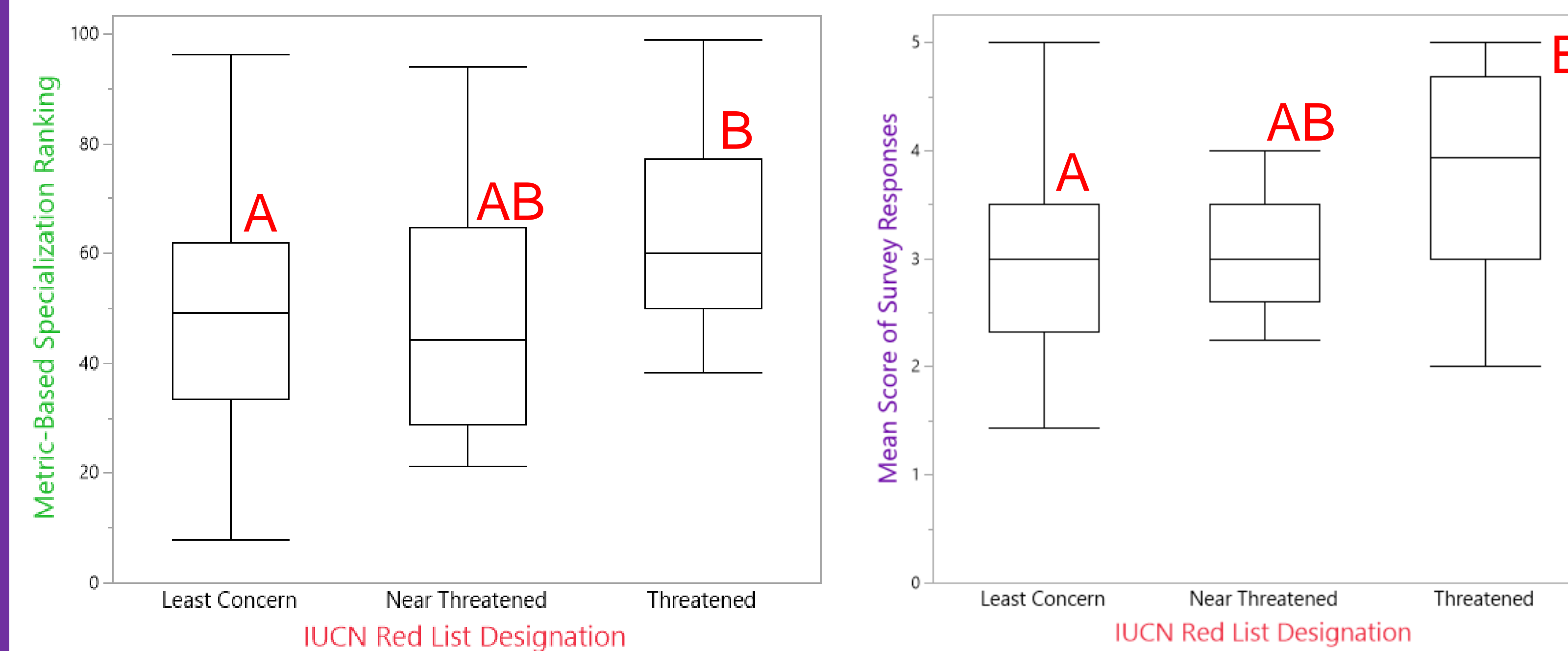


Figure 2. One-way ANOVA results between IUCN Red List Designations, Metric-Based Specialization Rankings, and Mean Score of Survey Responses. Displayed with Tukey-Kramer Connecting letters reports.

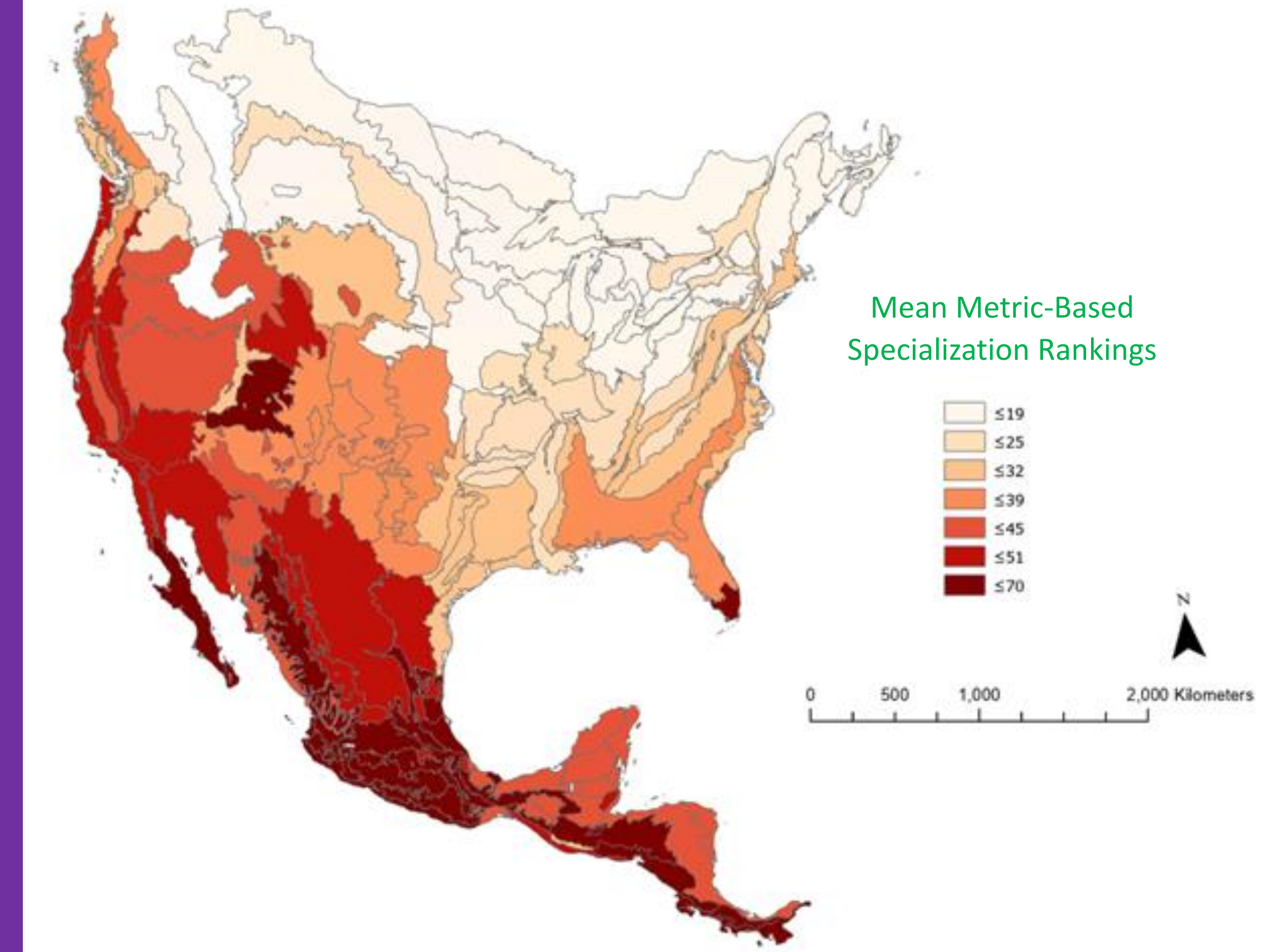


Figure 4. Mean MBSR of oaks within each Ecoregion.

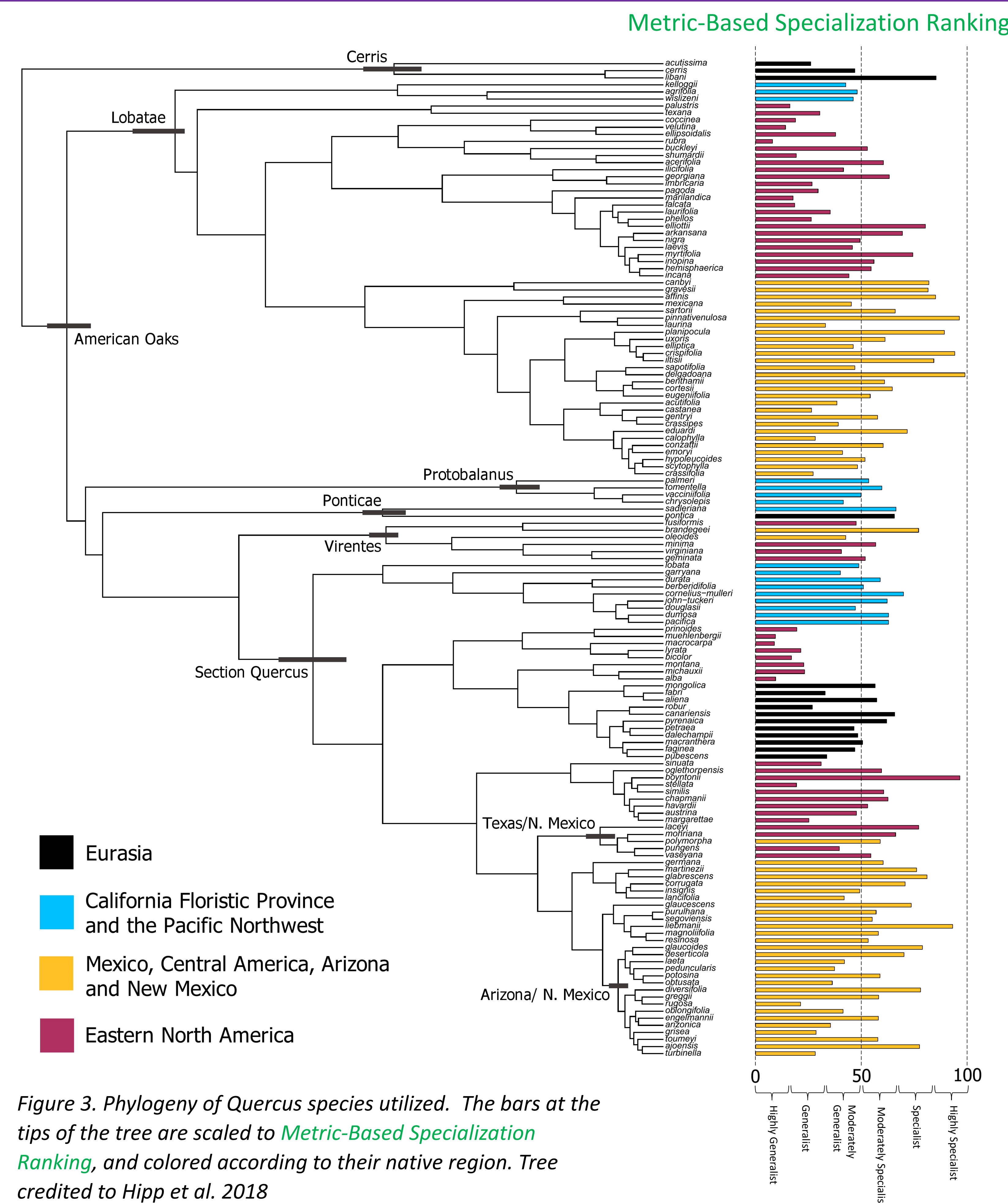


Figure 3. Phylogeny of *Quercus* species utilized. The bars at the tips of the tree are scaled to **Metric-Based Specialization Ranking**, and colored according to their native region. Tree credited to Hipp et al. 2018

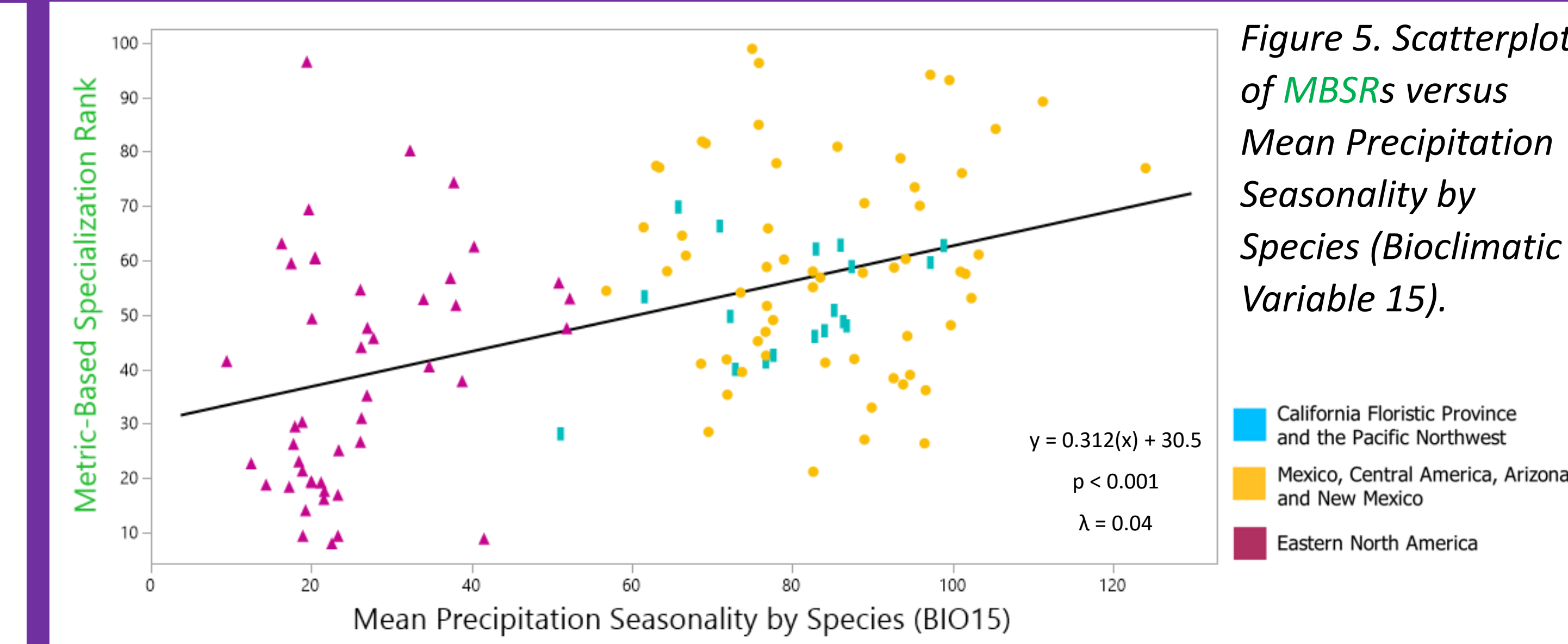


Figure 5. Scatterplot of MBSRs versus Mean Precipitation Seasonality by Species (Bioclimatic Variable 15).

Conclusions

- MBSR's can be representative of specialization in a consistent and practical manner with significant correlations to relevant metrics (Figure 2).
- Both **individual assessment** and **MBSR's** are viable methods of identifying a species' **threat level**. Data deficient species were more likely to be highly specialized, and higher specialization was positively correlated with greater **IUCN threat level**.
- MBSR's can reveal interesting insights when paired with the appropriate phylogenetic and geographic data (Figures 3-5).
- Specialization is shown to be largely influenced by environmental factors and moderately influenced by evolutionary history.
- The ancestral *Quercus* lineage comes from a moderately generalized ancestor (**MBSR of 44**).
- Frameworks for characterizing specialization using metric ranking are shown to be able to identify threatened species.

References & Acknowledgements

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