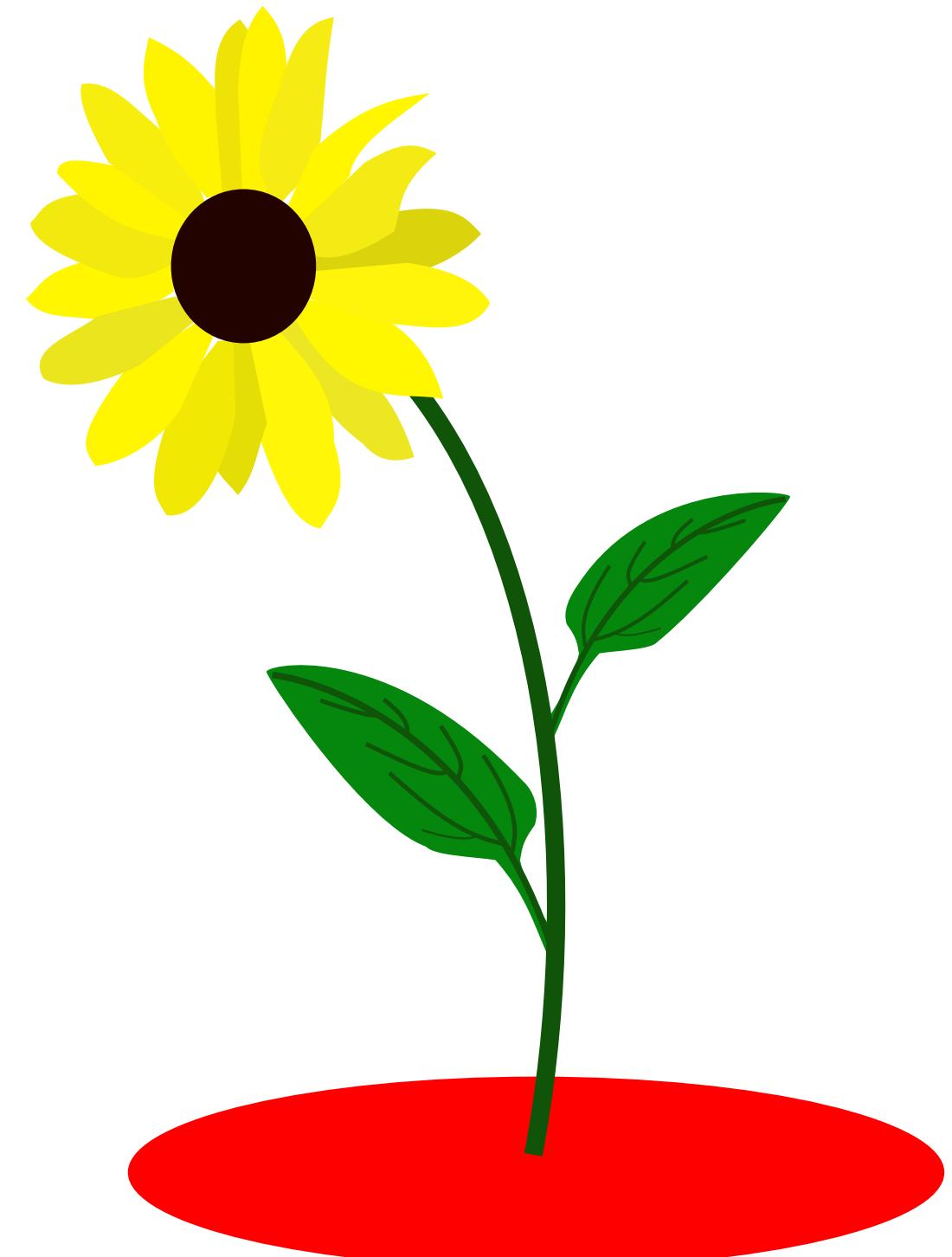


# Cytoplasmic genome sharing in annual sunflowers

or 9 species - 2 cytoplasms

Greg Owens,  
Assistant Professor  
University of Victoria



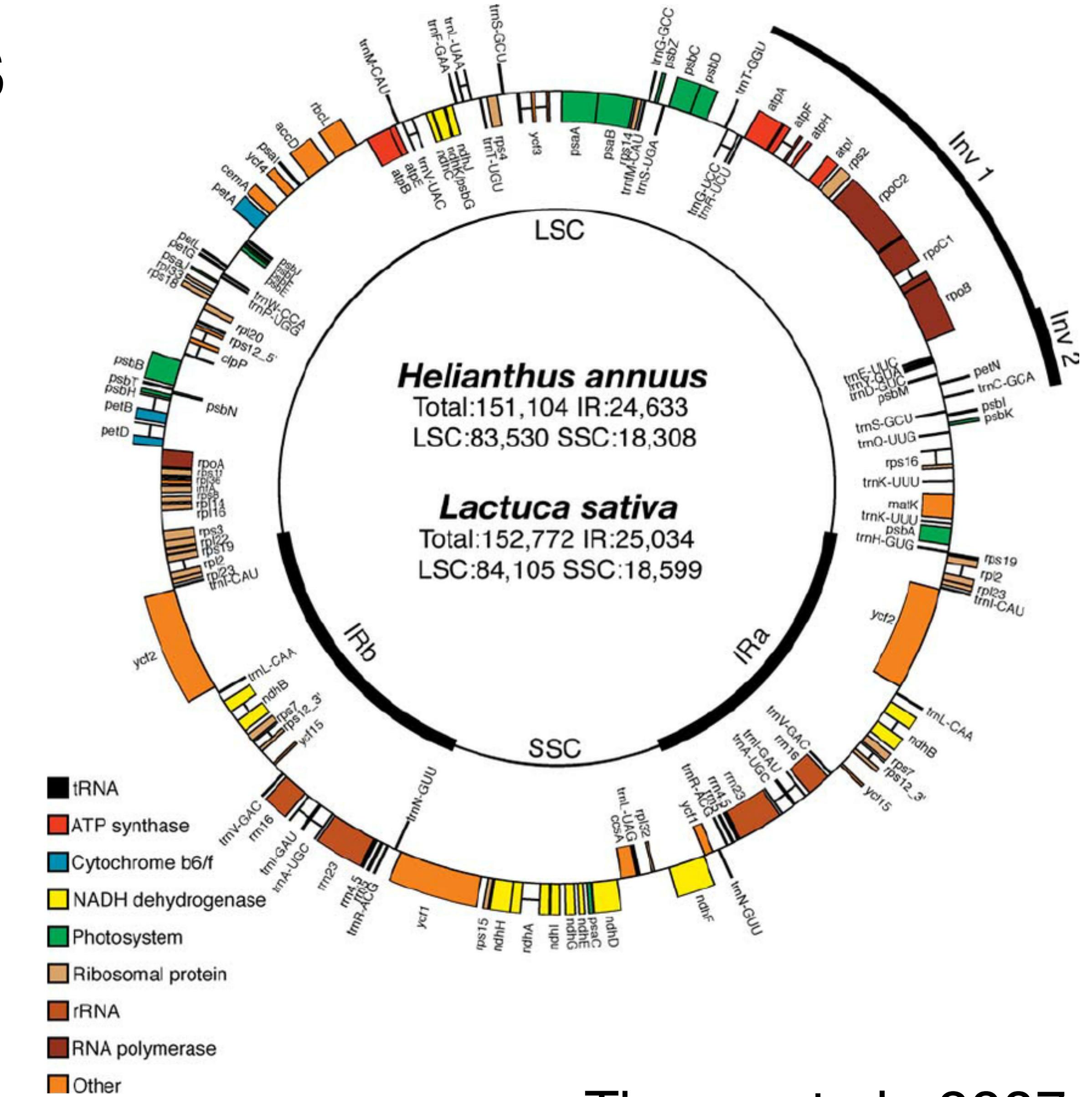
# Annual sunflowers (*Helianthus*)

- Sub-clade of 11 species with a crown age of ~2 mya
- Found across the USA
- Frequently hybridize



# Cytoplasmic Genomes

- Nuclear genome = 3-5 GBp
- Mitochondrial genome = 300 KBp
- Chloroplast genome = 150 KBp
- Both cytoplasmic genomes are maternally inherited



Timme et al., 2007

# Locally adaptive cytoplasm

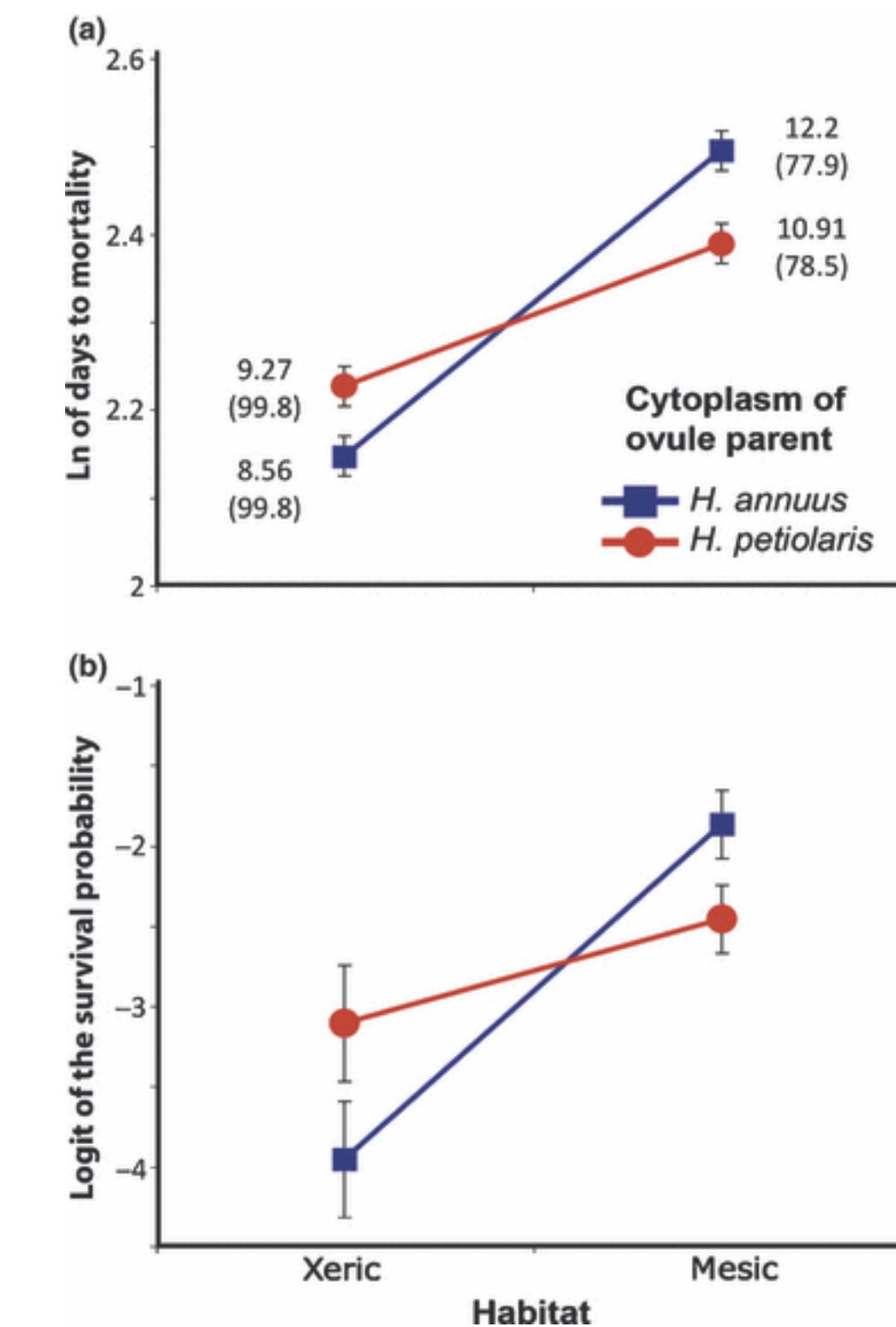


| Full Access

## Ecological selection maintains cytonuclear incompatibilities in hybridizing sunflowers

Julianno B. M. Sambatti, Daniel Ortiz-Barrientos , Eric J. Baack, Loren H. Rieseberg

First published: 01 September 2008 | <https://doi.org/10.1111/j.1461-0248.2008.01224.x> | Citations: 82



# Cytonuclear discordance from introgression



An evaluation of alternative explanations for widespread cytonuclear discordance in annual sunflowers (*Helianthus*)

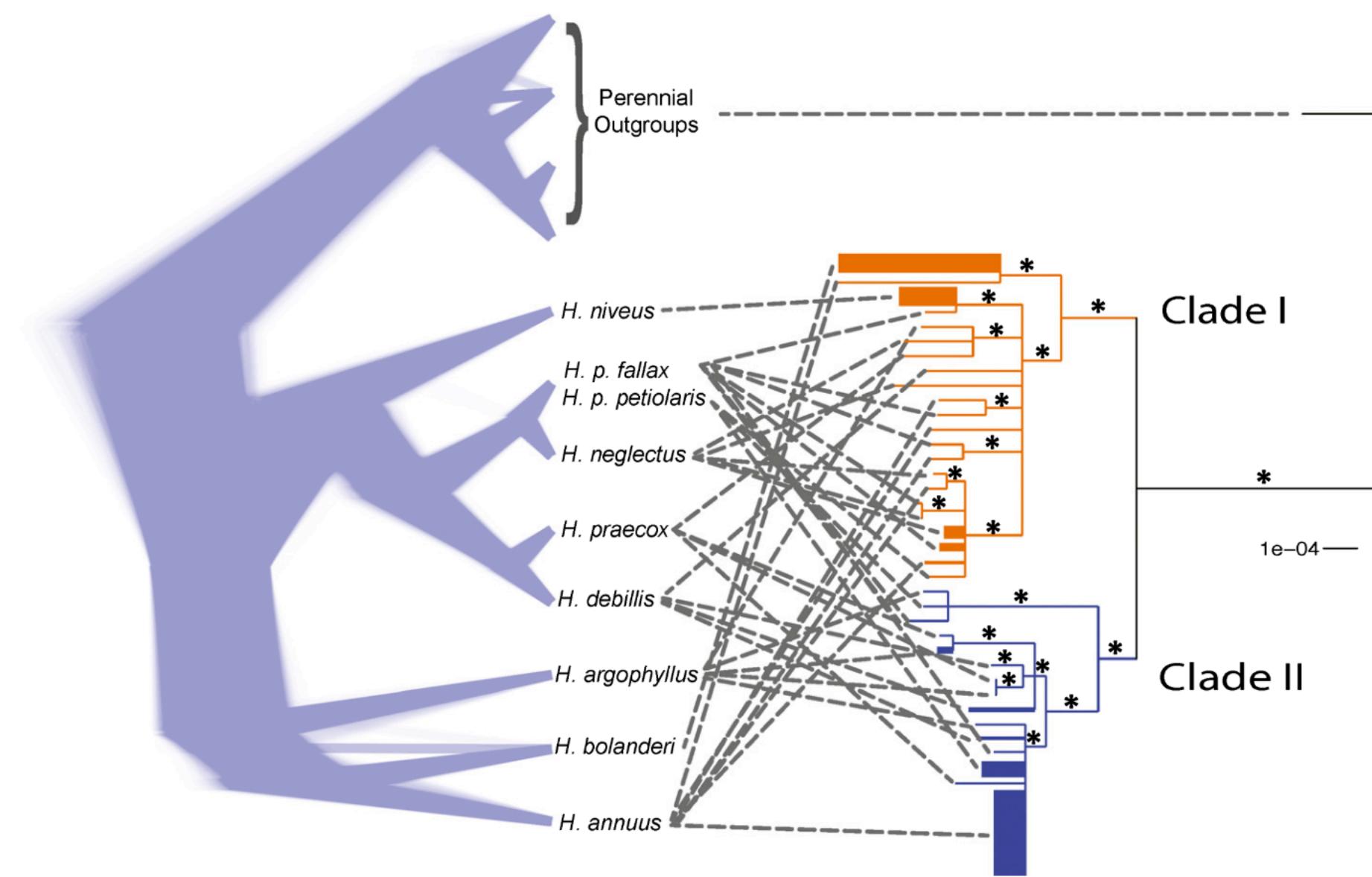
Julie A. Lee-Yaw<sup>1</sup>, Christopher J. Grassa<sup>1,2</sup>, Simon Joly<sup>3,4</sup>, Rose L. Andrew<sup>1,5</sup> and Loren H. Rieseberg<sup>1</sup>

<sup>1</sup>Department of Botany, University of British Columbia, Vancouver, BC V6T 1Z4, Canada; <sup>2</sup>Harvard University Herbaria, Cambridge, MA 02138, USA; <sup>3</sup>Institut Recherche en Biologie Végétale, QC H1X 2B2, Canada; <sup>4</sup>Jardin botanique de Montréal, Department Sciences Biologiques, Université de Montréal, Montréal, QC H1X 2B2, Canada; <sup>5</sup>School of Environmental and Rural Science, University of New England, Armidale, NSW 2351, Australia

Research

Nuclear SNPs

Whole chloroplast



# Why two cytoplasm clades?

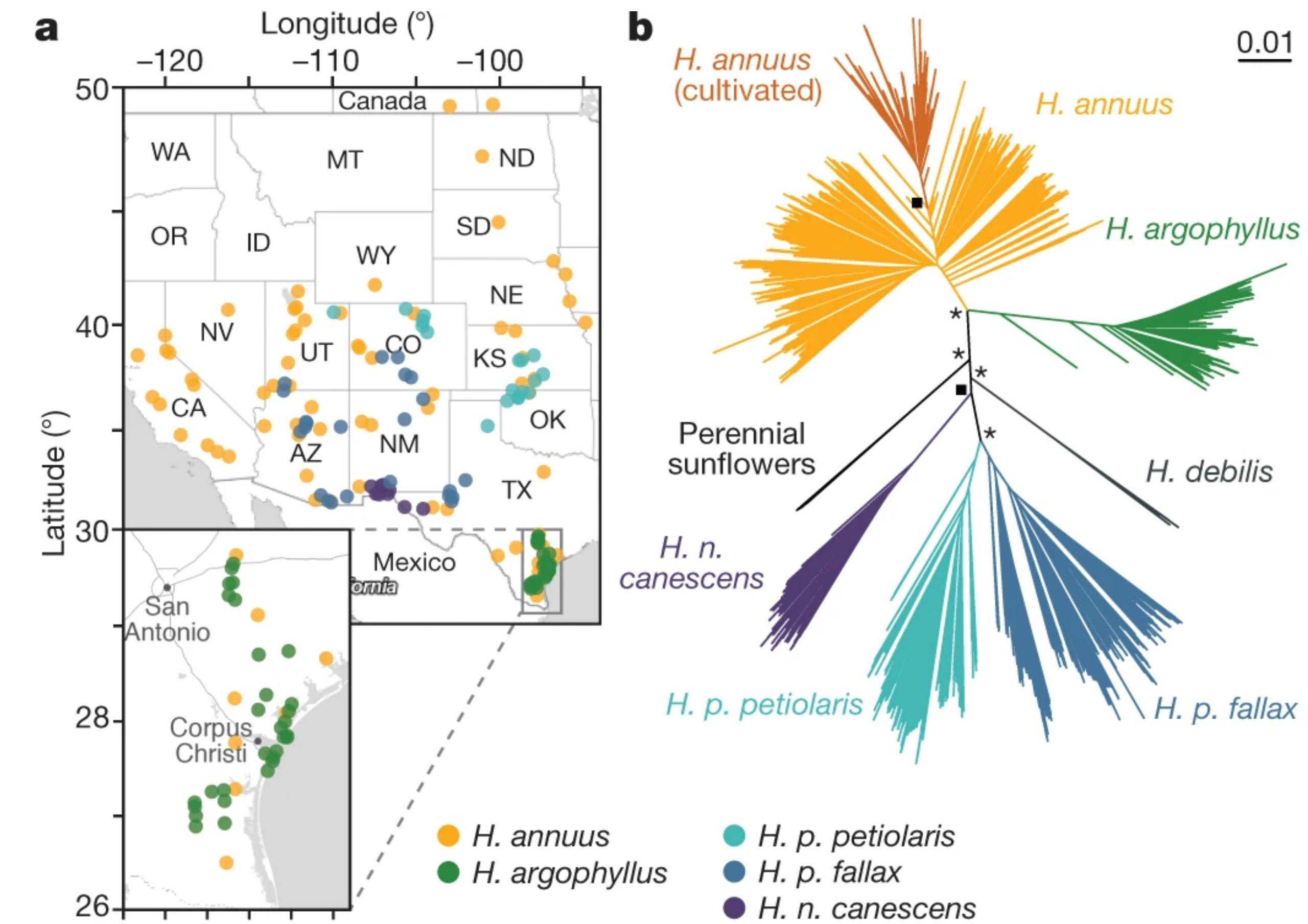
## Dataset:

1506 sunflowers from 4 species  
+ Whole genome sequencing  
+ Common garden phenotype  
+ Environment variables

**Massive haplotypes underlie ecotypic differentiation in sunflowers**

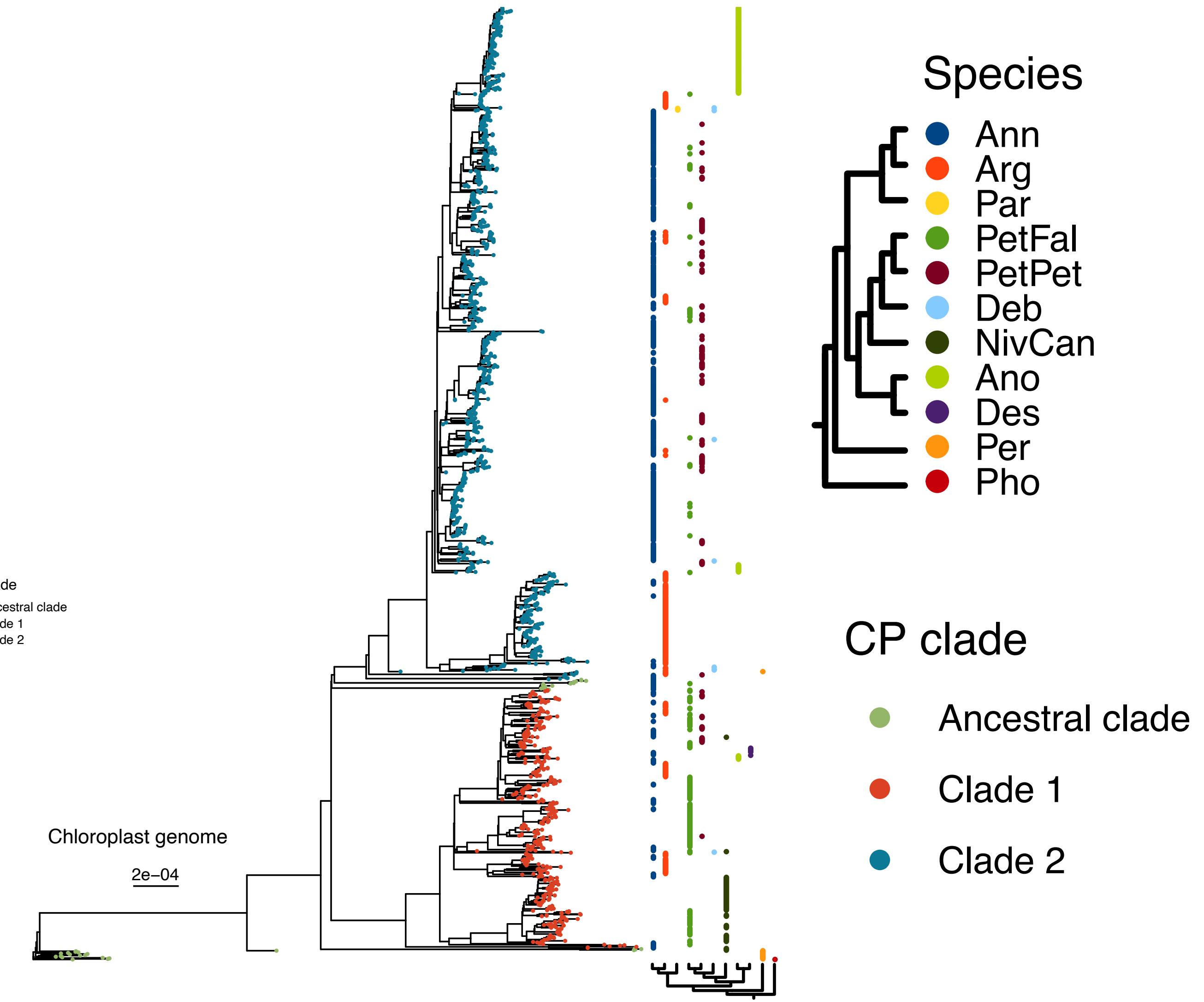
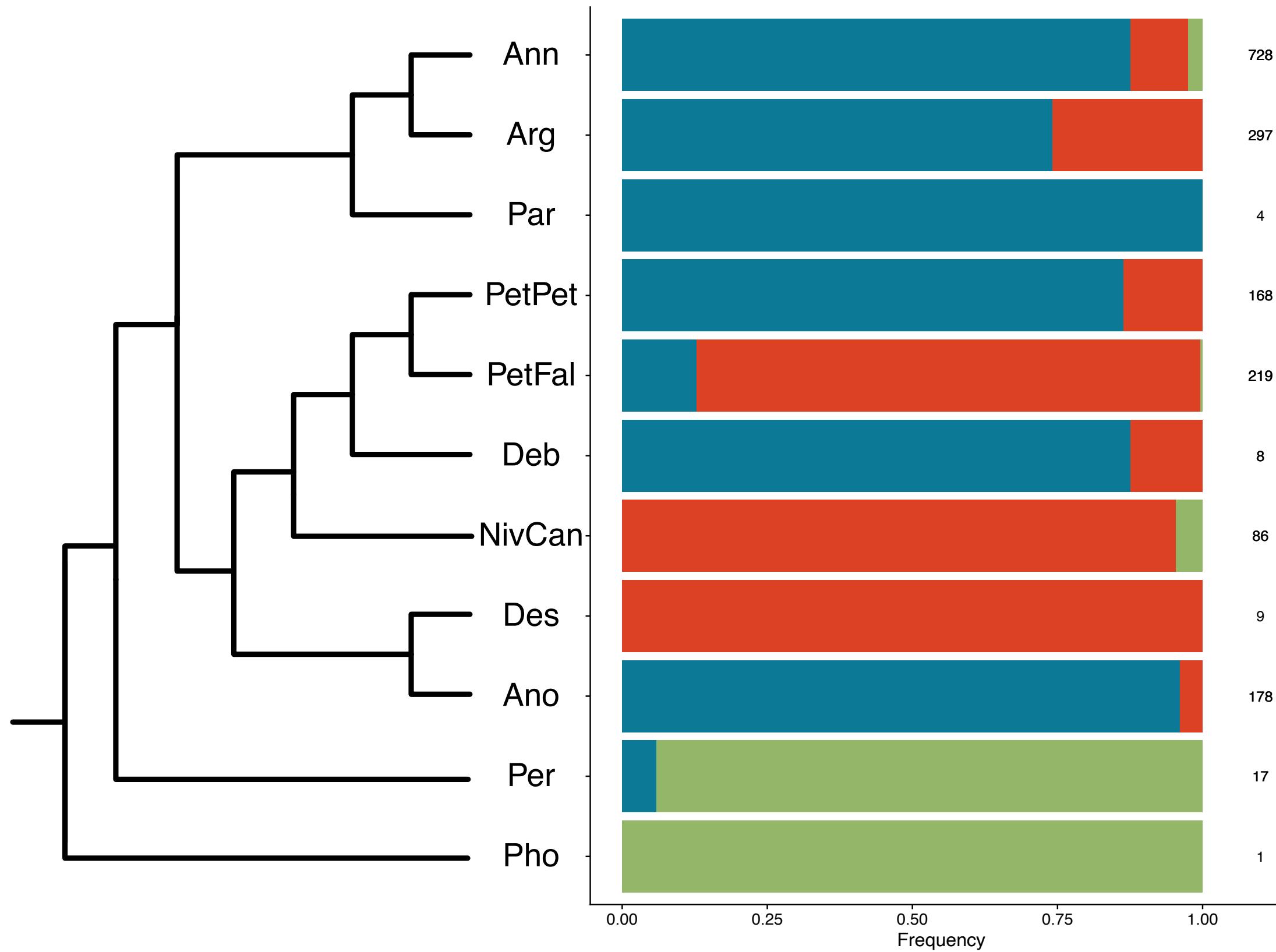
Marco Todesco, Gregory L. Owens, Natalia Bercovich✉, Jean-Sébastien Légaré, Shaghayegh Soudi, Dylan O. Burge, Kaichi Huang, Katherine L. Ostevik, Emily B. M. Drummond, Ivana Imerovski, Kathryn Lande, Mariana A. Pascual-Robles, Mihir Nanavati, Mojtaba Jahani, Winnie Cheung, S. Evan Staton, Stéphane Muños, Rasmus Nielsen, Lisa A. Donovan, John M. Burke, Sam Yeaman & Loren H. Rieseberg✉

Nature 584, 602–607 (2020) | [Cite this article](#)



# Why two cytoplasm clades?

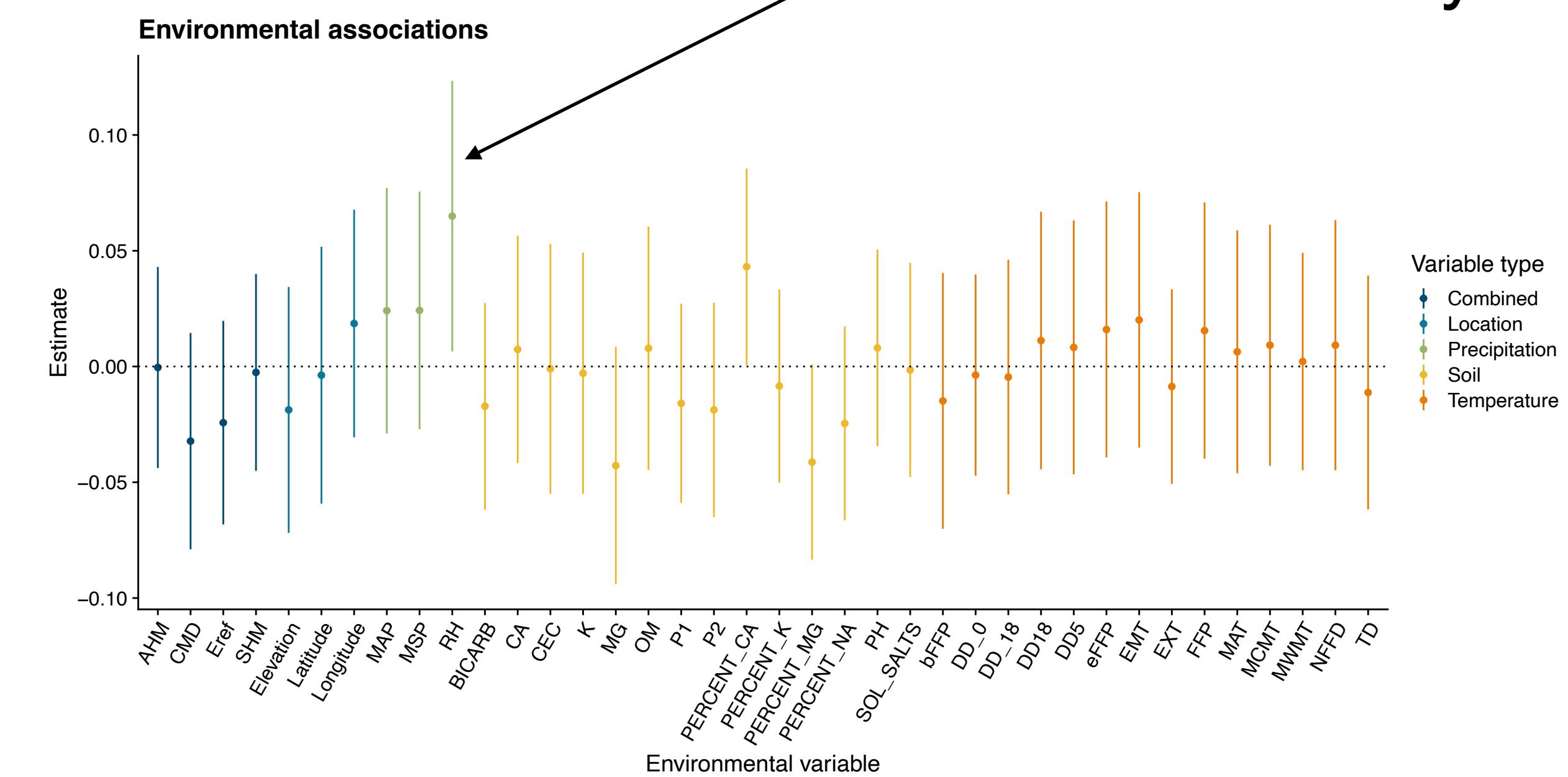
Both cytoplasm clades are found in almost all species



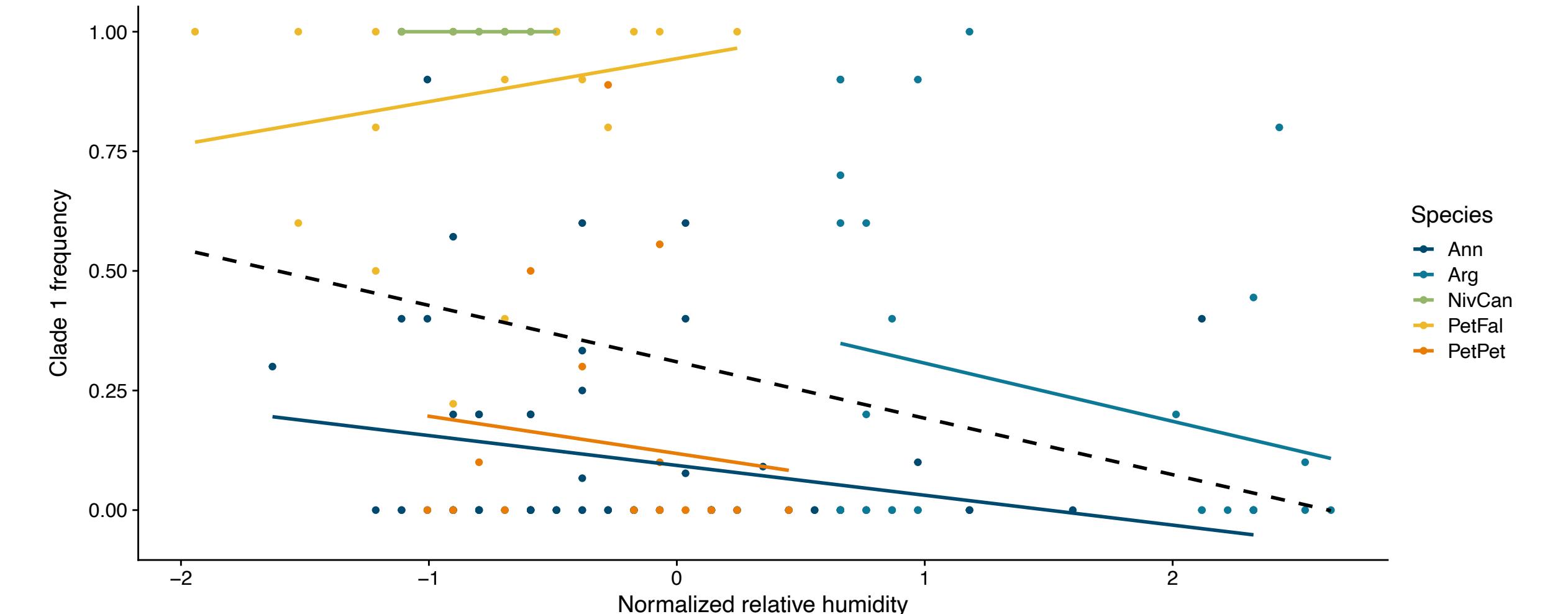
# Why two cytoplasm clades?

CP clade = env \* species

Relative Humidity



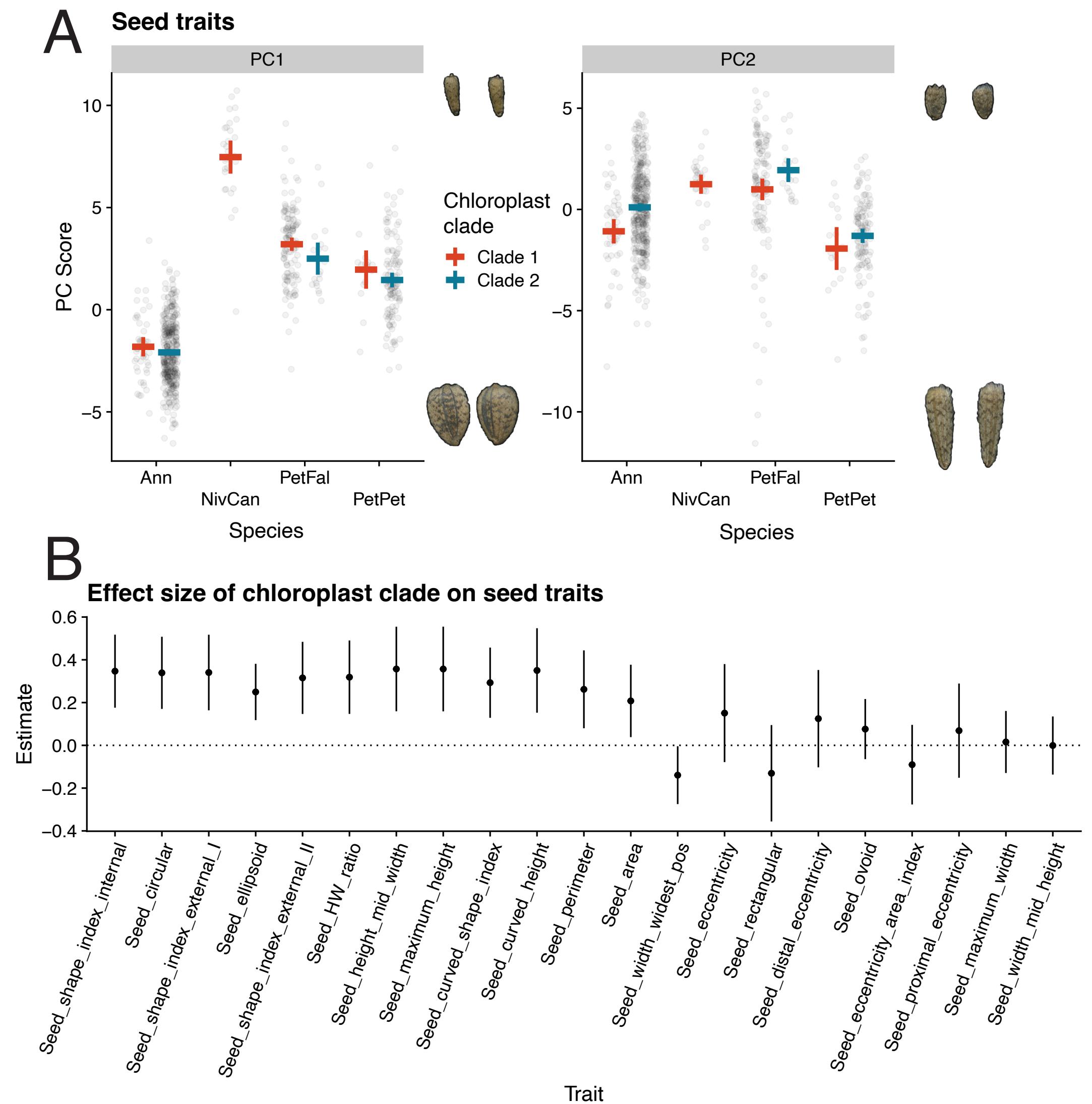
Cytoplasm clade is associated with relative humidity across and within species



# Why two cytoplasm clades?

Trait PC = CP clade \* species

Cytoplasm clade causes seeds  
to be taller and narrower  
across and within species.



# **Why two cytoplasm clades?**

**Cytoplasm clade effects seed size and environmental tolerance.**

**Trans-species balanced polymorphism!**

# Thank you!

## Co-authors

- Zhe Cai
- Natalia Bercovich
- Marco Todesco
- Julie A. Lee-Yaw
- Loren H. Rieseberg

