

Morphological and ecological diversity in mainland *Draconura* clade anoles



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INTRODUCTION

Anoles are a diverse group of lizards that inhabit Central and South America as well as the Caribbean Islands. The Caribbean anoles are a well known example of repeated convergent evolution and can be categorized into six distinct ecomorphs based on their morphology and ecology. The mainland anoles, however, do not appear to conform to the same set of ecomorphs, but are also not extensively studied as compared to their Caribbean counterparts. The *Draconura* clade contains 150+ species of mainland anoles, but remains as one of the proportionately least-known groups (Poe et al., 2017).



OBJECTIVES

1. To compare the morphology of mainland *Draconura* clade anoles with Caribbean species.
2. To determine whether mainland anoles can be sorted into the main ecomorph classes or if they form their own morphological groups.
3. To examine patterns of morphological evolution in mainland anoles.

METHODS

We measured 15 morphological traits for 79 mainland *Draconura* species and 31 Caribbean species (1-5 specimens per species). The data was *ln* transformed and then size corrected with a linear regression model. The residuals of the regression were averaged per species then used as the data points for analysis.

To contrast the morphology of the mainland and Caribbean anoles, a phylogenetically informed principal component analysis was performed.

To group species based on morphology (morphotypes), the pc scores were used in a hierarchical clustering method (UPGMA).

To determine the distinguishing traits for each morphotype, a discriminant function analysis was conducted.

To map out patterns of morphotype evolutionary history, an ancestral state reconstruction model was used

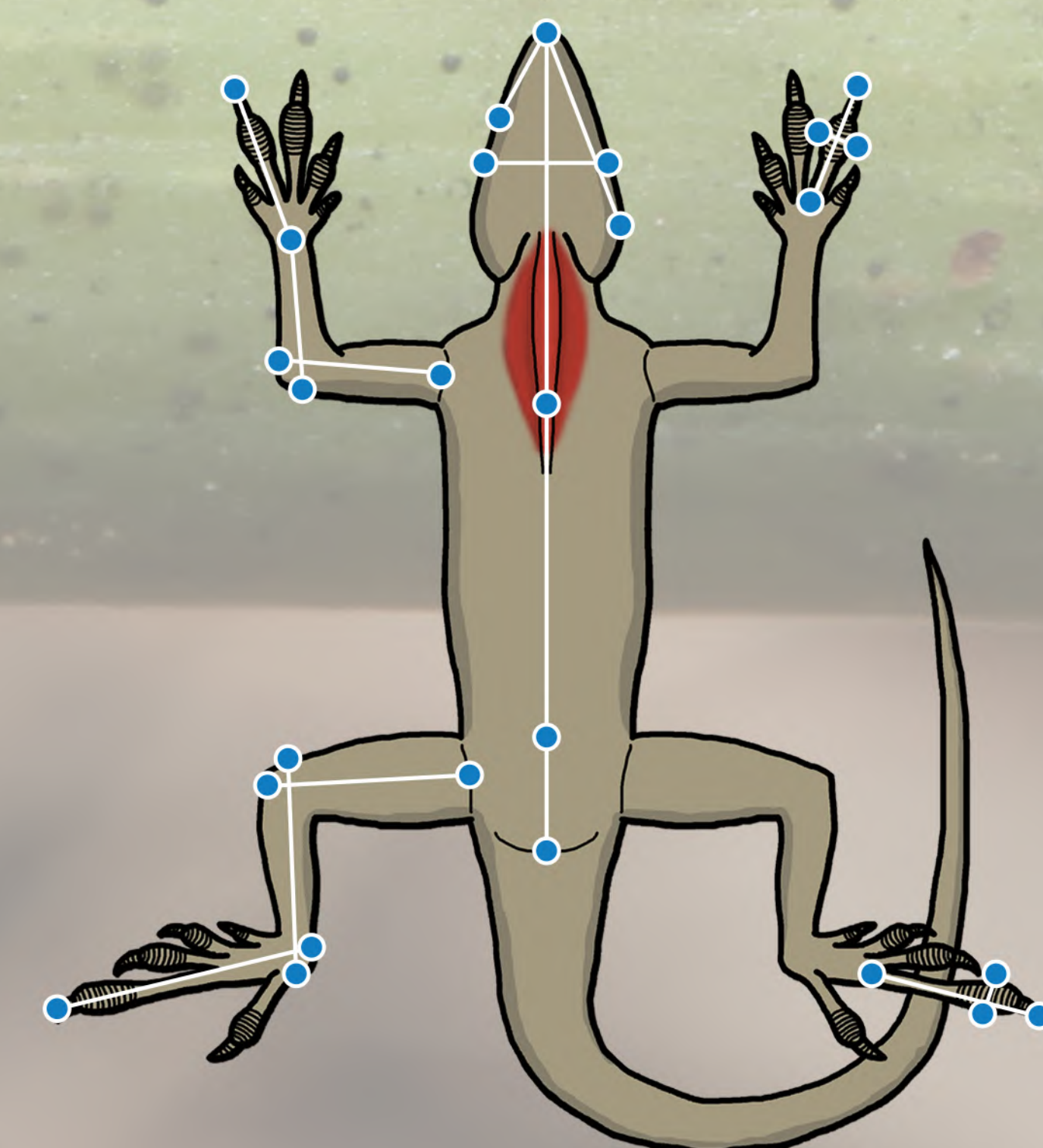


Figure 1. A diagram of an anole (ventral view) showing the 15 measured traits known to have ecological significance

MORPHOLOGICAL DIVERSITY

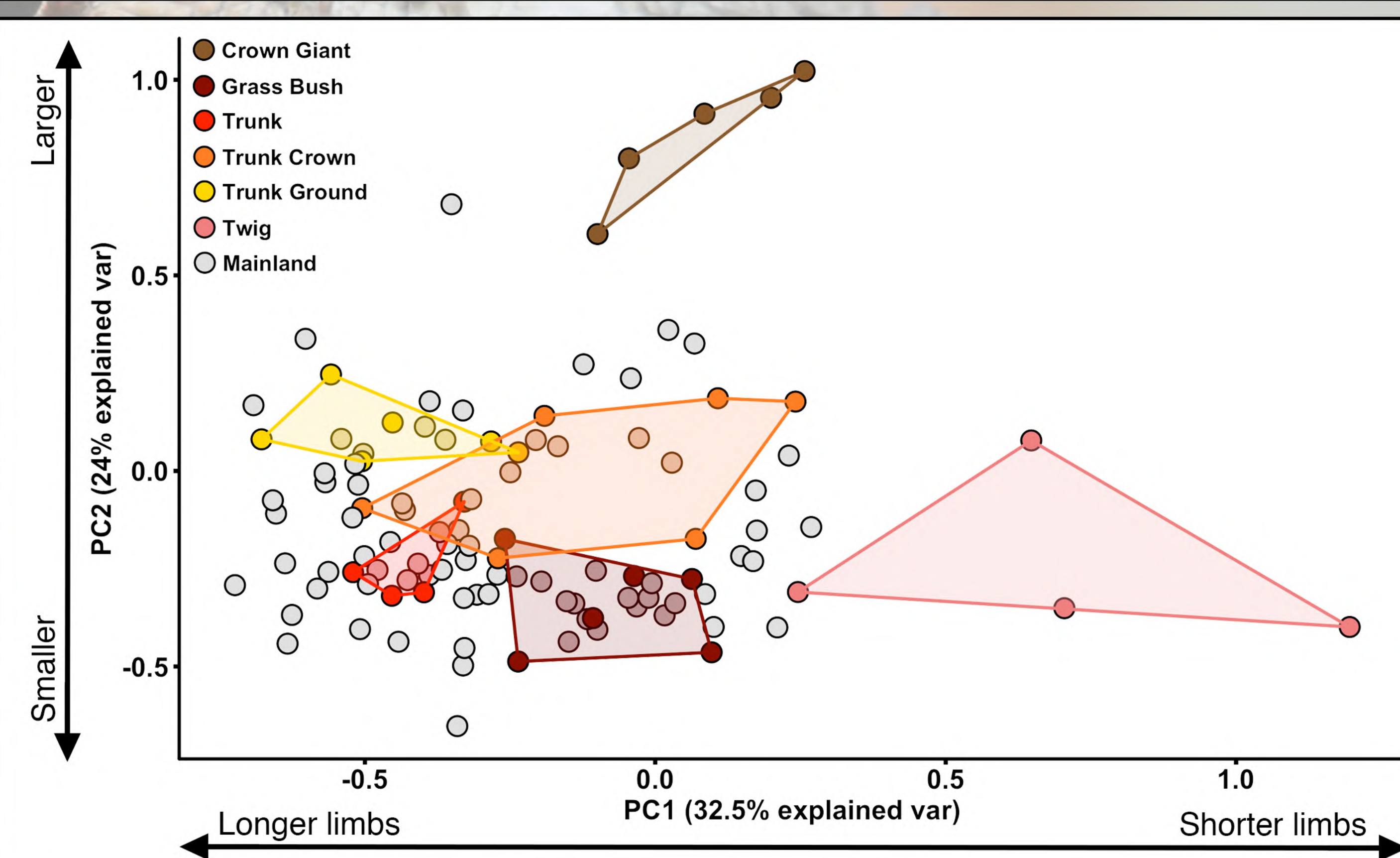


Figure 2. A phylogenetically informed principal component plot displaying the morphological diversity of the *Draconura* clade and Caribbean anoles. Polygons were drawn to indicate the morphological space occupied by each Caribbean ecomorph.

MORPHOTYPE CLUSTERING

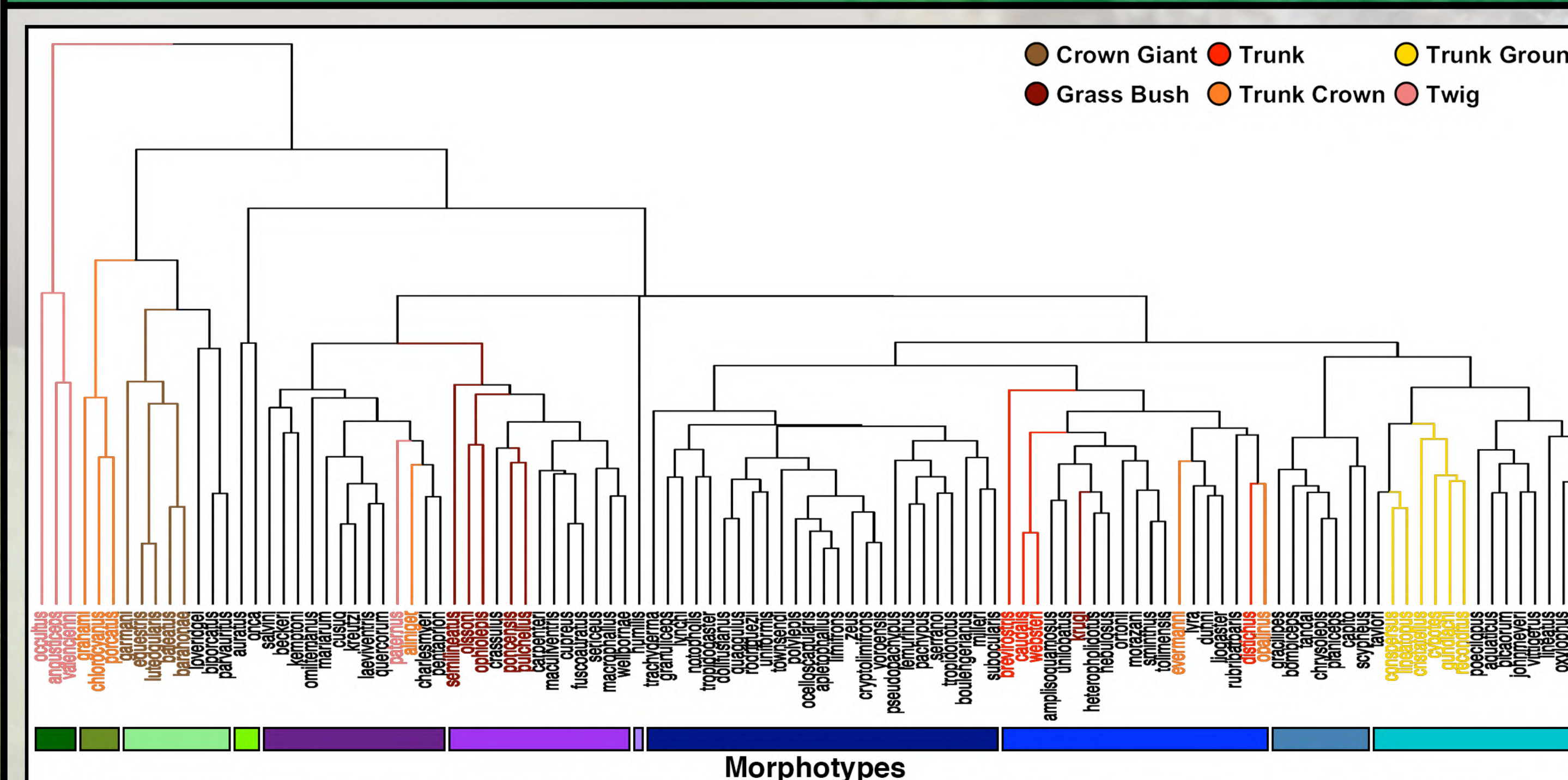


Figure 3. A dendrogram showing the hierarchical relationship between species as determined by the UPGMA with the Caribbean ecomorphs colored for reference. Colored bars also show how the clusters were used to form morphotypes.

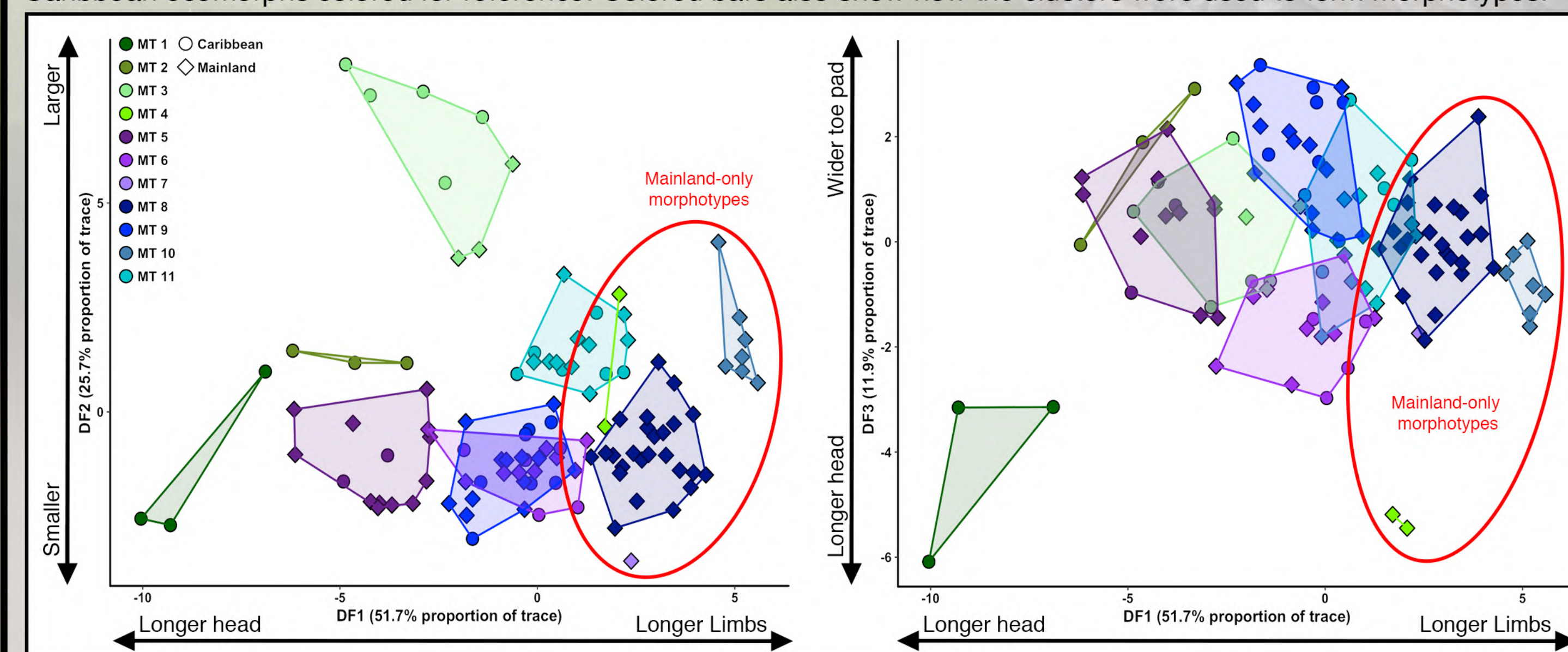


Figure 4. Two discriminant function analysis plots that emphasize the morphological traits that can be used to differentiate each of the morphotypes. Polygons were drawn to better visualize the morphological space occupied by each morphotype, while the ellipses indicate the mainland-only morphotypes.

MORPHOTYPE EVOLUTION

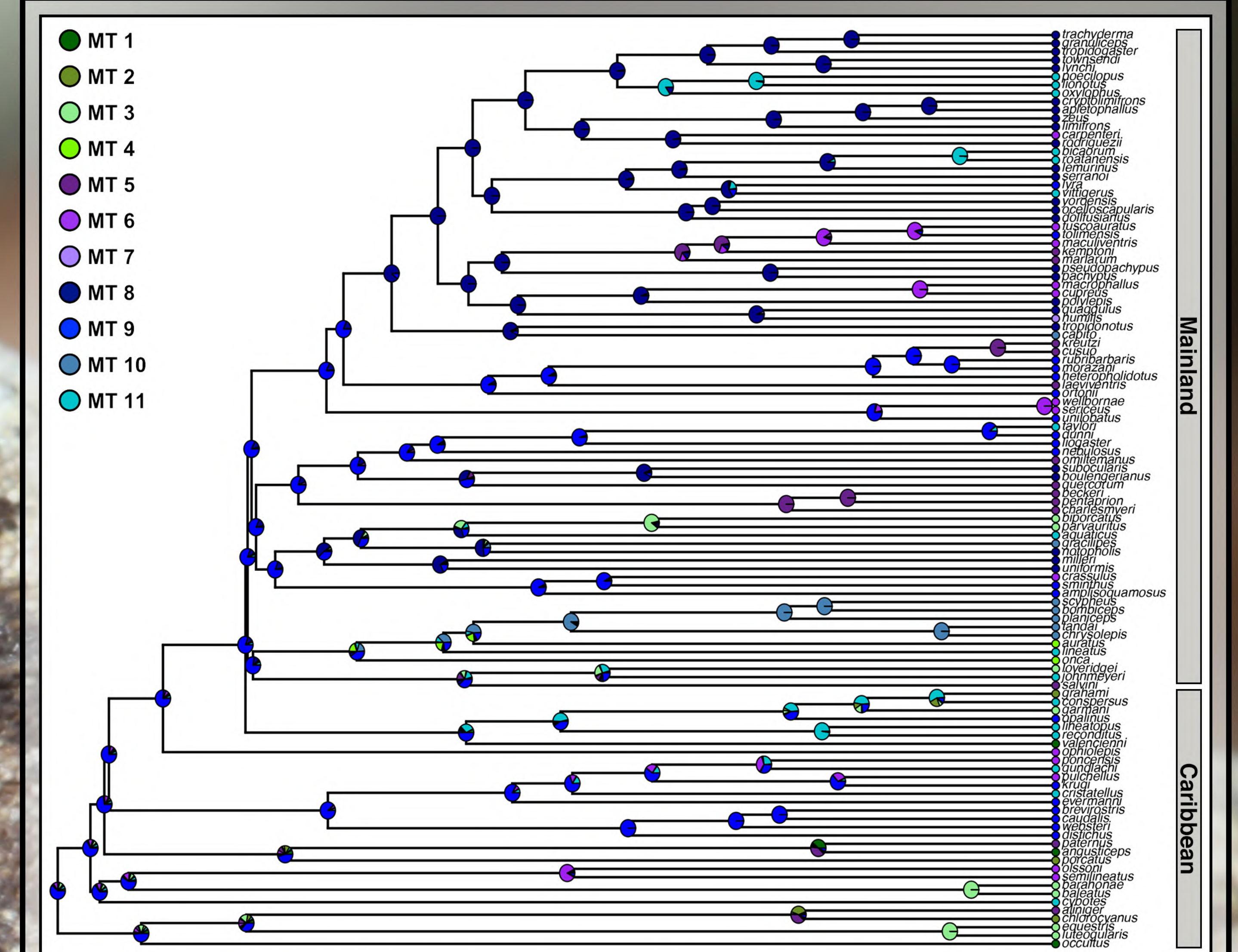


Figure 5. The results of an ancestral state reconstruction analysis using a "equal rates" model plotted on a phylogeny showing the evolutionary history of the morphotypes. Phylogenetic tree modified from Poe et al. (2017).

CONCLUSION

1. Some mainland *Draconura* species occupy a similar morphological space as some of the Caribbean ecomorphs, while others do not.
2. Many mainland and Caribbean species were placed within the same morphotype, while some morphotypes were exclusively comprised of either mainland or Caribbean species.
3. Each morphotype, with the exception of MT 7, has evolved several times, which provides evidence for convergence on the mainland.
4. The inference of mainland-only morphotypes suggests unrecognized ecomorphs that are exclusive to Central and South America, but future studies are required to determine whether members of these morphotypes share common ecologies.

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