Unveiling the rapid radiation of *Helianthemum* subg. *Eriocarpum* (Cistaceae) through target capture sequencing

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INTRODUCTION: The newly described subg. *Eriocarpum* (Martín-Hernanz et al., 2021) is formed by 32 subdesert specialists with the most widespread and disjunct distribution in the genus *Helianthemum.* It occurs in Macaronesia, the Mediterranean Basin, the Sahara, Arabia, Eastern and Central Asia and the Horn of Africa (Fig. I), where five out of the six species present in northern Somalia are endemic. Previous phylogenetic and biogeographic reconstructions of genus *Helianthemum* generally failed to include these taxonomically valuable endemic species (Aparicio et al., 2017; Martín-Hernanz et al., 2019). Here, we aim to uncover the phylogenetic relationships and biogeographic history of subg. *Eriocarpum* using genomic data and intensive taxon sampling.

M&M: We obtained 74 samples of subg. *Eriocarpum*, representing the 78% of its taxa, including four of the Horn of Africa endemics, and sequenced them through target capture sequencing with the Angiosperms353 kit. We reconstructed phylogenetic trees using supermatrix (partitioned concatenated matrix) and supertree (coalescent) approaches (Fig. II), estimated the lineage divergence times, and elaborated an ancestral area reconstruction of the subg. *Eriocarpum* (Fig. III).


Sara Martín Hernanz

H. canariense

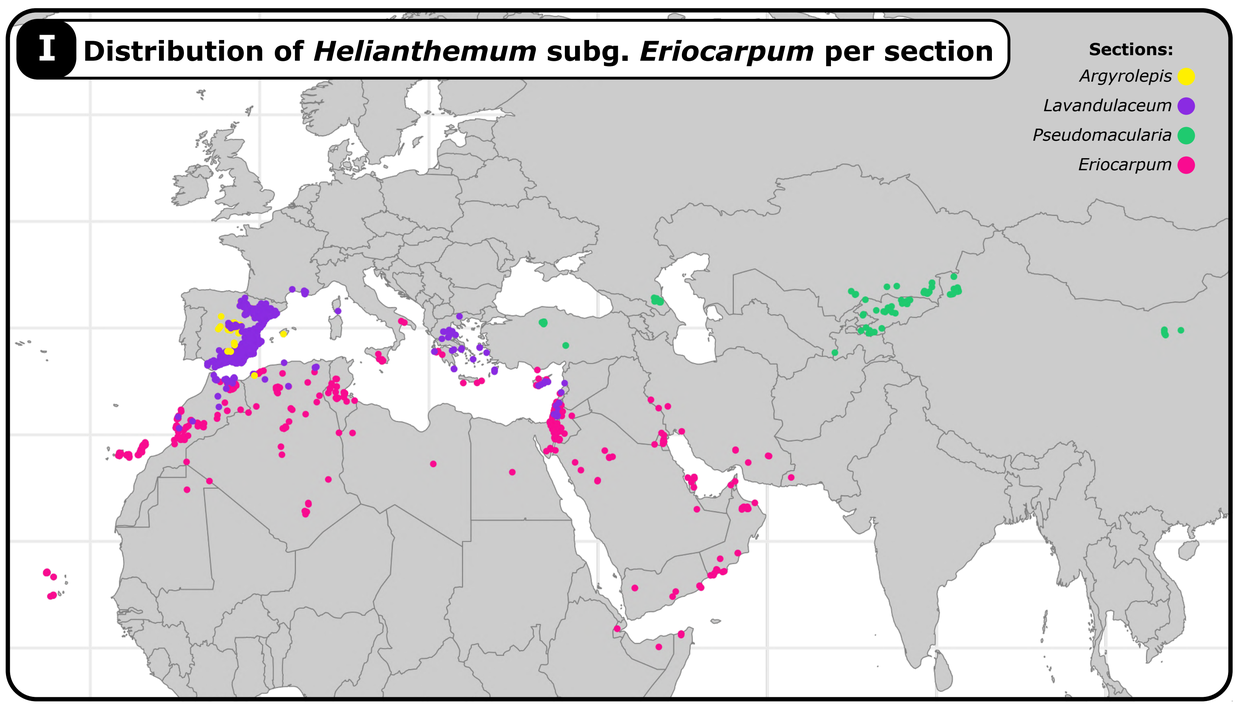

Abelardo Aparicio

H. syriacum

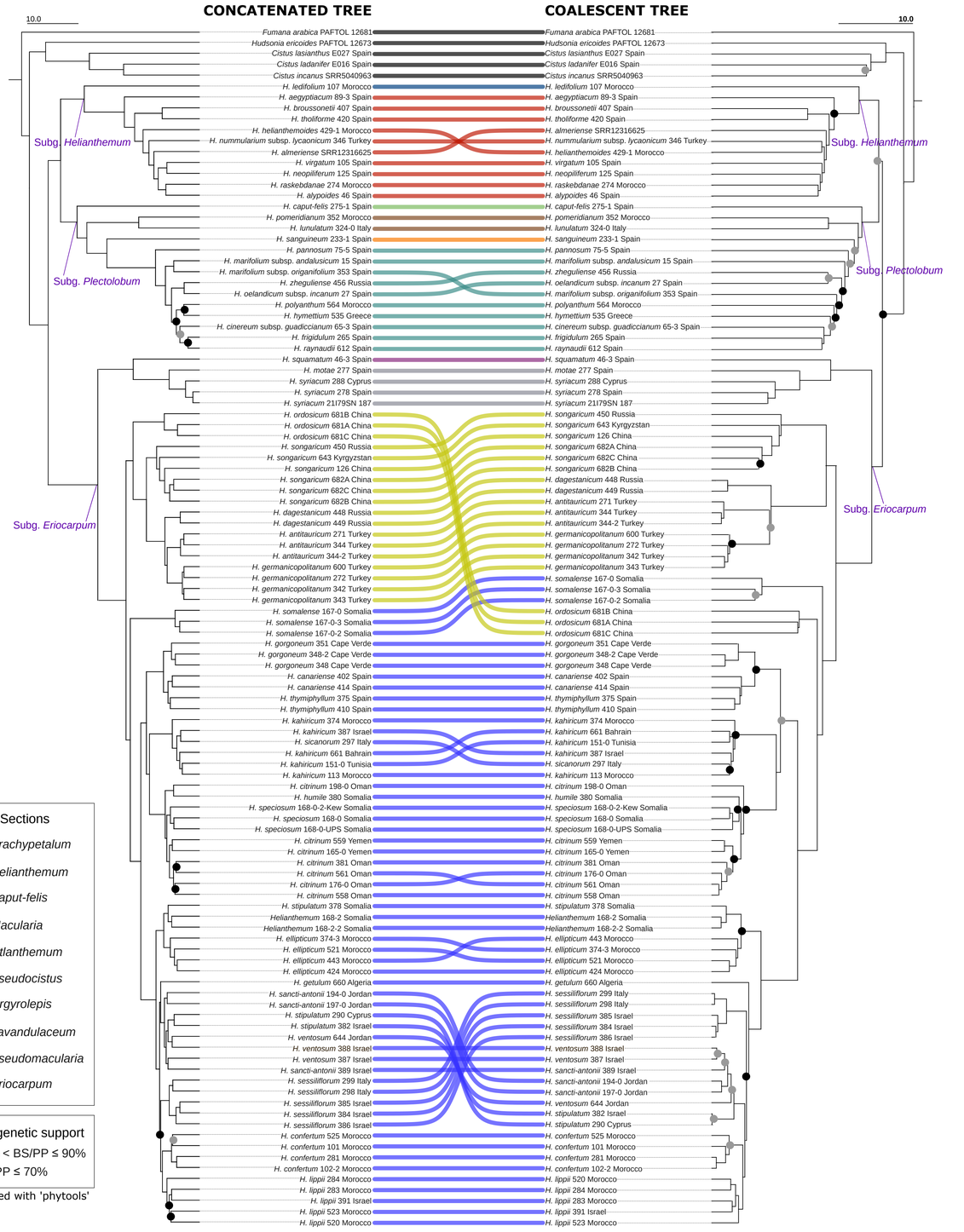

Rafael G. Albaladejo

H. stipulatum

I Distribution of *Helianthemum* subg. *Eriocarpum* per section



II Phylogenetic reconstruction of *Helianthemum* subg. *Eriocarpum*

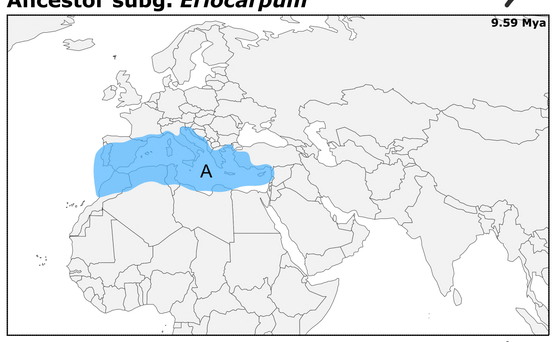


- Monophyly of subg. *Eriocarpum* and sects. *Argyrolepis* and *Lavandulaceum*.
- Likely ancient hybridisation event due to incongruency in the position of *H. ordosicum*.
- Lack of taxonomical consensus among regional floras, as suggested by the non-monophyly of several taxa (i.e., *H. thymiphyllum*, *H. canariense*, *H. kahiricum*, *H. citrinum*, *H. stipulatum*, *H. sancti-antonii* and *H. ventosum*).
- New ascription of *H. dagestanicum* to sect. Pseudomacularia.

III Biogeographic reconstruction of *Helianthemum* subg. *Eriocarpum*

- Ancestor of sects. *Pseudomacularia* and *Eriocarpum* abandons the Mediterranean in the Pliocene and spreads throughout the Horn of Africa and Eastern and Central Asia.

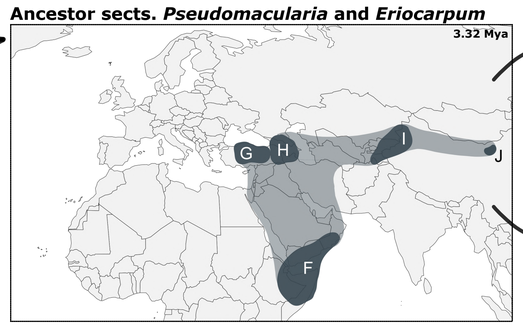
Ancestor subg. *Eriocarpum*



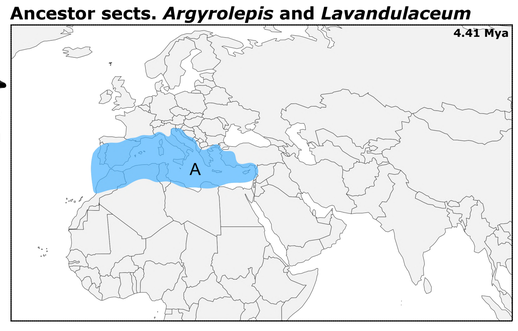
- Subg. *Eriocarpum* originates in the Mediterranean during the late Miocene.

- Ancestor of sects. *Argyrolepis* and *Lavandulaceum* remains in the Mediterranean Region.

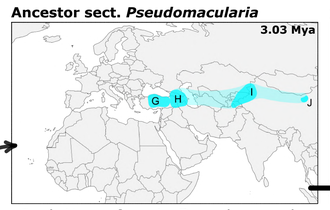
Ancestor sects. *Pseudomacularia* and *Eriocarpum*



Ancestor sects. *Argyrolepis* and *Lavandulaceum*

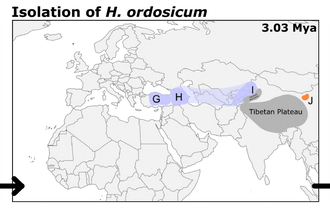


Ancestor sect. *Pseudomacularia*

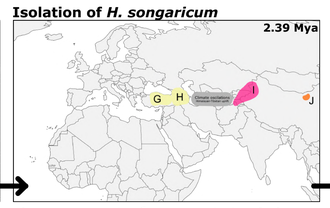


- Isolation of sect. *Pseudomacularia* in Asia

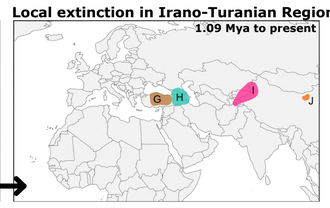
Isolation of *H. ordosicum*



Isolation of *H. songaricum*

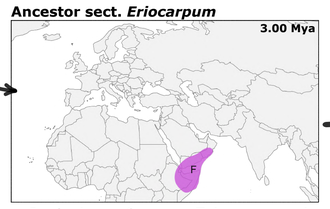


Local extinction in Irano-Turanian Region



- Successive vicariance events fragmentate Asian populations of sect. *Pseudomacularia* during Pliocene and Pleistocene.

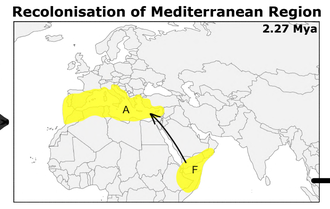
Ancestor sect. *Eriocarpum*



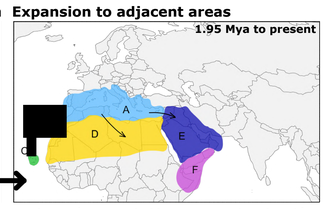
- Isolation of sect. *Eriocarpum* in the Horn of Africa, where *H. somalense* arises as an early-diverging species.

- Sect. *Eriocarpum* recolonises the Mediterranean and later expands to adjacent areas.

Recolonisation of Mediterranean Region



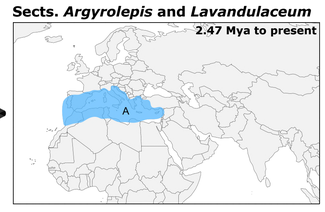
Expansion to adjacent areas



- Local speciation events in the Horn of Africa generate high level of endemicity, making northern Somalia the speciation centre of sect. *Eriocarpum*.

- Sects. *Argyrolepis* and *Lavandulaceum* stay in the Mediterranean since their respective origins in the Pliocene.

Sects. *Argyrolepis* and *Lavandulaceum*



LATE MIOCENE | PLIOCENE | PLEISTOCENE & HOLOCENE

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