Discovering Diagnostic Traits for Hidden Species in the Lichen Genus *Peltigera*

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Introduction

- At a minimum, lichens are a symbiosis between a fungus and either a green alga or a cyanobacterium.
- Lichens are complex and variable, often leaving lichenologists with limited morphological traits to accurately identify species.
- Using molecular data, lichenologists have discovered several species hidden within traditionally morphologically-delimited species of many genera.

Figure 1: *Peltigera praetextata* Copyright: J. Hollinger - Ways of Enlichenment

- The lichen genus *Peltigera* is an excellent example of this, with >50 new species recently discovered within existing species concepts (Magain et al. 2018).
- Anatomy has been used successfully to discriminate outwardly similar species among some genera, but has not been examined quantitatively in this genus.

Purpose

- To use anatomical traits to help differentiate previously hidden species of *Peltigera* sequenced through a collaboration between the Alberta Biodiversity Monitoring Institute (ABMI) and Duke University.

Methods

- **Anatomical Measurements:**
  - Using samples collected from ABMI sites, we created two kinds of sections: *longitudinal* (LS) and *transverse* (TS)
  - Examine all quantitative qualities of specimens when the samples are wet and dry
  - Traits were measured using Leica digital software and scaled photos of sections
  - <u>Dry Section:</u> minimum and maximum section thickness, upper cortex (including tomentum), algal layer, medulla, pilemma/veins

Figure 2: A slide with LS and TS *Peltigera* sections

  - <u>Wet Section:</u> minimum and maximum section thickness, tomentum, upper cortex, algal layer, medulla, veins

- **Comparative Analysis:**

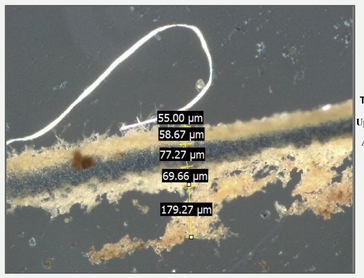

Figure 3: *P. fuscopraetextata*, wet

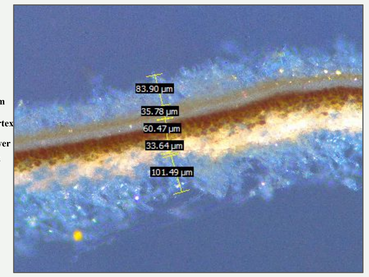

Figure 4: *P. praetextata,* wet

  - Compare the traits measured of select molecularly-delimited species in R statistical software.
  - Determine any distinguishing features that can be used to identify molecular species

Results

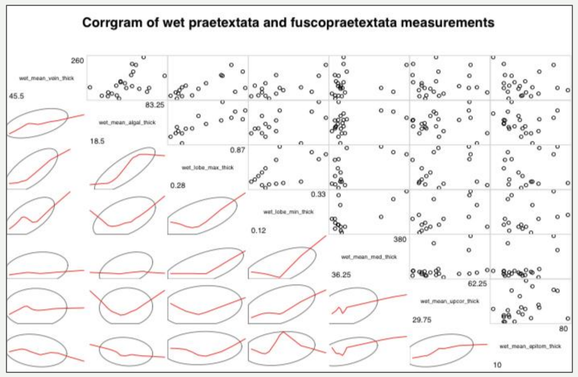

Figure 5: Correlations in anatomy metrics. Upper panel shows scatter plots, the lower panel shows confidence ellipses and smoothed lines, and the range of each metric is annotated on the diagonal.

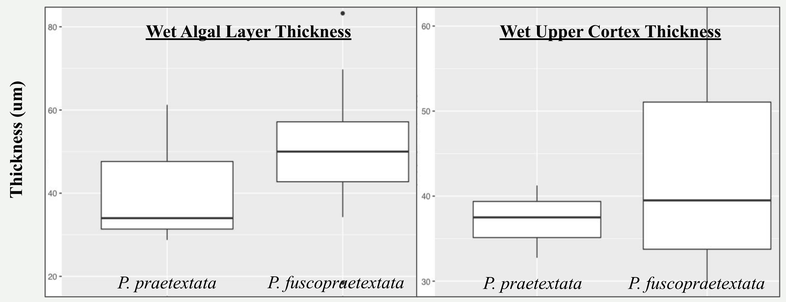

Figure 6: Boxplots comparing the two species' algal and upper cortex thickness. Boxes represent the minimum, 25% percentile, median, 75th percentile and maximum values.

Preliminary Conclusions

- While we are conducting these measurements for >10 species, here we provide some preliminary comparisons between two outwardly similar *Peltigera* species.
- There are weak correlations between anatomical traits within both species, suggesting that most traits vary independently (Figure 5).
- *P. praetextata* has a thinner algal layer on average as compared to *P. fuscopraetexta* (Figure 6).
- The upper cortex is thinner and less variable in *P. praetextata* as compared to *P. fuscopraetextata* (Figure 6)
- More replication is needed for both species for robust statistical comparisons

Future Work

- More measurements for more accurate representation of anatomical variation
- Analyze data to look for patterns among species
- If anatomy can be used to differentiate species, it will allow more accurate identification without the need for molecular data.

Figure 8: *P. rufescens* living its best life

Acknowledgements

- I would like to thank my PI, supervisor, and the rest of my research team for aiding me in my all my learning and development.
- Finally, I would also like to thank WISEST for supporting me in making this experience possible.

<u>References:</u>

- Magain, N., Tniong, C., Goward, T., Niu, D., Goffinet, B., Sérusiaux, E., Vitikainen, O., Lutzoni, F. and Miadlikowska, J. (2018), Species delimitation at a global scale reveals high species richness with complex biogeography & patterns of symbiont association in Peltigera section Peltigera (lichenized Ascomycota: Lecanoromycetes). Taxon, 67: 836-870. https://doi.org/10.12705/675.3