

New records of hemiepiphytes provide insight into the evolution of fern habit

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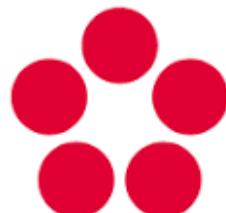
Heveakore Maraia

Dept. of Ecosystem Biology

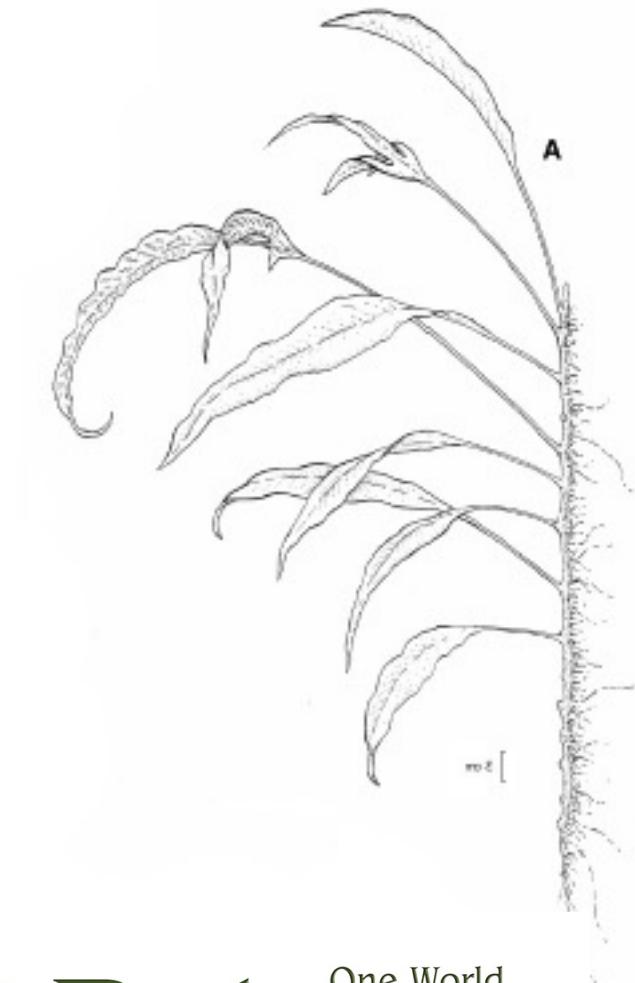
University of South Bohemia, Czech Republic



Royal
Botanic Garden
Edinburgh



Jihočeská univerzita
v Českých Budějovicích
University of South Bohemia
in České Budějovice



One World
Botany
Boise, Idaho
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Being a plant is hard enough — Epiphytes have real problems



Drought stress



High light intensity



Absence of soils

Aroids



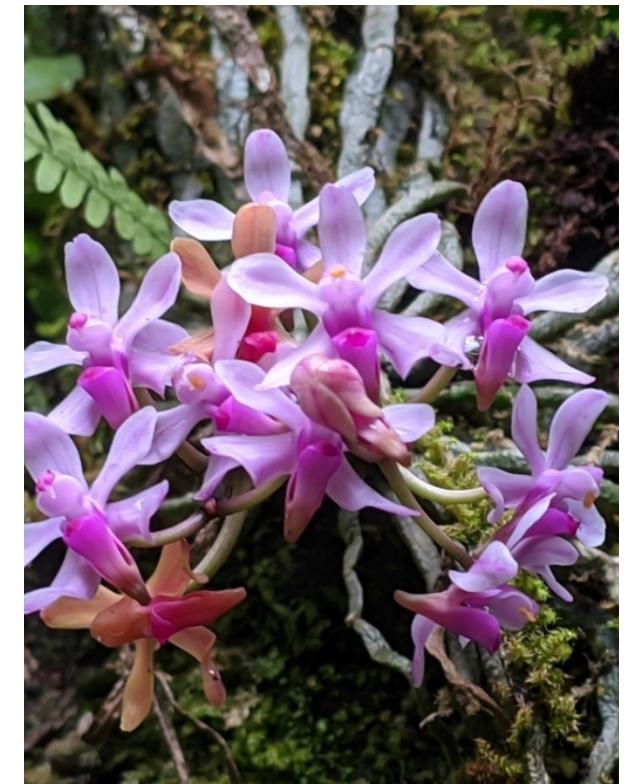
Bromeliads

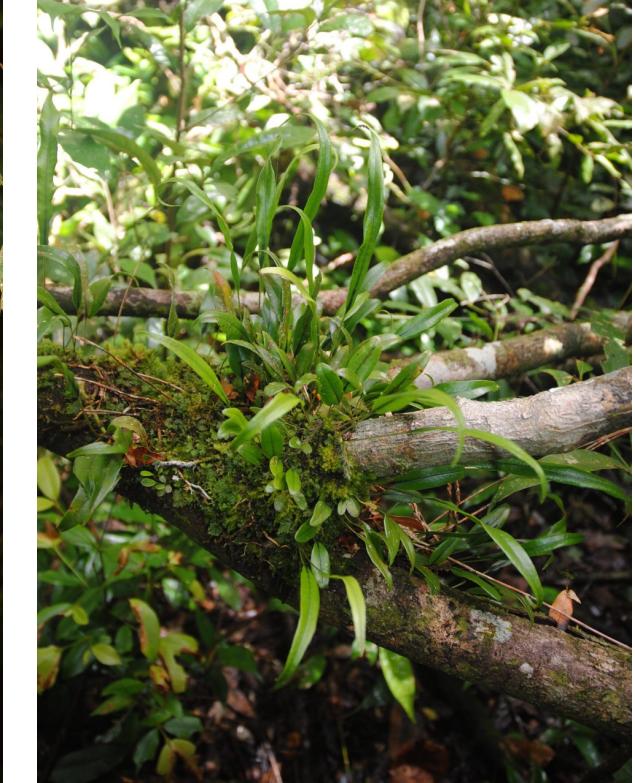


Gesneriads



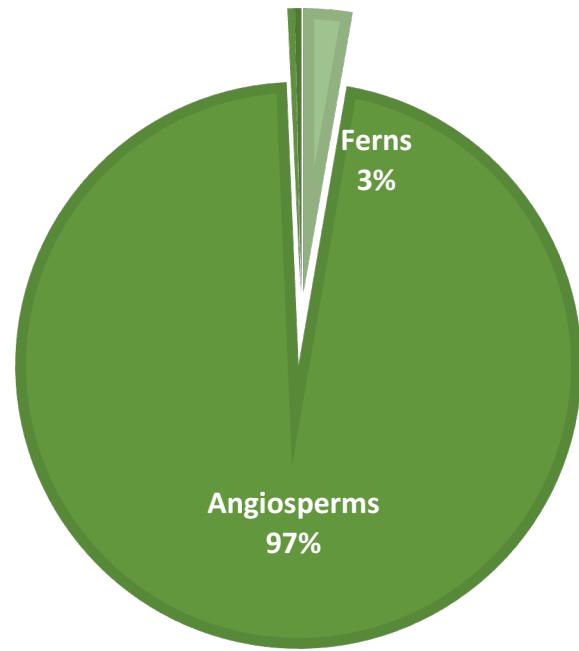
Orchids



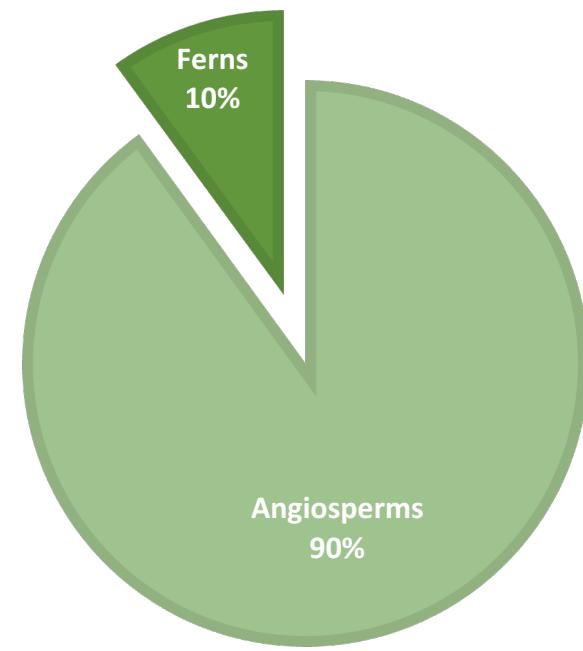


Ferns prosper in the epiphytic niche!

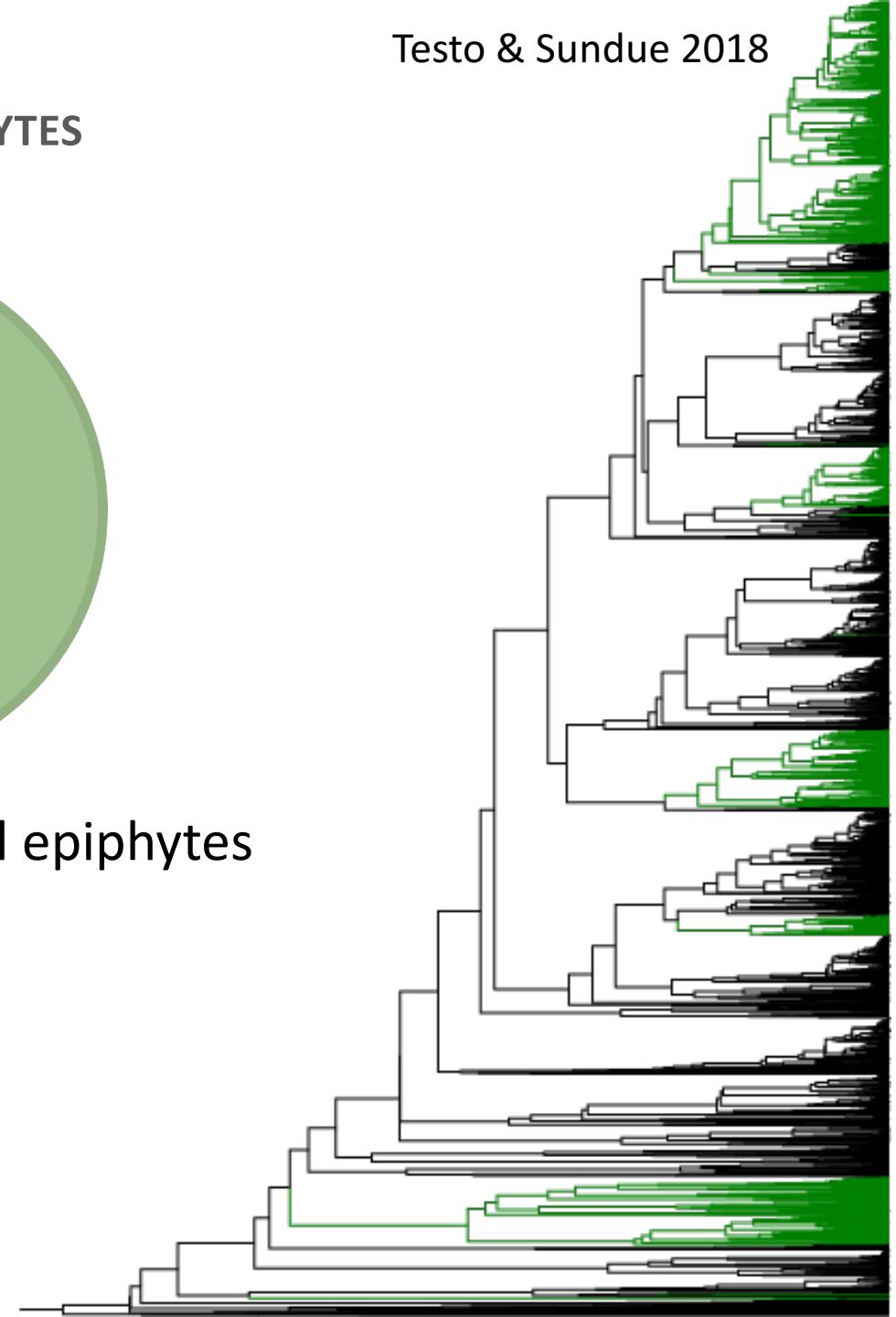
VASCULAR PLANT DIVERSITY



PROPORTION EPIPHYTES



Ferns are only 3% of all vascular plants – but 10% of all epiphytes



Epiphytic ferns in space and time



Hopetedia praetermissa – 250 ma



Hymenophyllum axsmithii – 55 ma



Other habits of ferns in trees



Epiphytes

Attached to host
without soil contact



Root climbers

Start on ground and
Climb host with adhesive roots



Hemiepiphytes

Start on host and then connect to
Ground via long roots

Documenting Hemiepiphytes

S. E. Fawcett



Establish on trees



Roots later head downward



Roots contact soil



Plants are never seen terrestrially

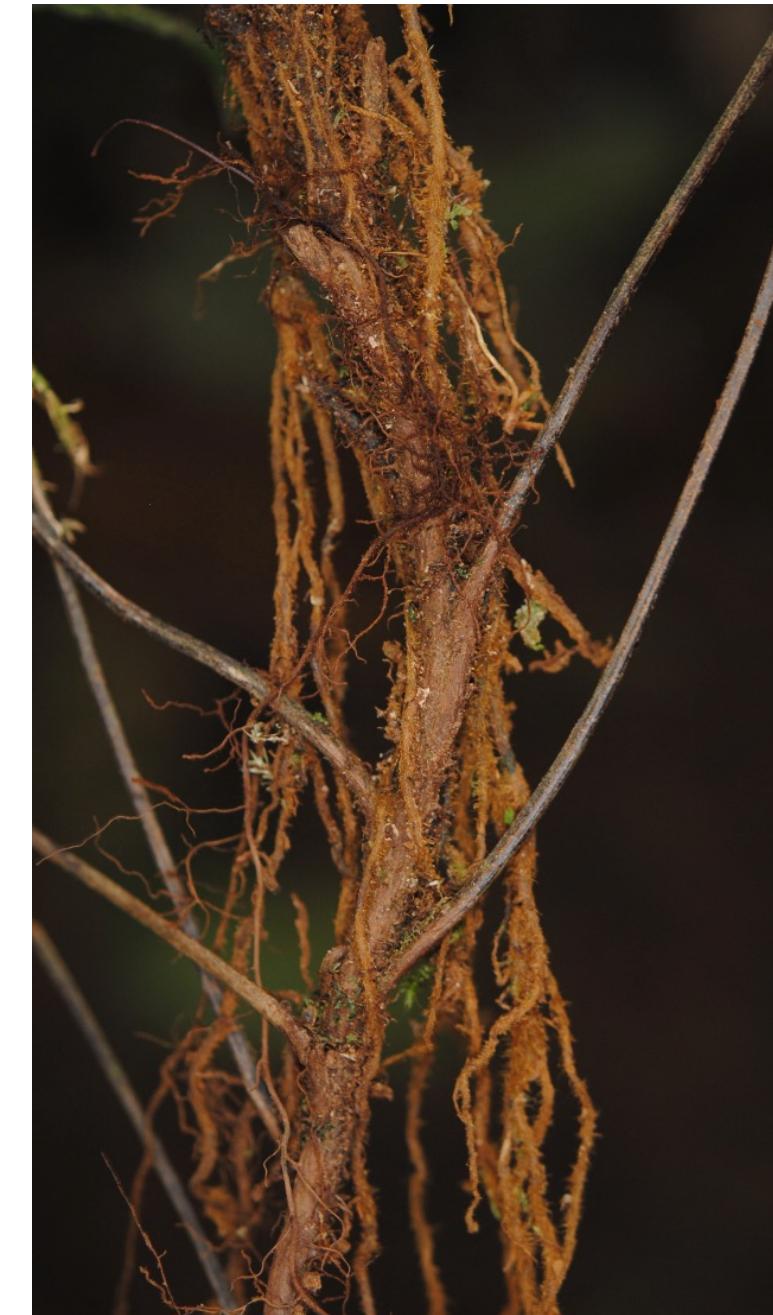




Dorsiventral rhizomes

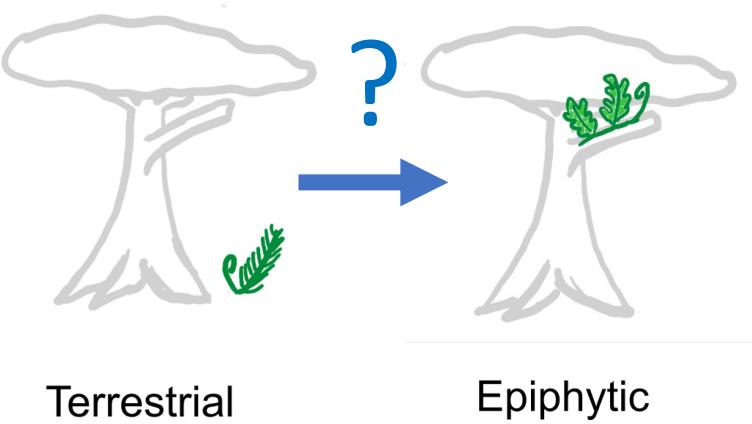


Short 'clasping' roots

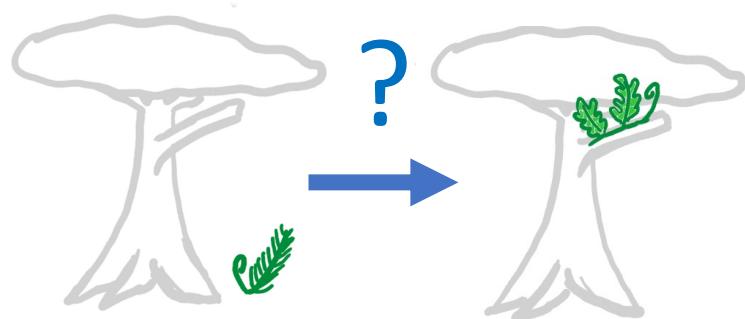


Long 'feeding' roots

Evolution of habits

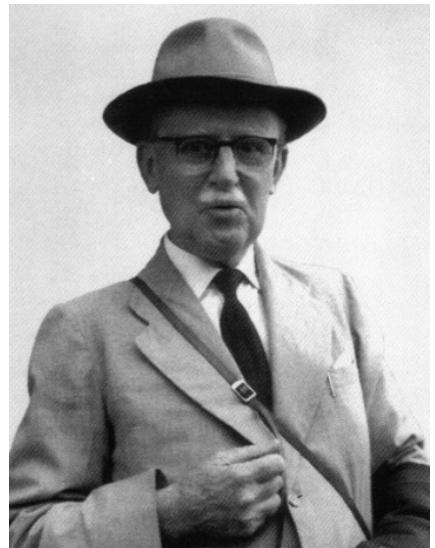


Evolution of habits



Terrestrial

Epiphytic



R.E. Holttum

Epiphytes
Elaphoglossum



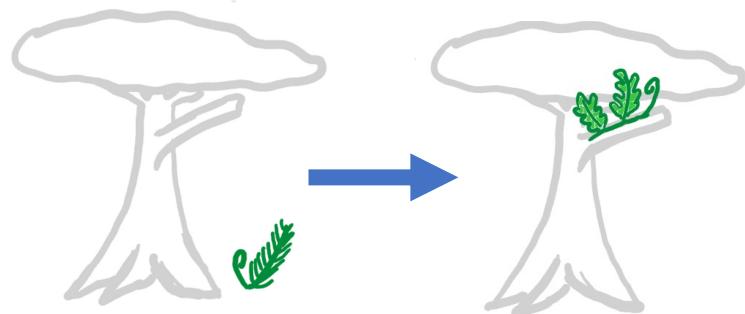
Root climbers
Lomagramma etc.



Terrestrials
Bolbitis



Evolution of habits



Terrestrial

Epiphytic



R.E. Holttum



R.C. Moran

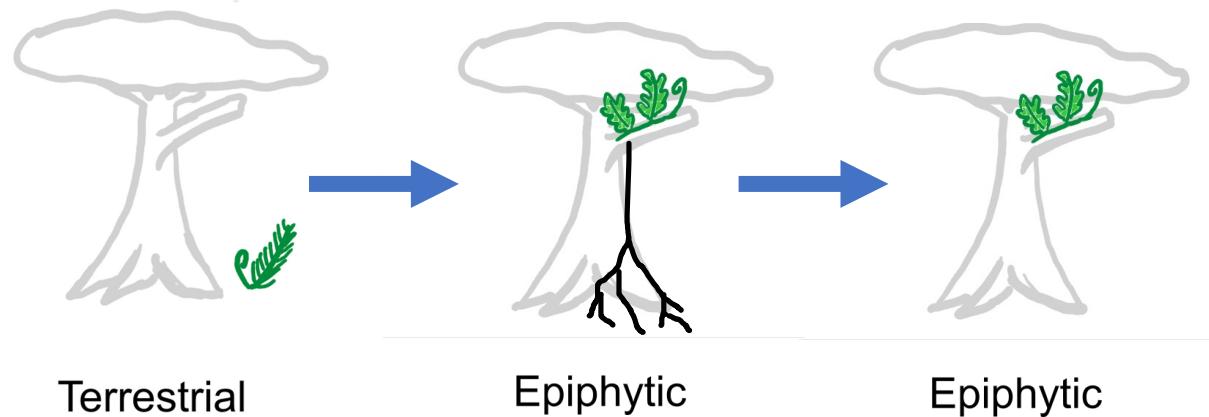
Epiphytes
Elaphoglossum

Root climbers
Lomagramma etc.

Terrestrials
Bolbitis



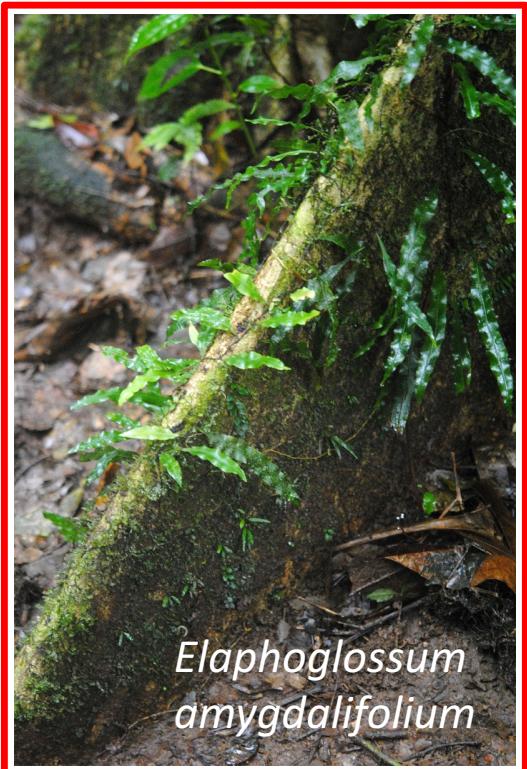
Evolution of habits



Terrestrial

Epiphytic

Epiphytic

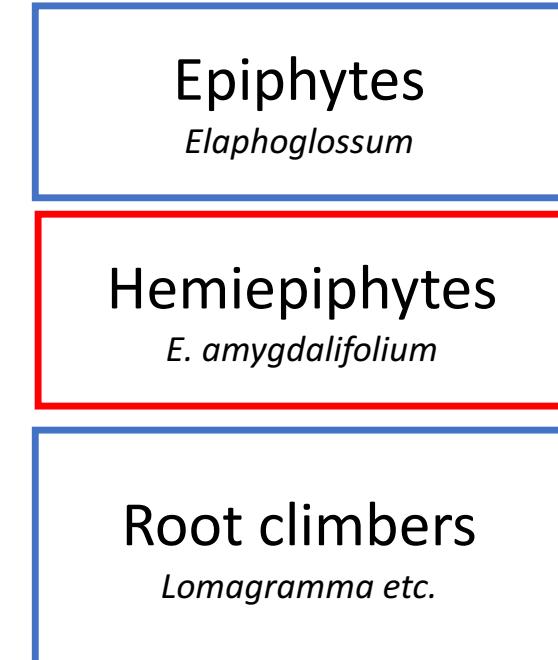


*Elaphoglossum
amygdalifolium*



A.L. Grusz

L.P. Lagomarsino



Epiphytes

Elaphoglossum

Hemiepiphytes

E. amygdalifolium

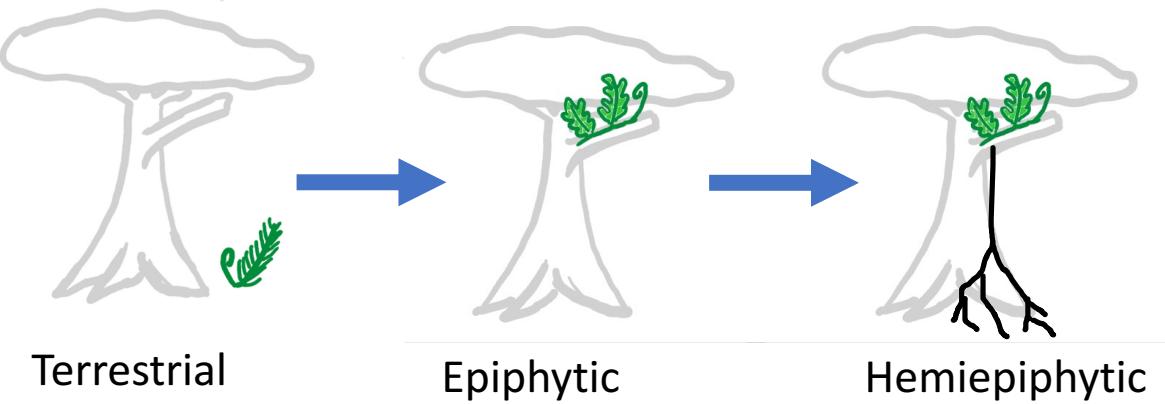
Root climbers

Lomagramma etc.

Terrestrials

Bolbitis

A reversal!



Epiphytic

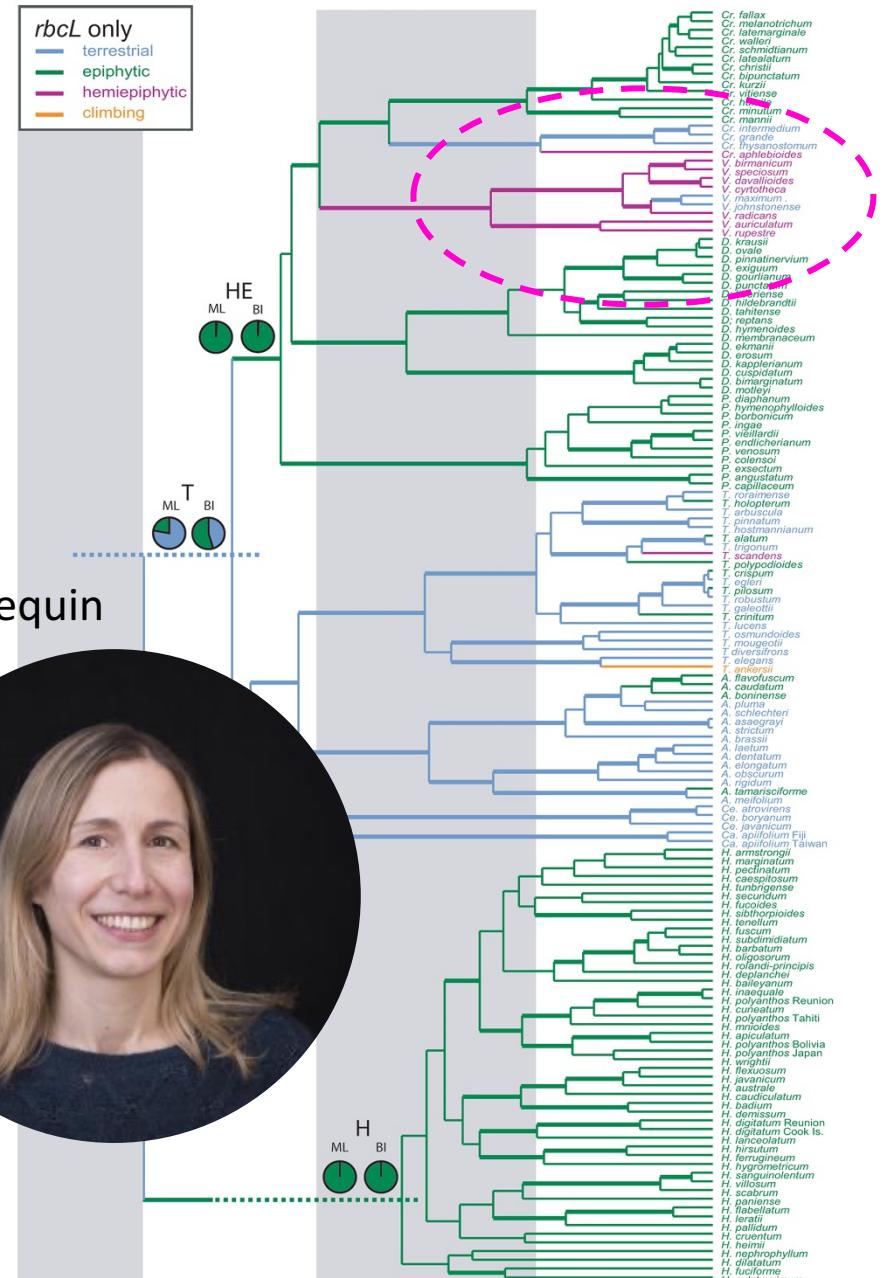
Hemiepiphytic

J.H. Nitta



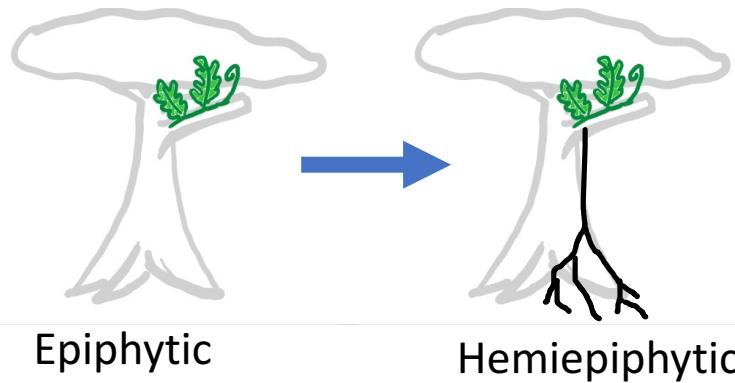
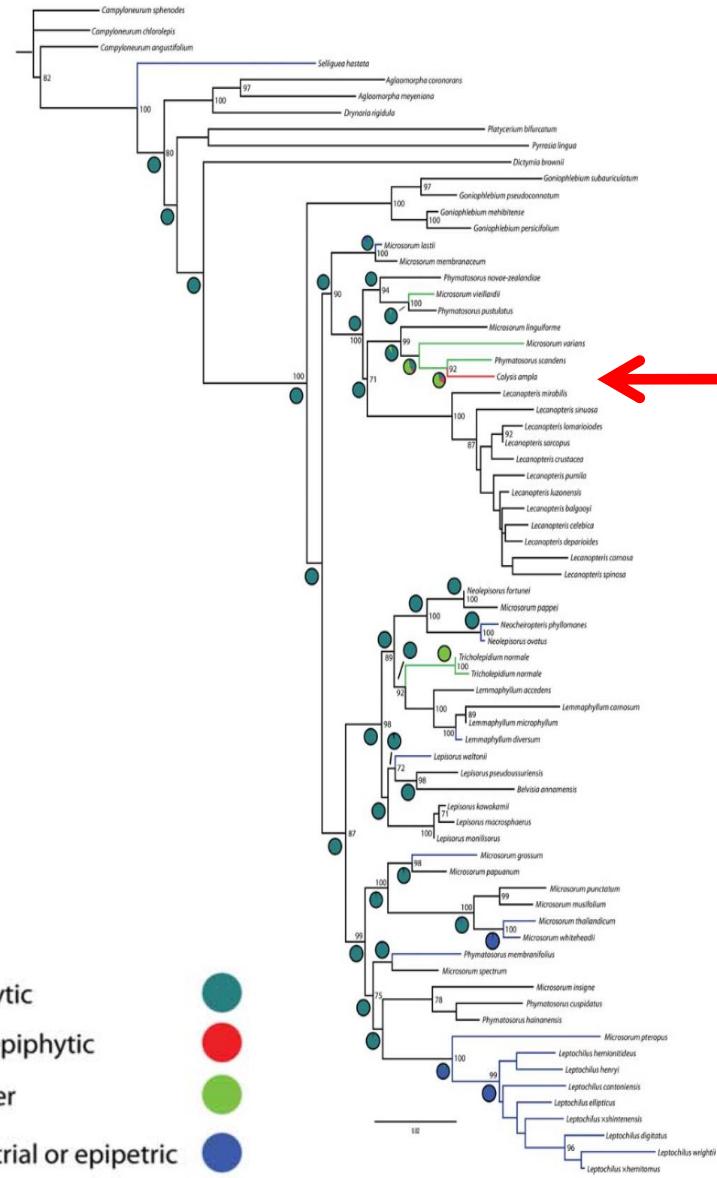
Vandenboschia collariata

Vandenboschia nested In epiphytic clades

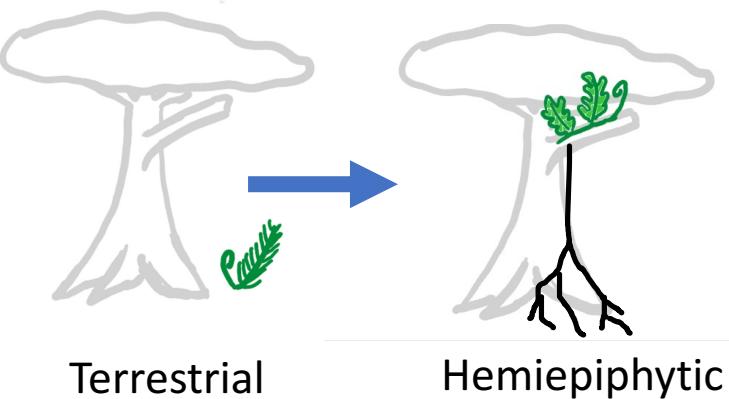


More reversals...

W. L. Testo



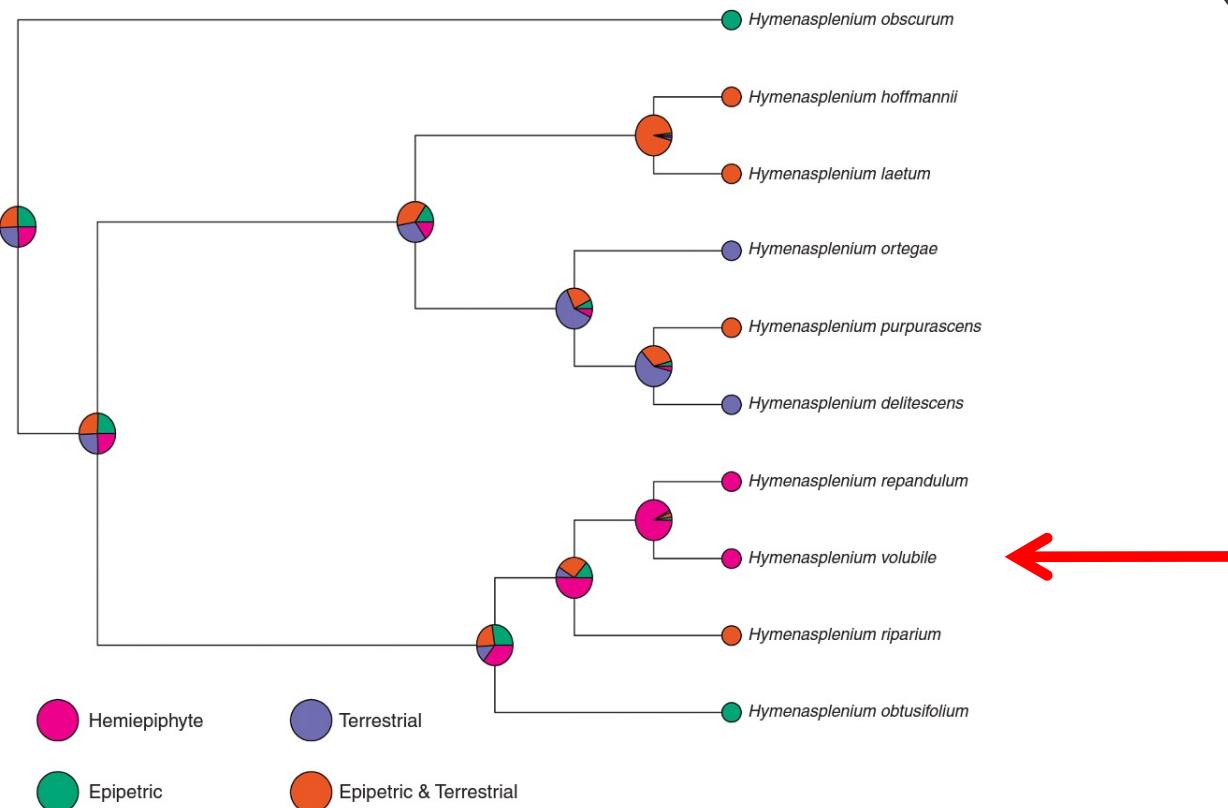
Yet another scenario...



J. L. Watts



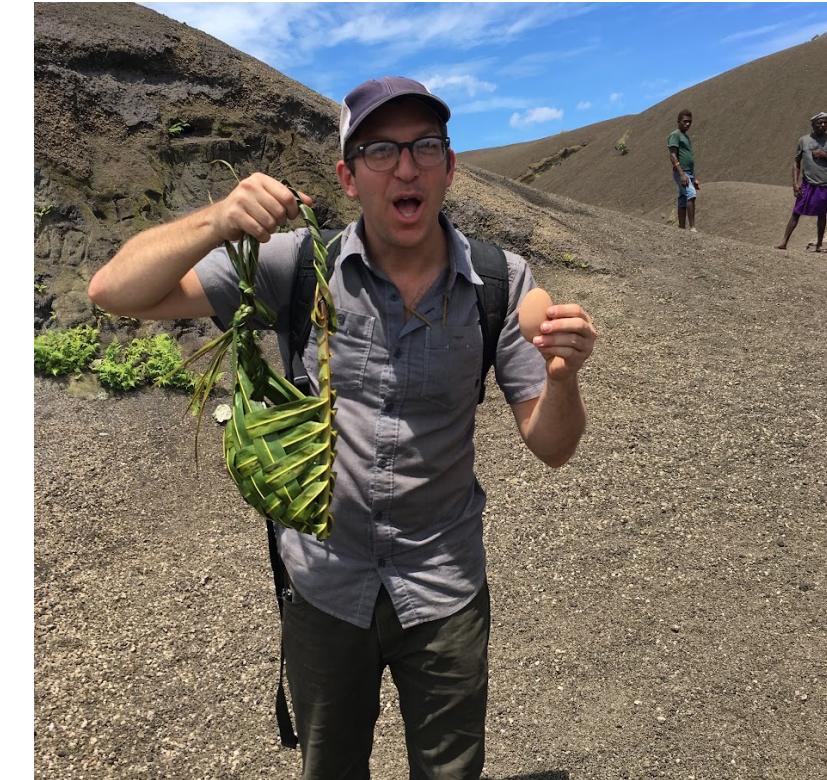
J. E. Watkins



We need more plants!



Kore Maraia, PhD student



If you go: Order the Megapode eggs boiled in a volcanic hot spring



Methods



Results



319 Collections

206 Species

15 Hemiepiphytic species

12 New hemiepiphytic records

7 Documented sufficiently to publish

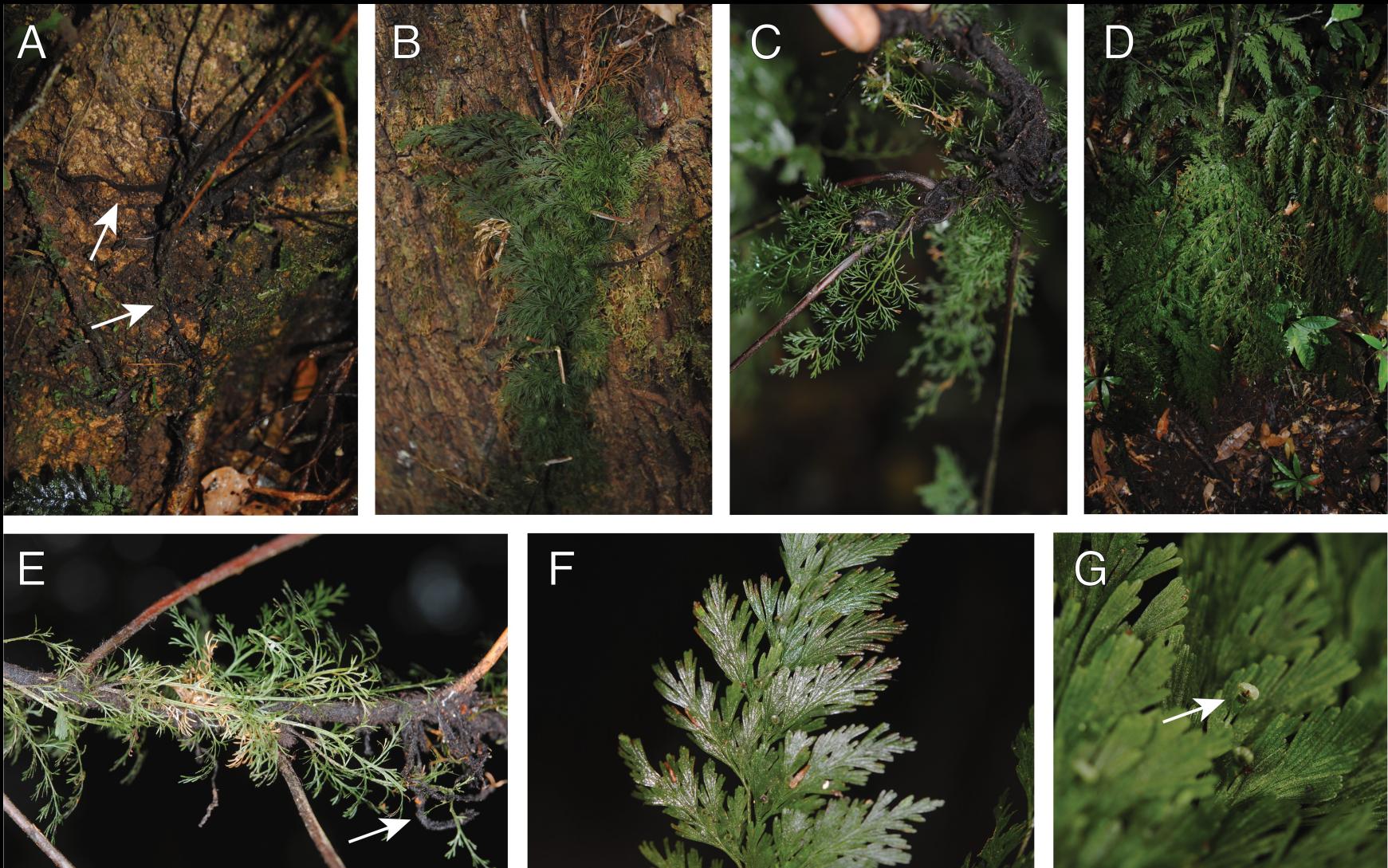
*~7% of the species inventoried had
a hemiepiphytic habit*

Species distributed in:

- *Aspleniaceae*
- *Hymenophyllaceae*
- *Lindsaeaceae*
- *Polypodiaceae*
- *Tectariaceae*
- *Thelypteridaceae*

Results:

New lineages and
Further evidence for
morphological convergence
• Dorsiventral rhizome
• Long and short roots



**Crepidomanes
aphleboides**

Results:

Many new records of
Asplenium indicating the
entire *A. scandens* clade
(~6 spp.) is hemiepiphytic

Asplenium scandens



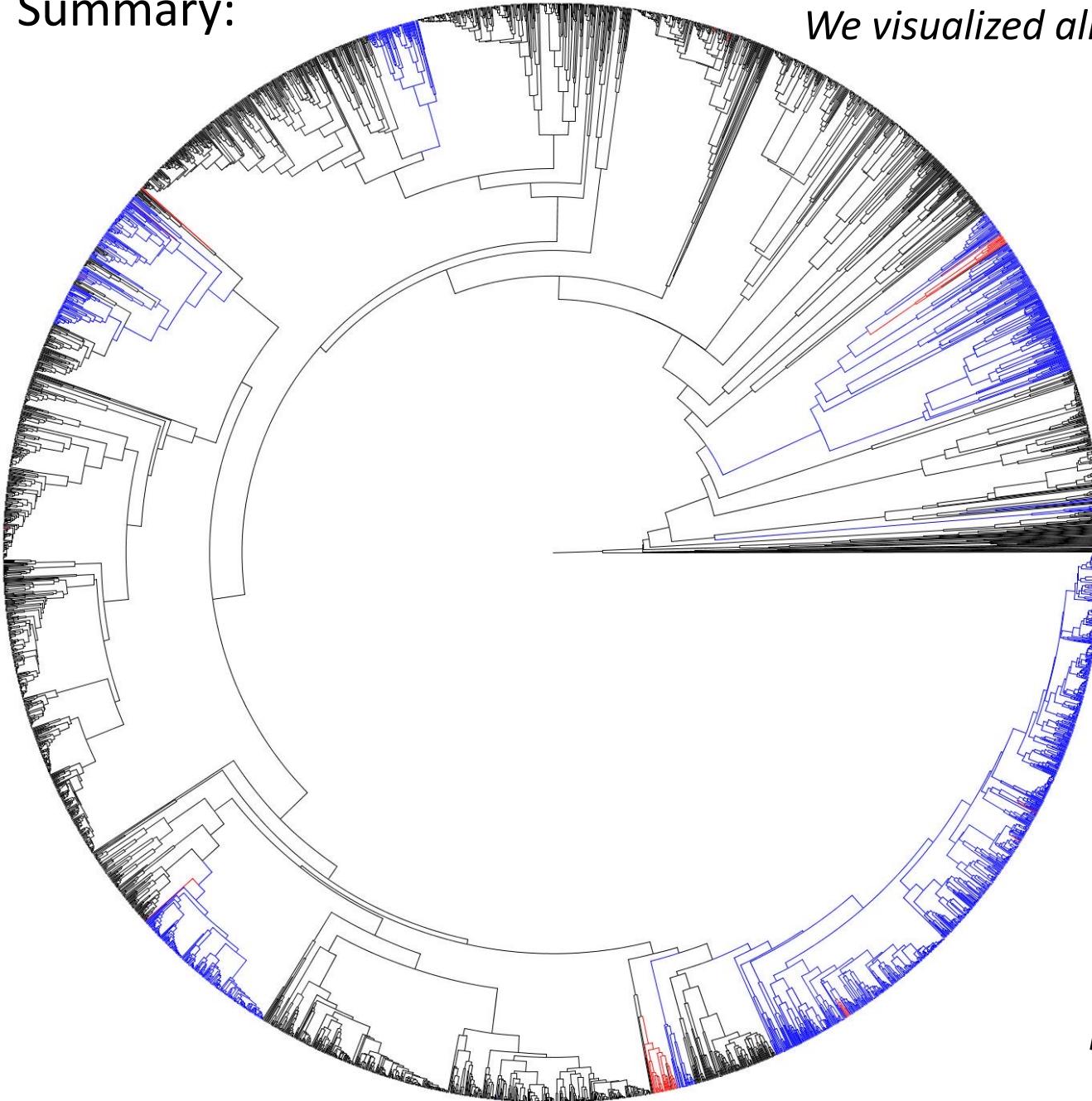
Results:

A Thelypteridaceae!



**Sphaerostephanos
scandens**

Summary:



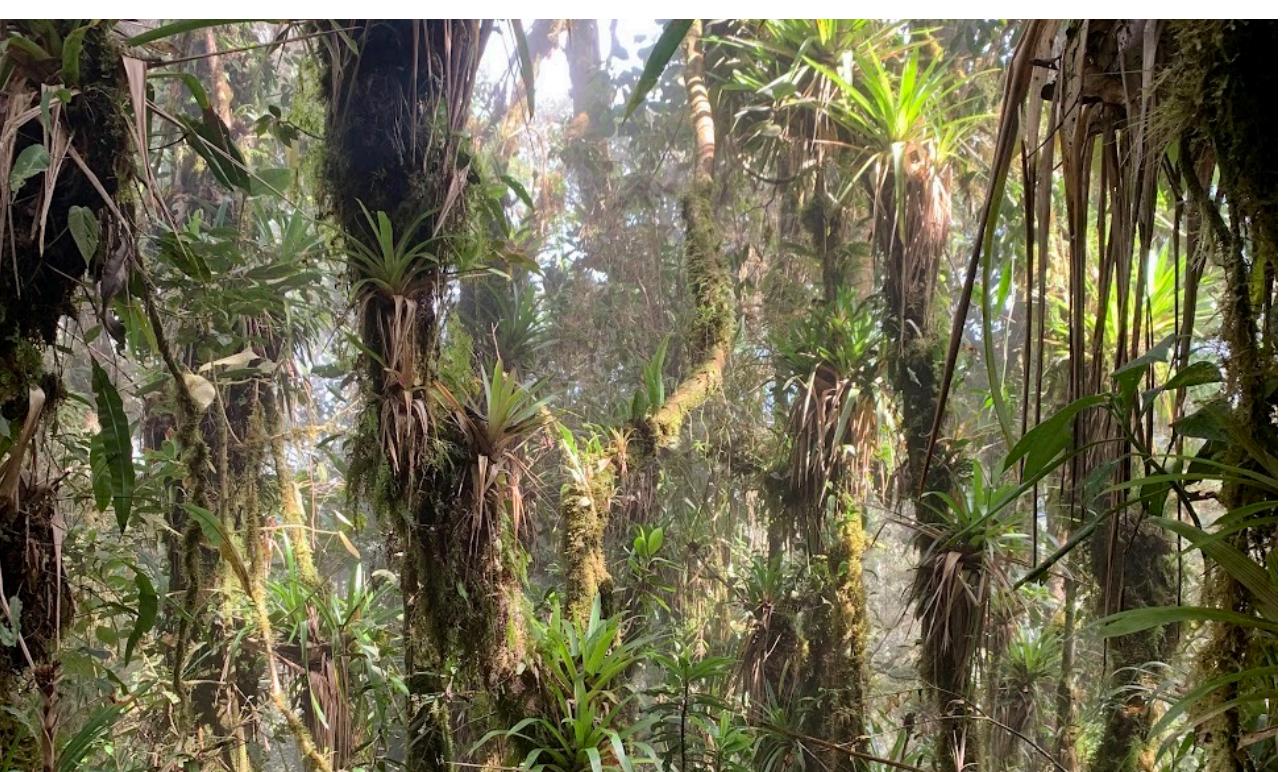
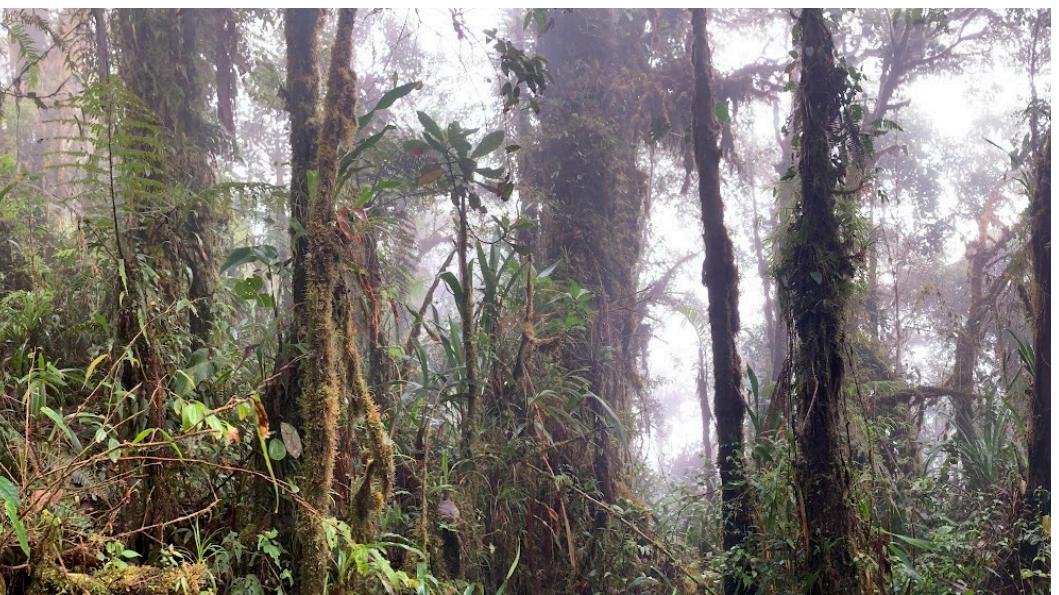
We visualized all known epiphytes and hemiepiphytes onto a 4k-tip tree

- Epiphytes
- Hemiepiphytes

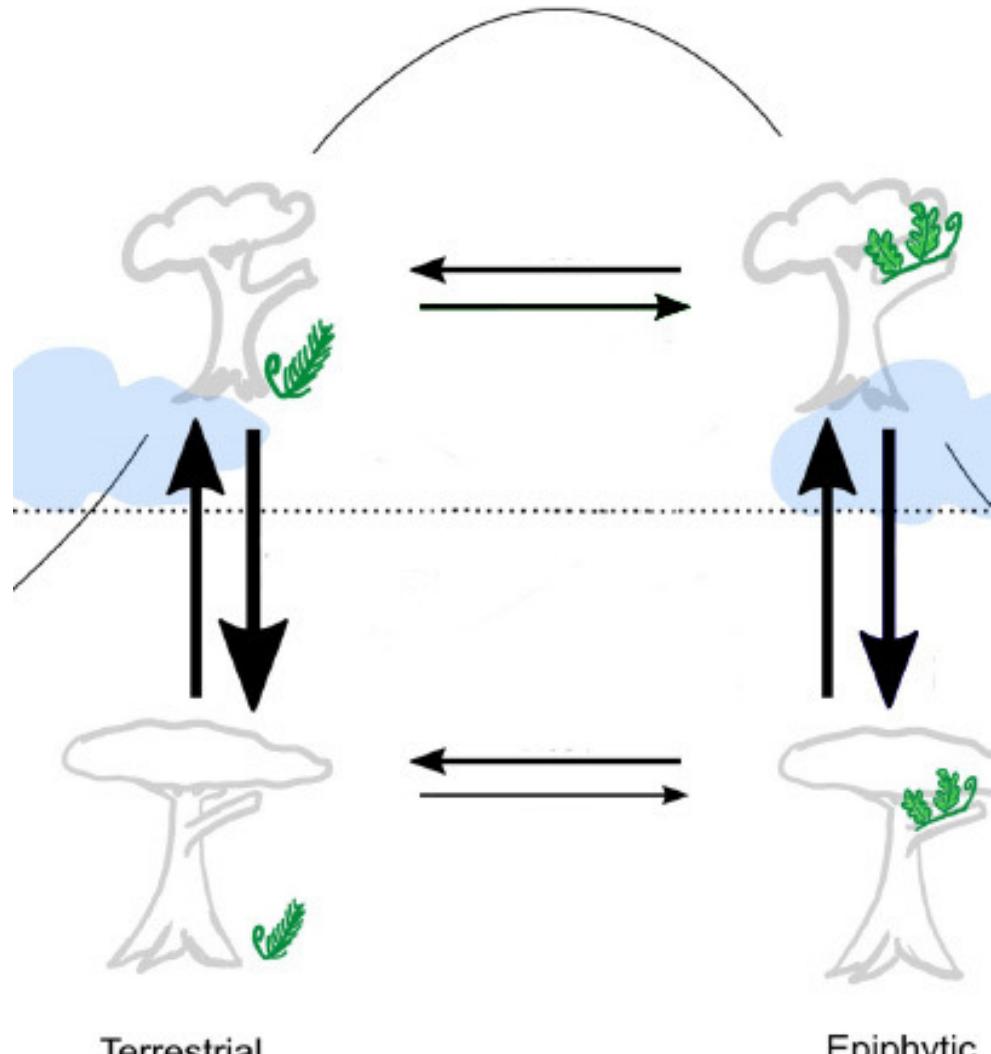
- **Most hemiepiphytes evolve within epiphytic clades**
- **A minority evolve within terrestrial or epipetric clades**
- **Many hemiepiphytes are one-offs, but there are small radiations:**
 - *Lomariopsis*
 - *Vandenboschia*
 - The *Trichomanes Lacostea* clade
 - The *Asplenium scandens* clade

How else can we use these data?...

*What if the transition is ecological
rather than morphological ?*

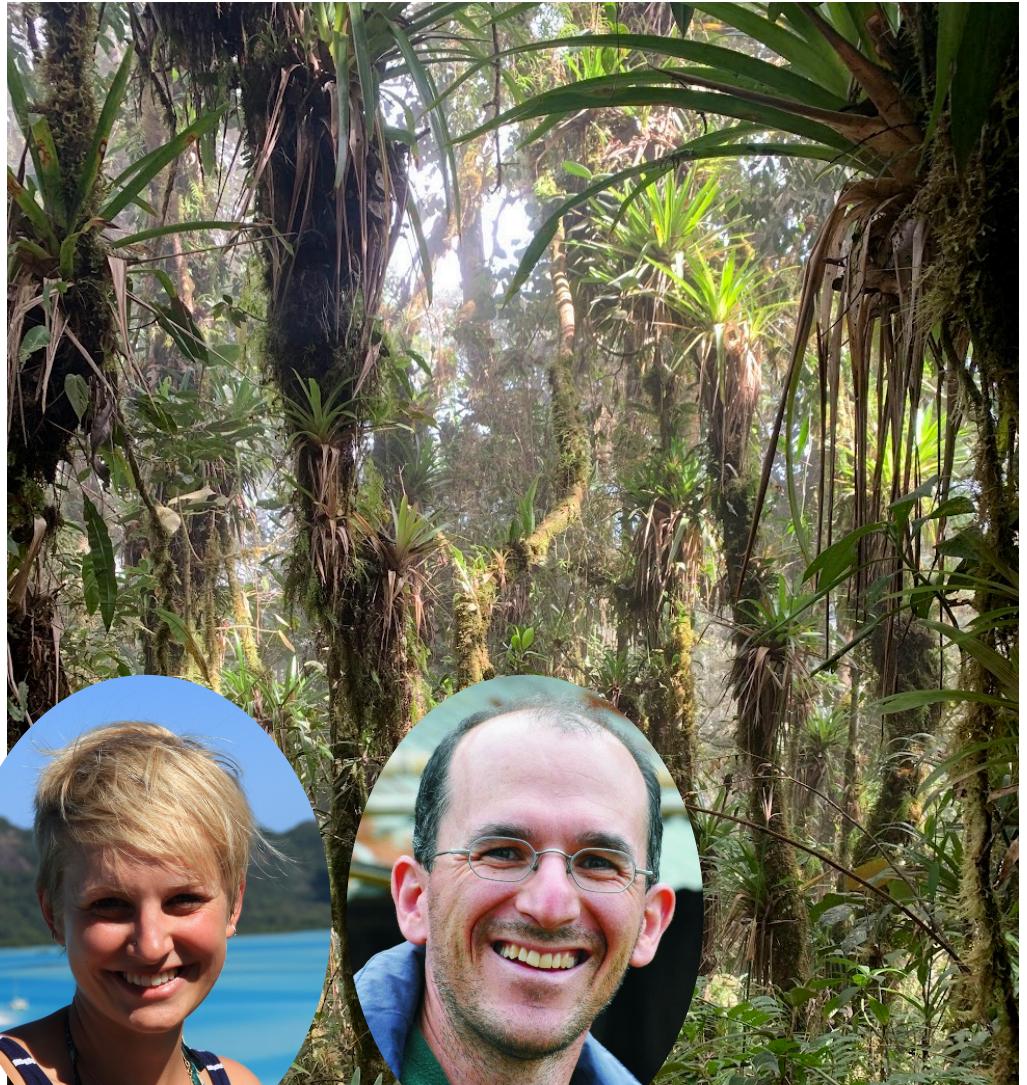


Future directions...



Terrestrial

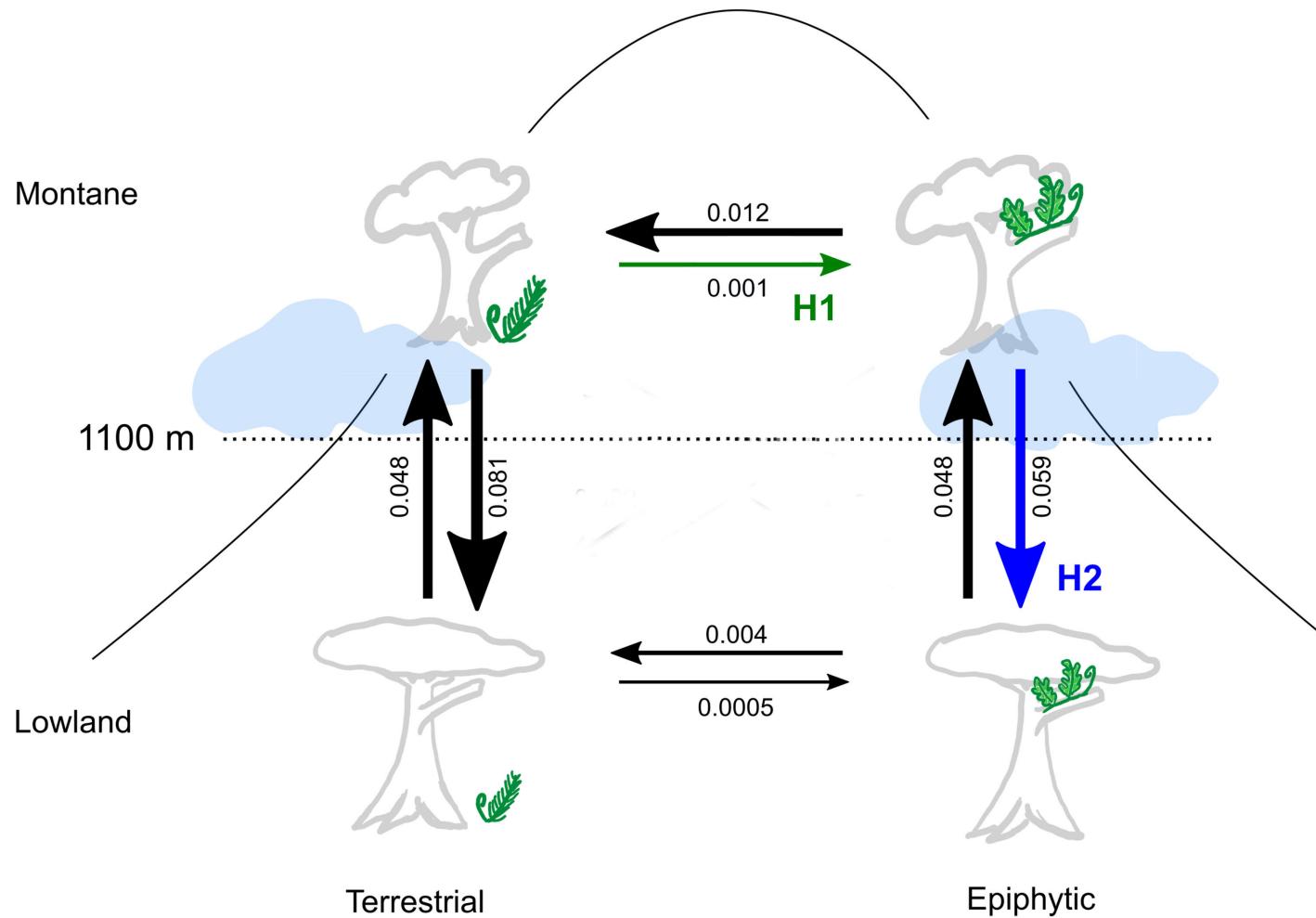
Epiphytic



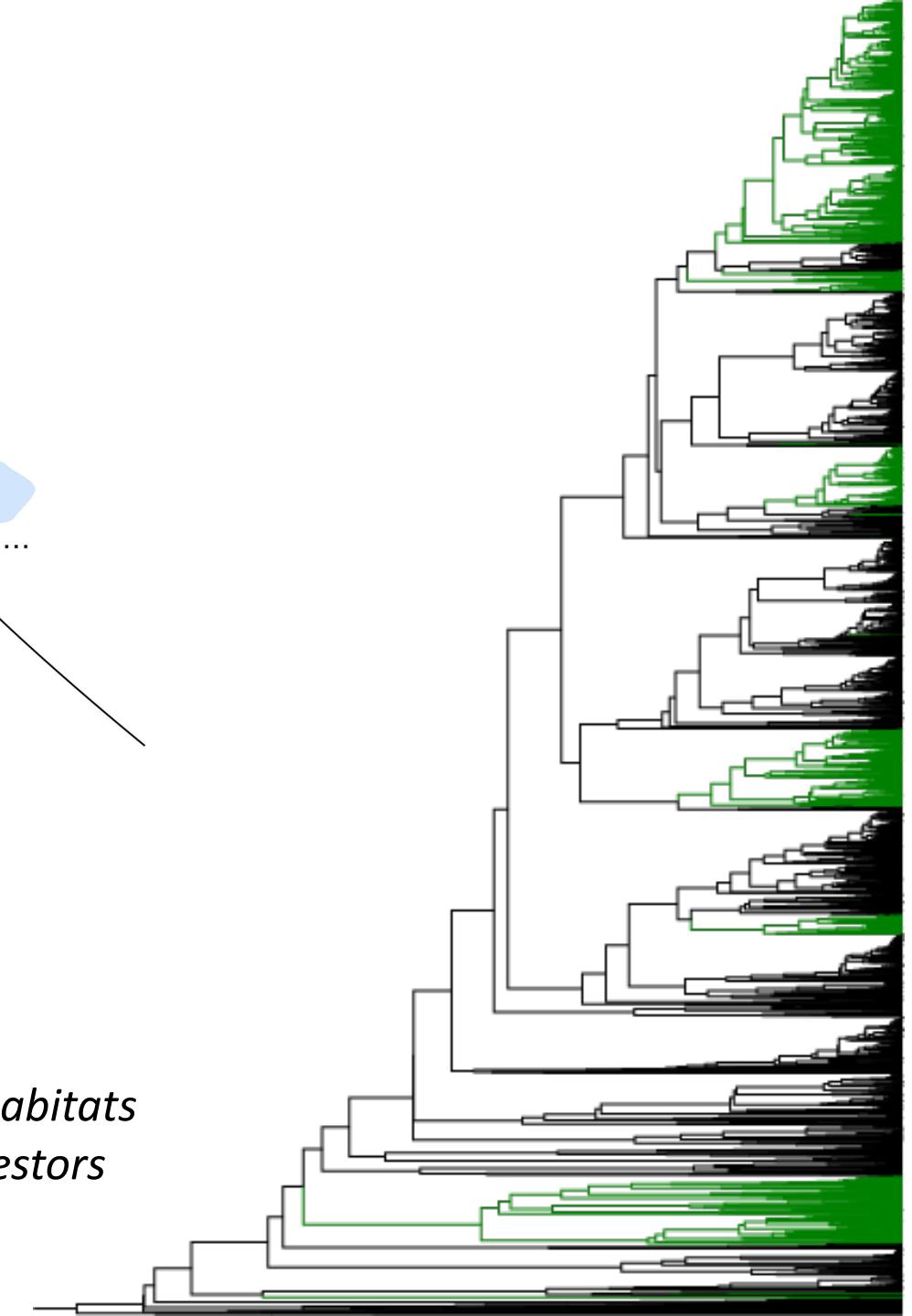
Sarah Noben

Michael Kessler

Preliminary results...



- *Transitions to epiphytism are 2x more likely in cloud forest habitats*
- *The primary route for lowland epiphytes is from upland ancestors*



Acknowledgments

Robbin Moran – For spending 20 years of his life talking about ferns with me!

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Ferns of Colombia Crew:

Alejandra Vasco

Susana Vega Betancur

Weston Testo

Kimberlie Sasan

