Afro-Asian disjunctions within *Helianthemum* subg. *Eriocarpum*: hybridisation reveals vicariance and intermediate extinction

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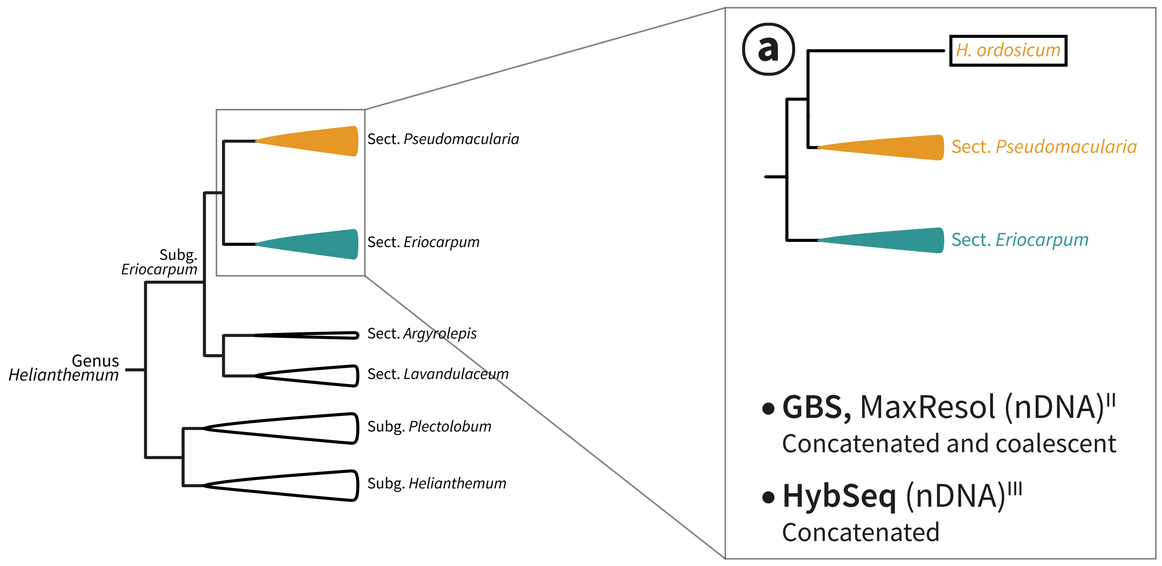
CASE STUDY: The recently described *Helianthemum* subg. *Eriocarpum* includes a broadly disjunct Afro-Asian lineage (sects. *Eriocarpum* and *Pseudomacularia*). To this group belongs *H. ordosicum*, the easternmost species of the genus, which exhibits an inconsistent phylogenetic placement despite its unquestionable taxonomic assignment to sect. *Pseudomacularia*. Clarifying its evolutionary history could provide critical insights into the disjointed distributions within the subgenus.

M&M: We performed HybSeq on 78% of the species of subg. *Eriocarpum*. We reconstructed phylogenetic trees based on nuclear and plastid data (Fig. I), estimated the lineage divergence times, and elaborated an ancestral area reconstruction of the subgenus (Fig. II). Additionally, we tested a possible hybrid origin of *H. ordosicum* through PhyloNetworks (Fig. III) and bioinformatically estimated its ploidy based on allelic ratio estimates using nQuire (Fig. IV).

I Alternative topologies for *Helianthemum ordosicum*



- **GBS,** MaxResol (nDNA)[II]
  Concatenated and coalescent
- **HybSeq** (nDNA)[III]
  Concatenated

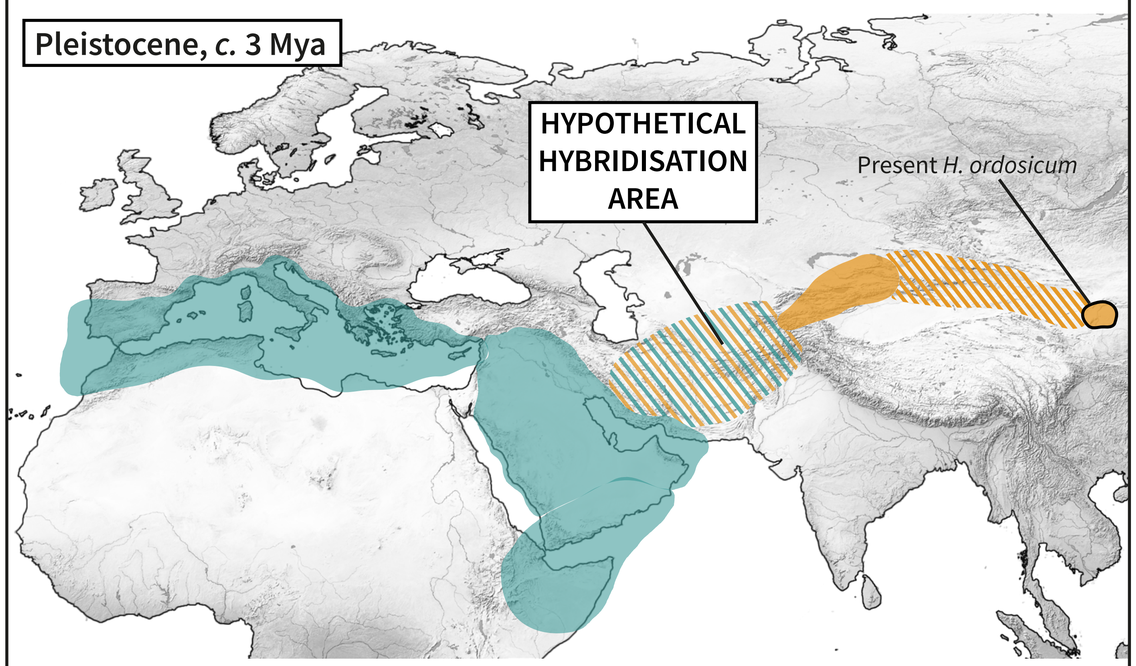
- **GBS,** MinError (nDNA)[II]
  Concatenated and coalescent
- **HybSeq** (nDNA)[III]
  Coalescent
- **HybSeq** (pDNA)[III]

- **Sanger** (nDNA + pDNA)[I]

Results from [I]Aparicio et al. 2017, [II]Martín-Hernanz et al. 2019, and [III]Current study

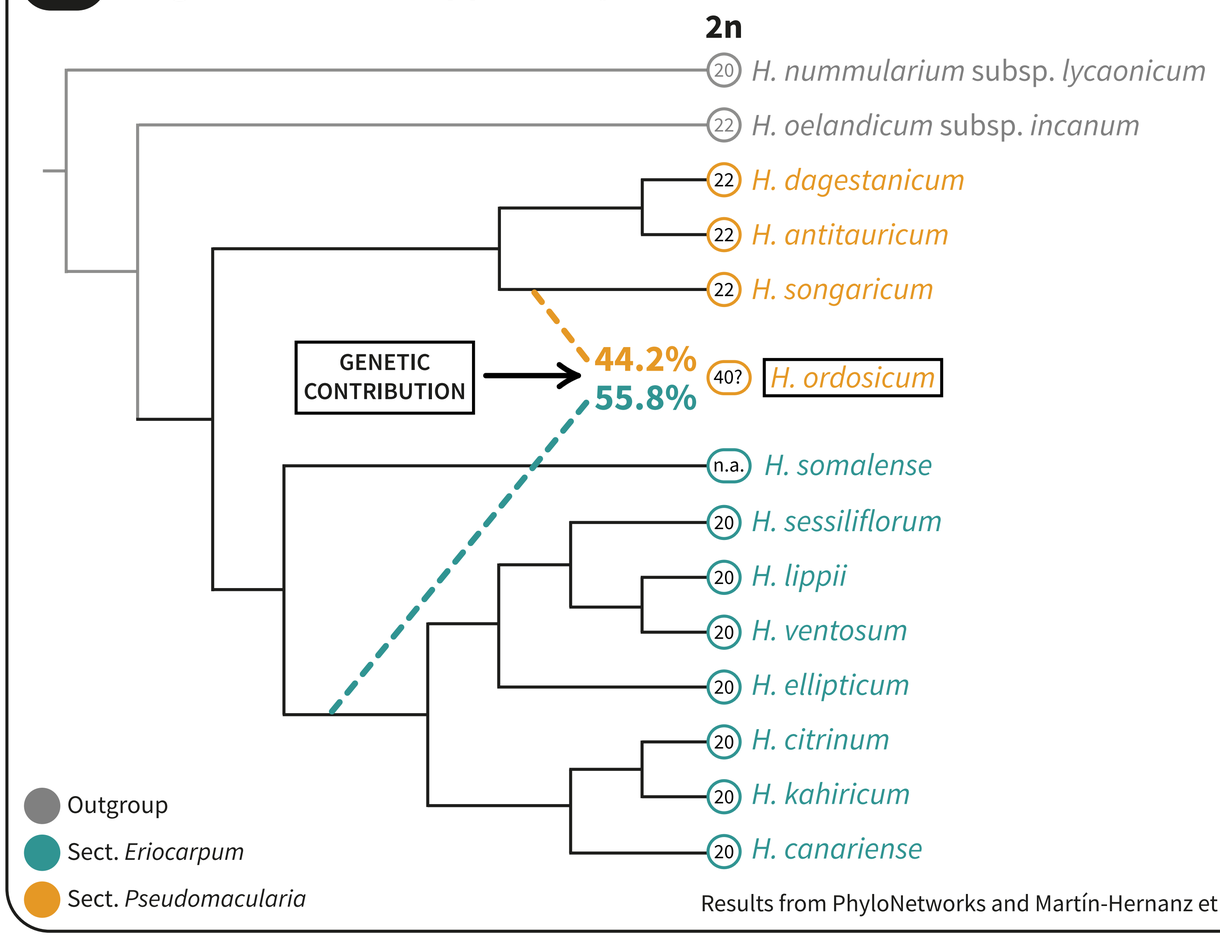
Could these incongruences mean that *H. ordosicum* is the result of an ancient hybridisation event?

II Where and when could this hybridisation have occurred?



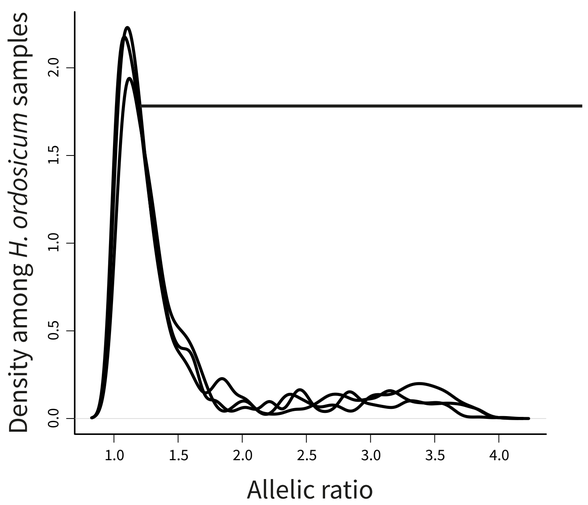
Results from BioGeoBEARS

III Do genomic data support a hybridisation event?



Results from PhyloNetworks and Martín-Hernanz et al. 2023

IV Could this hybridisation have resulted in allopolyploidy?



Peak at **1:1**

DIPLOID

Post-polyploid diploidisation?

Results from nQuire

CONCLUDING REMARKS

- *H. ordosicum* is the consequence of an ancient hybridisation event between the ancestors of *H. songaricum* (sect. *Pseudomacularia*) and sect. *Eriocarpum*.
- Despite its slightly higher genetic percentage from sect. *Eriocarpum*, we still consider *H. ordosicum* part of sect. *Pseudomacularia*, given its ecology, distribution, and morphology.
- The geographical disjunction between both sections can now be more certainly explained by vicariance and intermediate extinction rather than long-distance dispersal.
- The allelic ratio of *H. ordosicum* could only confirm its diploid behaviour. Therefore, a reliable chromosome count remains the missing step for its cytogenetic ascription and for understanding the genomic evolution of subg. *Eriocarpum*.

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