Spot the difference: Can physical traits replace DNA to identify cryptic *Peltigera* lichens?
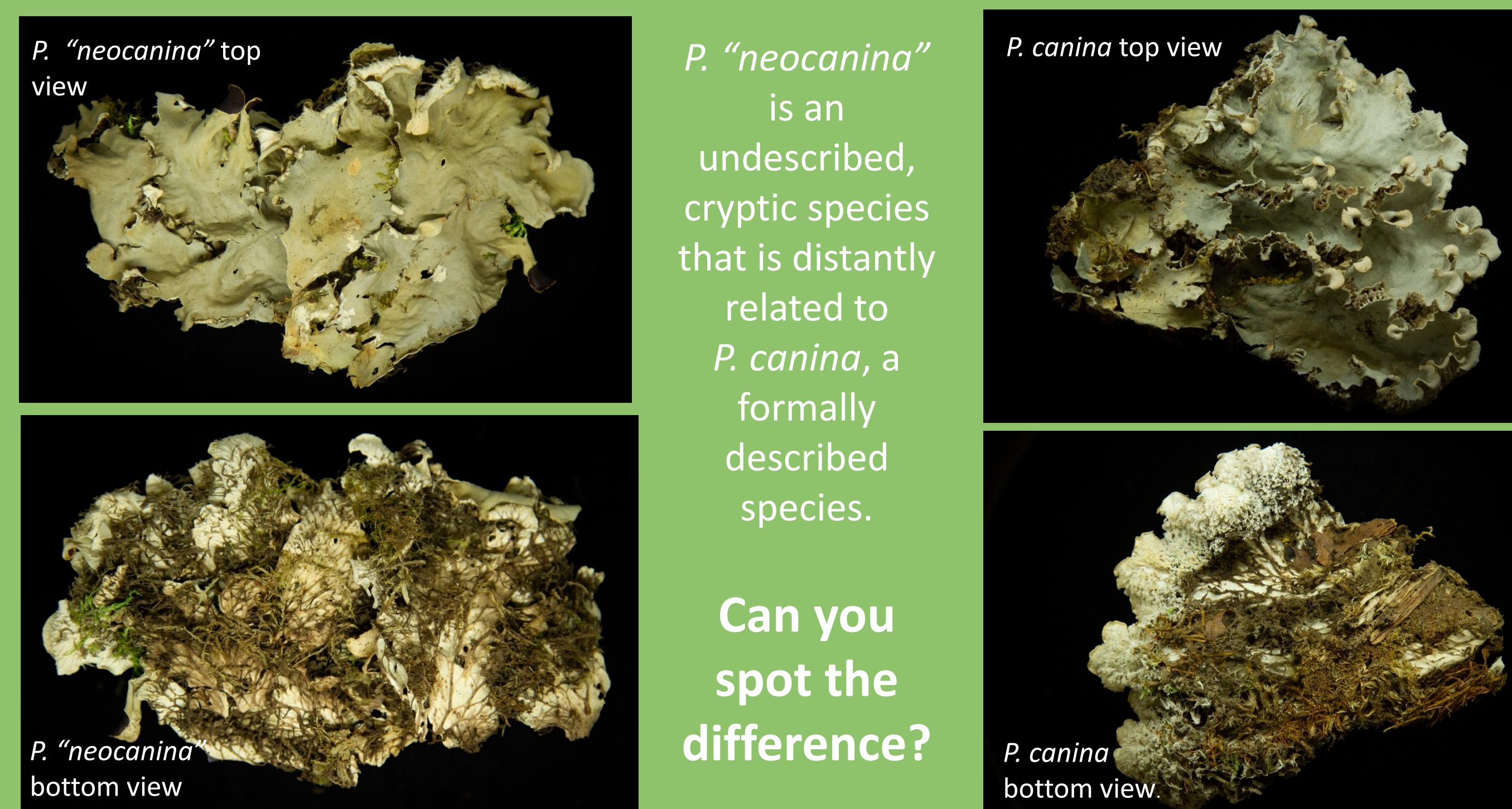
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Introduction

- "A lichen is not a single entity, but a composite of a fungus and an organism capable of producing food by photosynthesis." (Brodo *et al.*, 2001)
- Cryptic species look the same but are genetically and evolutionarily distinct. *Peltigera* lichens have many undescribed cryptic species (Magain *et al.* 2018).
- Accurate conservation assessments and species counts require scientists to identify cryptic species. To date, identification has required molecular data. We investigated physical traits as possible proxies for genetic data.
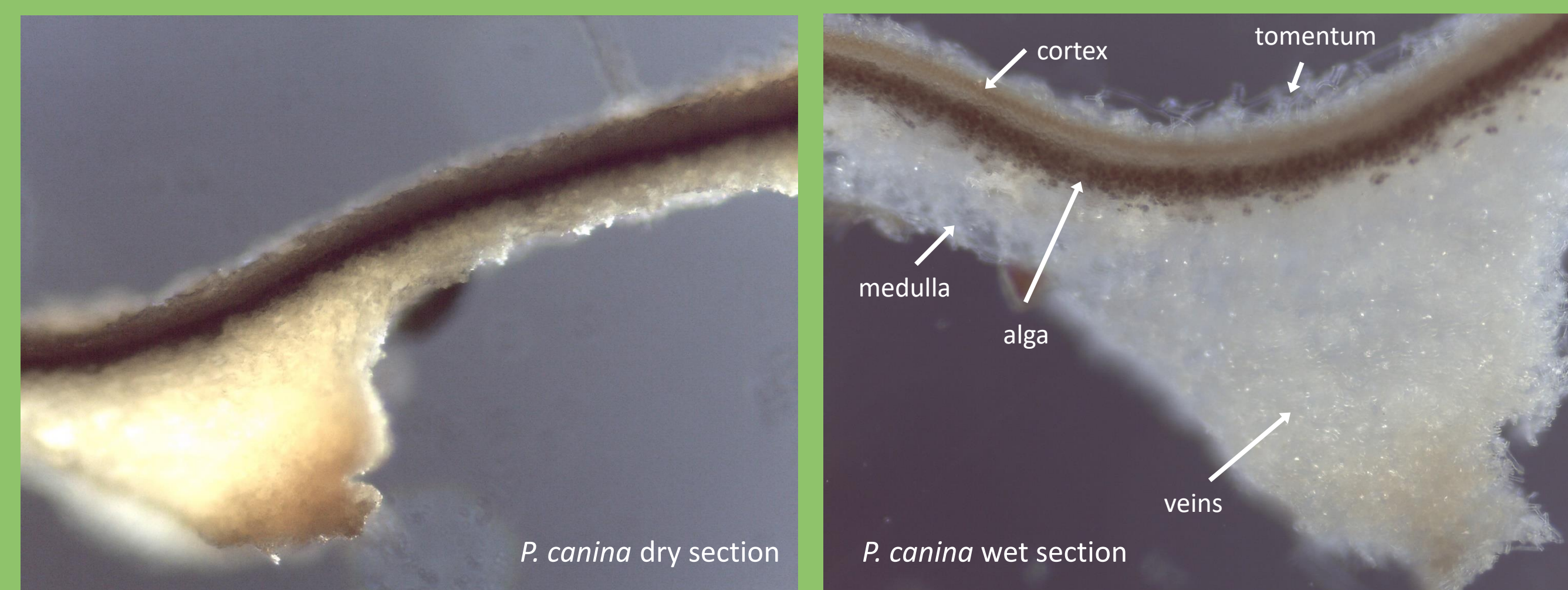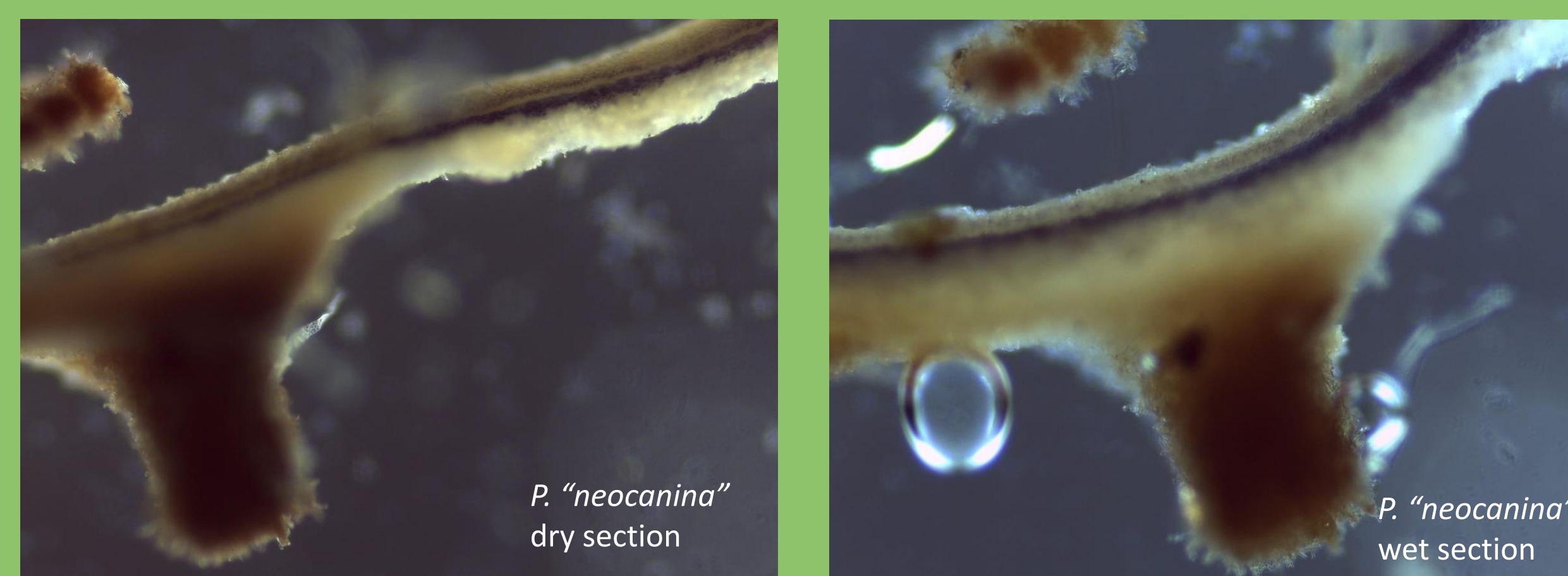

P. "neocanina" top view

P. "neocanina" bottom view

P. canina top view

P. canina bottom view.

P. "neocanina" is an undescribed, cryptic species that is distantly related to *P. canina*, a formally described species.

Can you spot the difference?

Purpose

- To investigate physical traits to differentiate cryptic species without genetic data in the lichen genus *Peltigera*
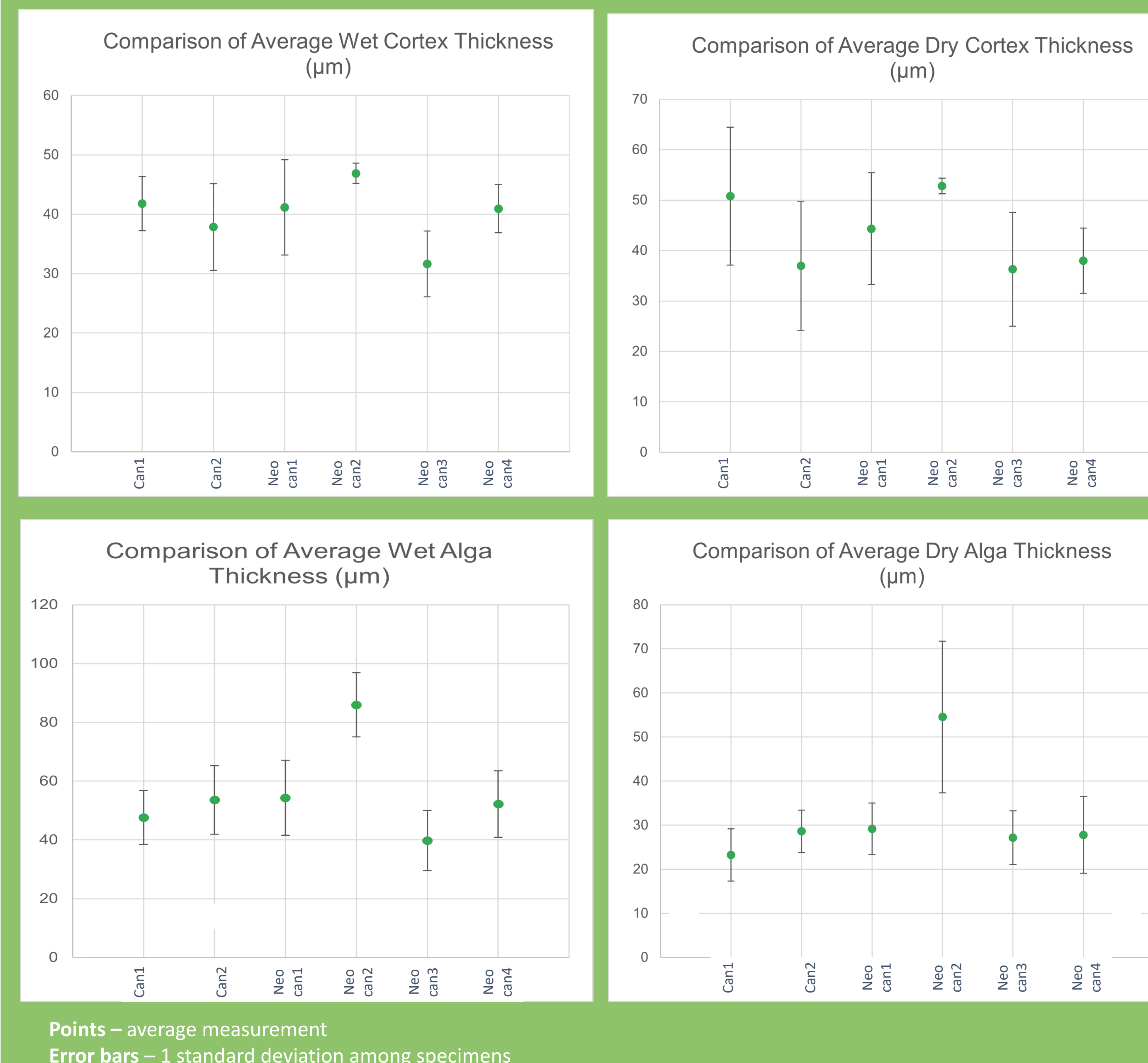
Methods

- **Anatomical measurements**
  - Sectioned specimens from around the world to create slides.
  - Under a microscope take photos of dry and wet sections using the Leica LAS EZ software

P. "neocanina" dry section

P. "neocanina" wet section

(Results section - top)

cortex

tomentum

medulla

alga

veins

P. canina dry section

P. canina wet section

- Examine the anatomical traits by taking measurements.
- <u>DRY:</u> minimum, maximum, cortex, alga, medulla, veins.
- <u>WET:</u> minimum, maximum, tomentum, cortex, alga, medulla, veins.

Results

Comparing cortex and alga thicknesses between *P. canina* and *P. "neocanina"*

Comparison of Average Wet Cortex Thickness (µm)

Comparison of Average Dry Cortex Thickness (µm)

Comparison of Average Wet Alga Thickness (µm)

Comparison of Average Dry Alga Thickness (µm)

Points – average measurement
Error bars – 1 standard deviation among specimens

Conclusions

- *P. canina* and *P. "neocanina"* have similar anatomical dimensions and wet:dry ratios, suggesting their similarities are more than 'skin deep'.

Simplified phylogeny showing *P. canina* and *P. "neocanina"* from Magain *et al.*, 2018.

- We conclude we cannot use the physical traits investigated to separate these cryptic species. Gene sequencing is the only means of identification right now for *P. canina* and *P. "neocanina*."
- The species look similar but have different evolutionary histories, suggesting convergent evolution. They could physically resemble each other because of similar environmental factors shaping their structure.

Future Work

P. Islandica top view
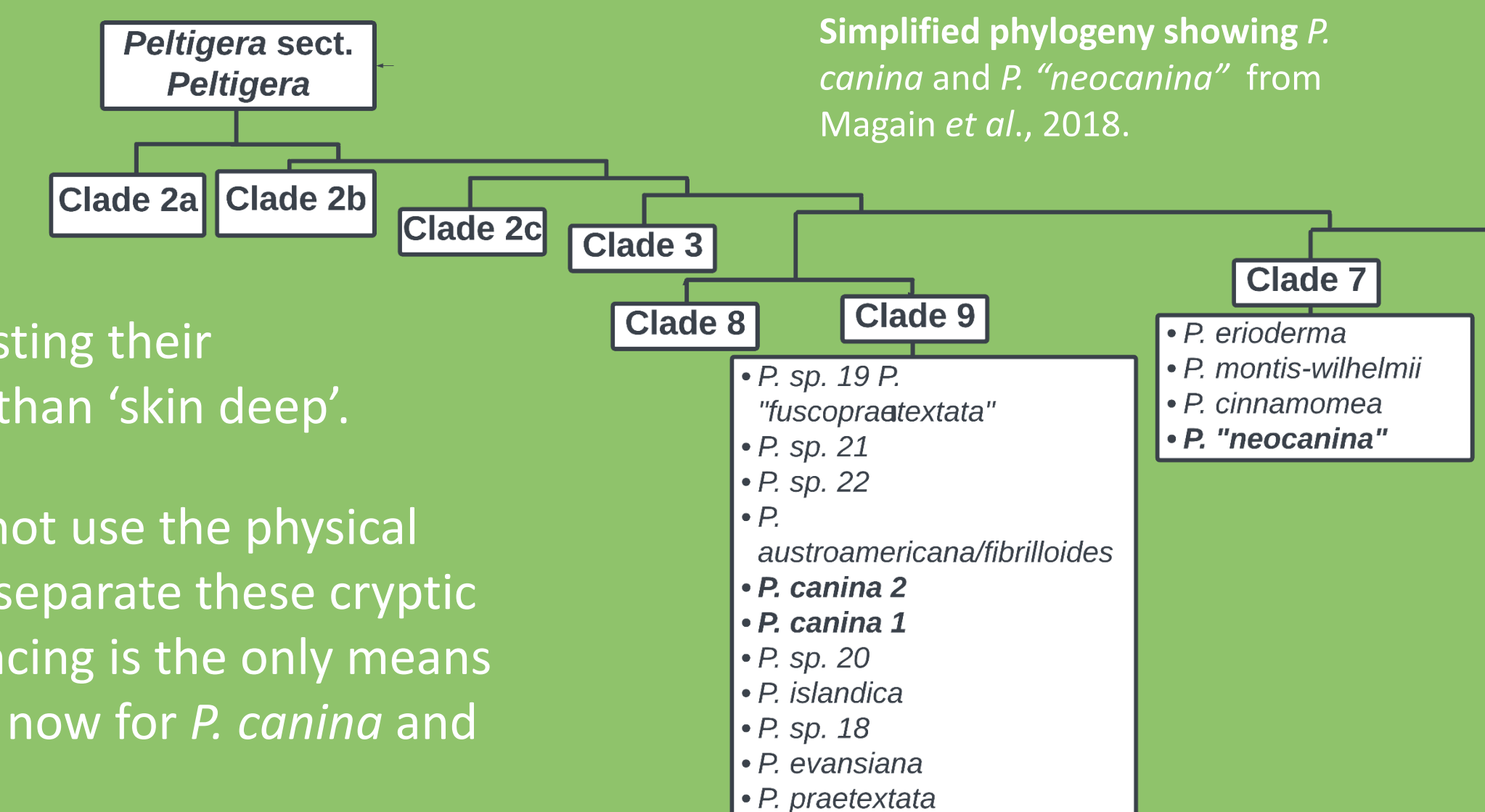
- Investigate the environmental factors that could have affected the development of similar physical traits.
- Compare and contrast *P. canina* and *P. "neocanina"* with other *Peltigera* attributes to investigate if physical traits are more distinct between other *Peltigera* species or clades.

Acknowledgements & References

References:

Magain *et al.* (2018) Species delimitation at a global scale reveals high species richness with complex biogeography and patterns of symbiont association in Peltigera section Peltigera. Taxon 67 (5): 836-870.

Brodo *et al.* (2001) Lichens of North America. Yale Press.