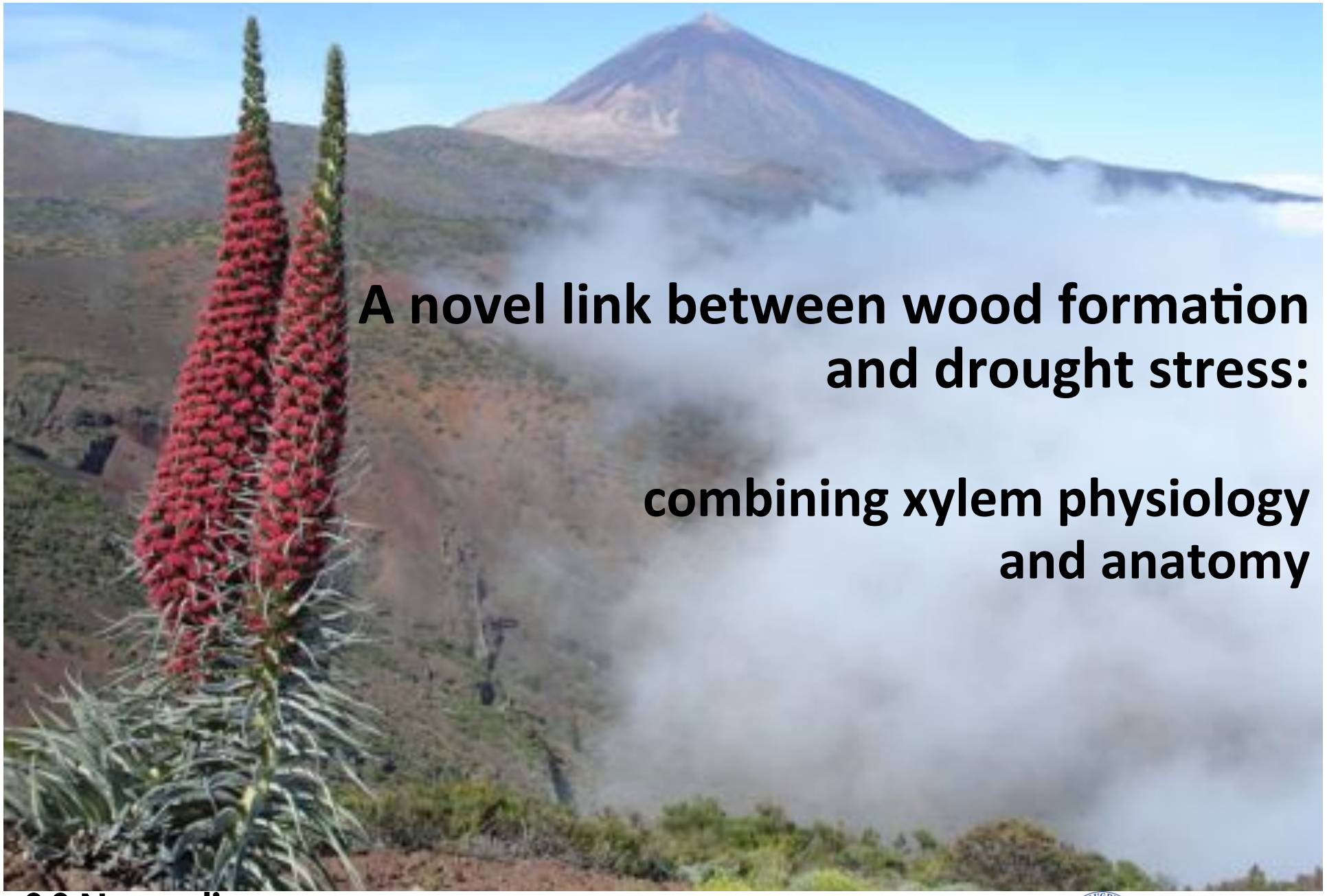


A novel link between wood formation and drought stress:

combining xylem physiology and anatomy

Naturalis Biodiversity Center

Frederic Lens, Thibaud Chauvin, Pauline Bouche, Max Larter, Régis Burlett, Gaëlle Capdeville, Sylvain Delzon

Universiteit Leiden

primary woodiness ➔

herbaceousness ➔

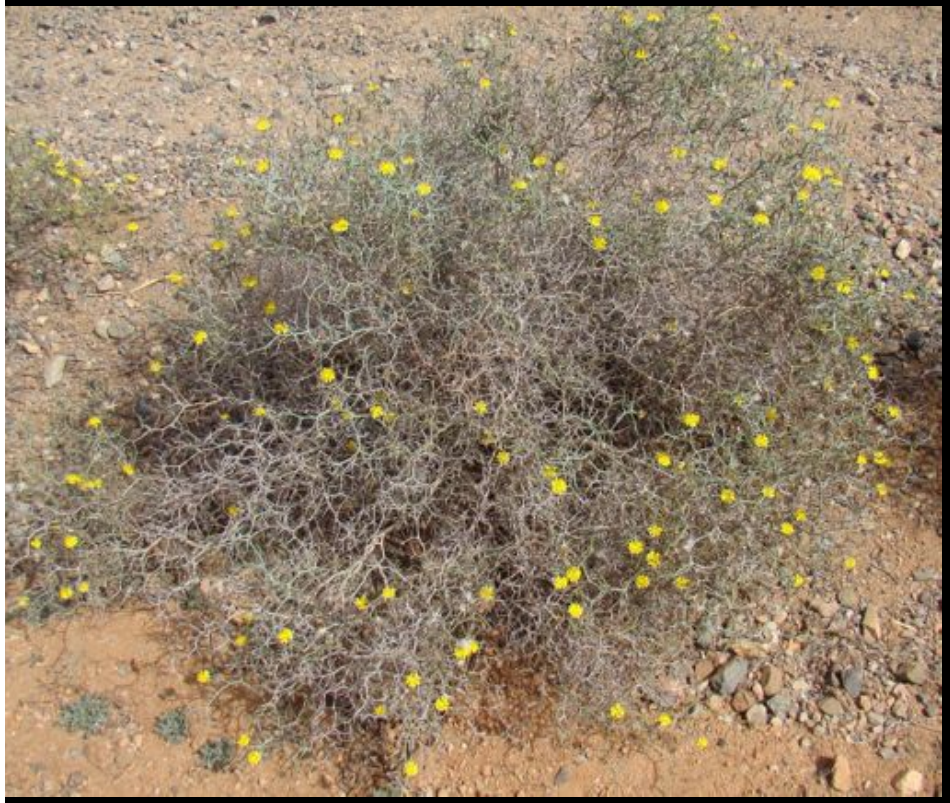
secondary woodiness

(insular woodiness)

ONGOING REVIEW OF SECONDARY WOODINESS WITHIN ANGIOSPERMS

- Preliminary dataset includes 456 secondarily woody genera:
  - Magnoliids: 1% (5 genera);
  - base of (core) eudicots: 2% (9 genera);
  - Rosids: 14% (65 genera);
  - Caryophyllales: 21% (95 genera);
  - Asterids: 62 % (282 genera);
    - Asteraceae: 30% (140 genera).
- Distribution:
  - Islands: 33% (151 genera);
  - Continents: 67% (305 genera);
    - Steppes, savannahs, (semi-)deserts: 70% (210 genera).
- Clear link between wood formation and drought stress

SECONDARY WOODINESS IN DESERT SHRUBS



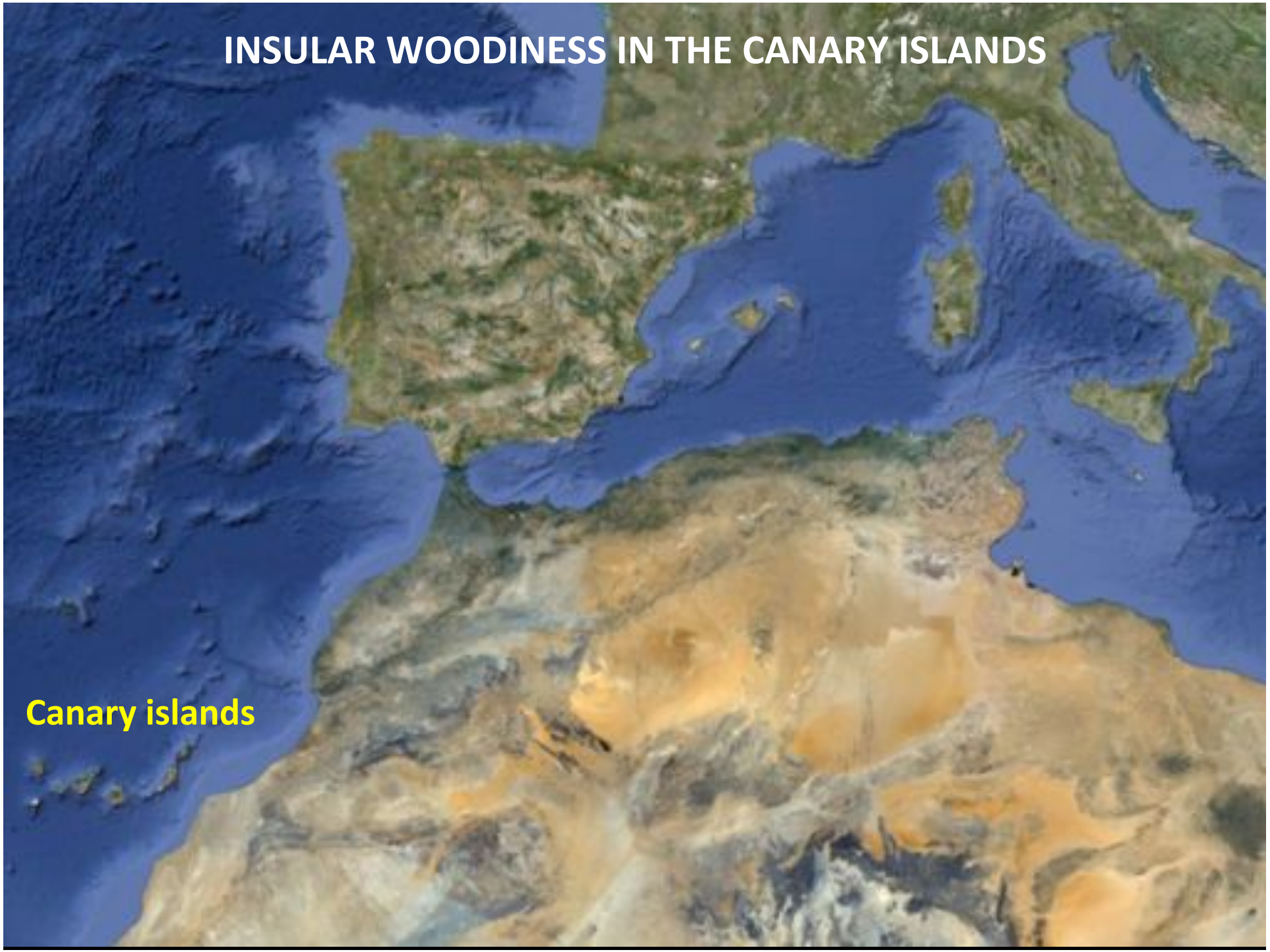
Launaea arborea:
Asteraceae, northern Africa and central Asia

Zilla spinosa:
Brassicaceae, northern Africa and Arabia

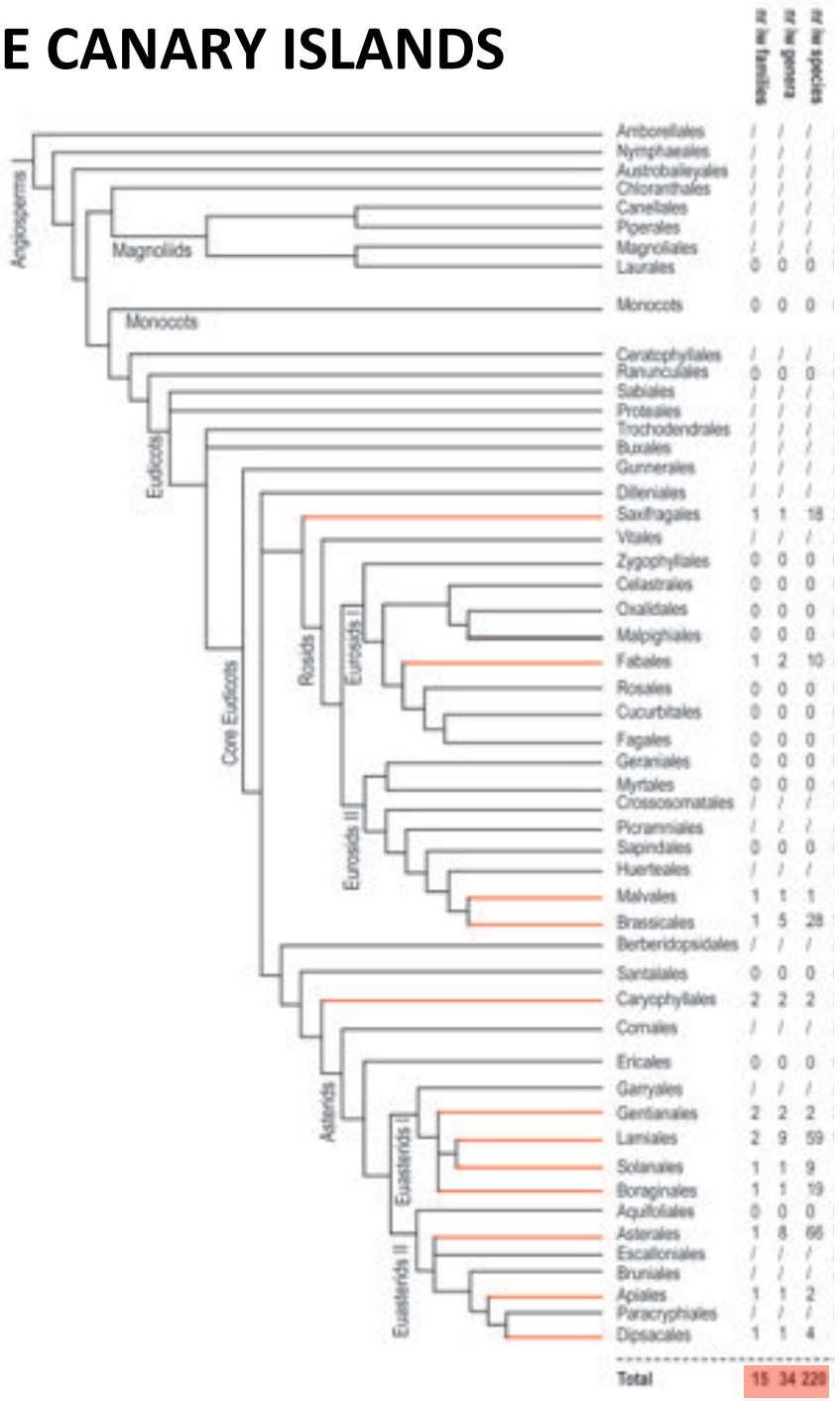
MOUNT KINABALU, SABAH, MALAYSIA

Begonia spec nov (< 1000m asl)

Begonia spec nov (> 2000m asl)


INSULAR WOODINESS IN THE CANARY ISLANDS
Canary islands

INSULAR WOODINESS IN THE CANARY ISLANDS



Lens et al 2013 Int J Plant Sci 174: 992-1013

INSULAR WOODINESS IN THE CANARY ISLANDS

- Distribution of 220 insular woody species on the Canaries:
  - Dry lowland regions up to 700m asl: 58%
  - High altitude desert above 2000m asl: 6%.

- Link between insular woodiness and drought confirmed.

DIFFERENT HYPOTHESES EXPLAINING INSULAR WOODINESS

- Intraspecific competition for light
- Favourable climate (lack of seasonality, lack of frost)
- Lack of large native herbivores
- Higher chance of outcrossing (longevity hypothesis)

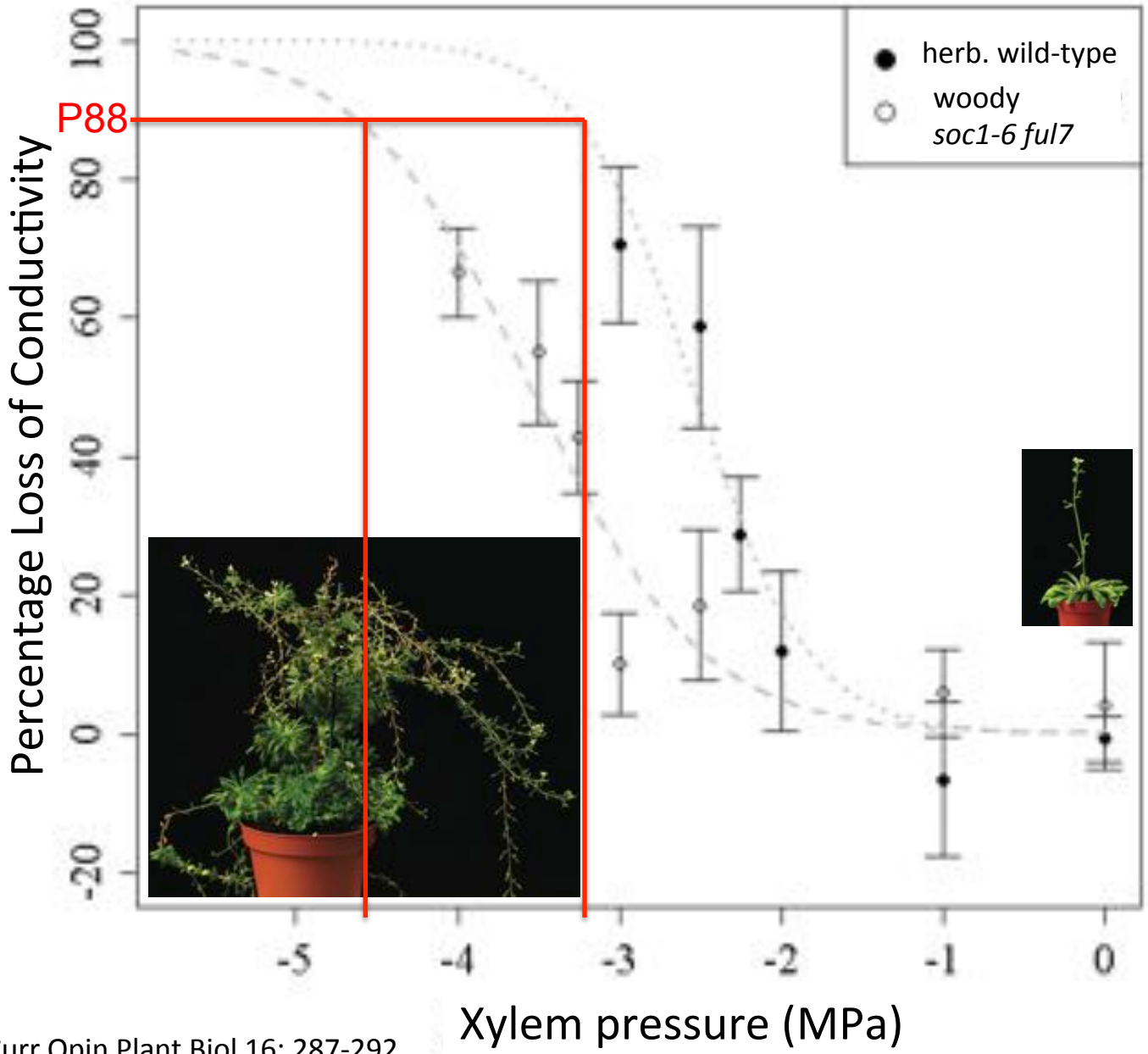
DIFFERENT HYPOTHESES EXPLAINING INSULAR WOODINESS

- Novel drought stress hypothesis:

  - ✓ Molecular dating approach: when did insular woody groups originate?
    - Cooler and drier periods during the glacial cycles (2-3Ma).

  - ✓ Hydraulic approach: investigate embolism resistance in insular woody species and their herbaceous relatives
    - Insular woody species more embolism resistant?

FIRST EXPERIMENTAL EVIDENCE FOR EMBOLISM RESISTANCE HYPOTHESIS



Lens et al 2013 Curr Opin Plant Biol 16: 287-292

SAMPLING STRATEGY

- Screening of 15 different insular woody groups

- Focusing on three groups based on S-shaped curves:
  - ✓ *Argyranthemum* vs *Leucanthemum* (daisies)
  - ✓ *Descurainia* (IW and herbaceous)
  - ✓ *Ixanthus* vs *Blackstonia* (Gentianaceae)

- VCs based on 10 individuals per species,
  2 stems per individual, 26 or 42 cm stems

- Hydraulics and anatomy (LM, SEM, TEM) on the same stems

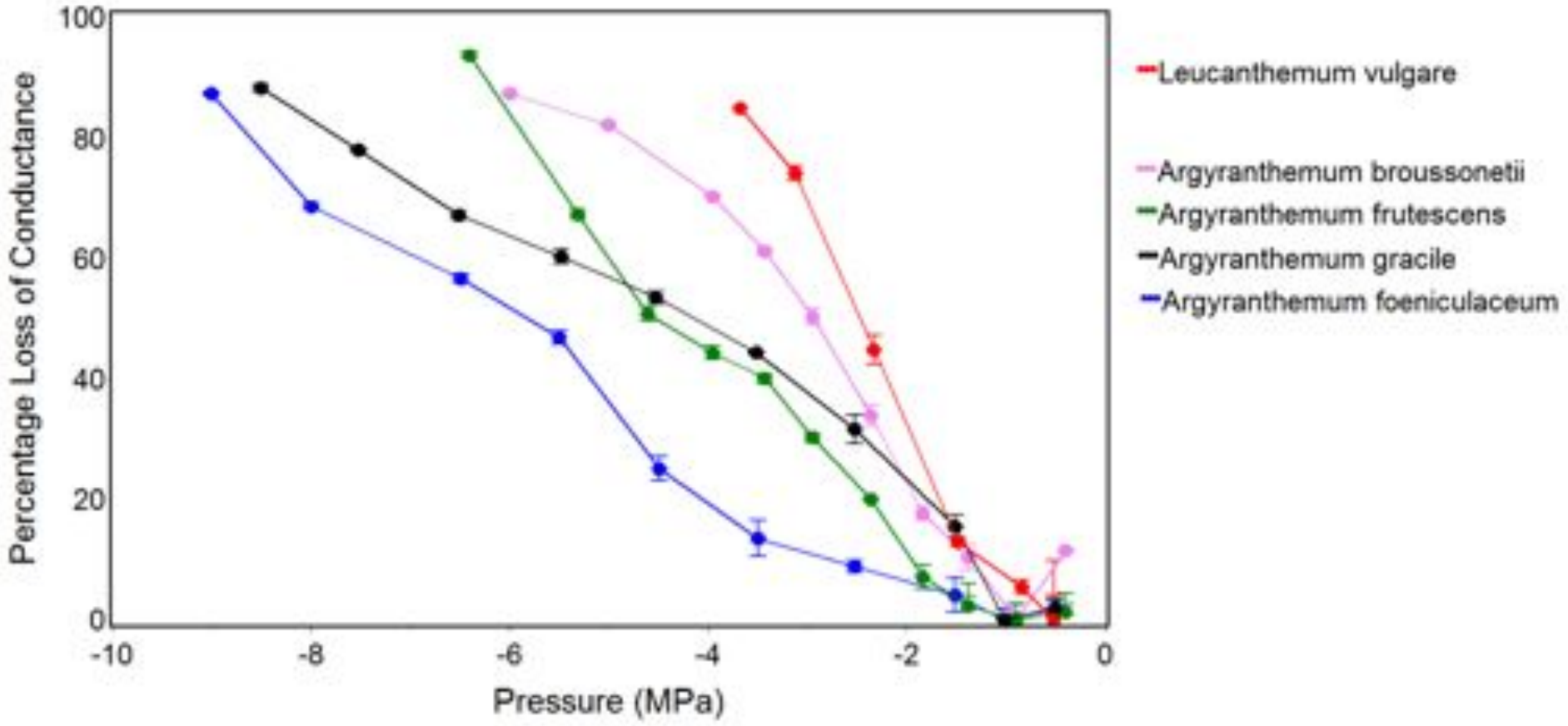
CAVIPLACE, UNIVERSITY OF BORDEAUX, FRANCE

LOOKING FOR ADDITIONAL SUPPORT IN THE DAISY LINEAGE

Argyranthemum foeniculaceum

Leucanthemum vulgare

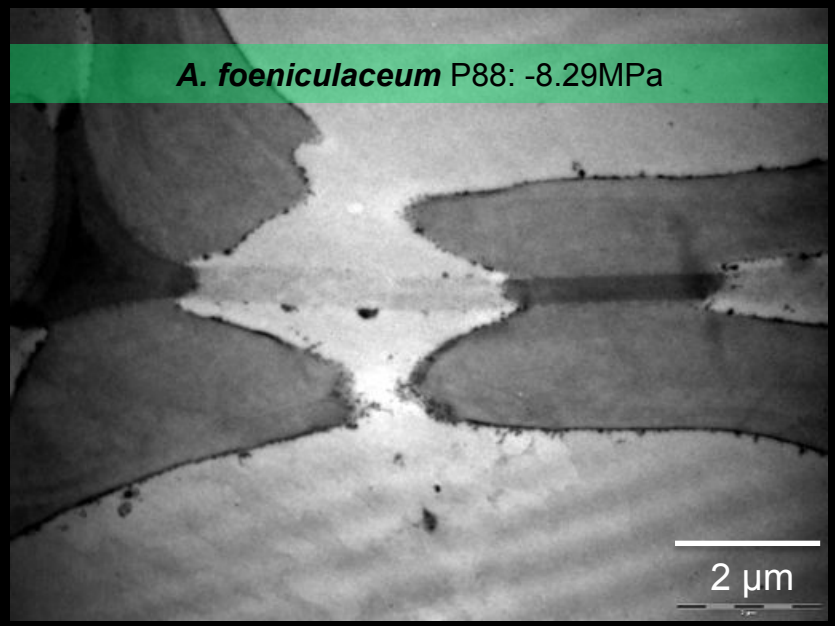
ADDITIONAL SUPPORT IN THE DAISY LINEAGE

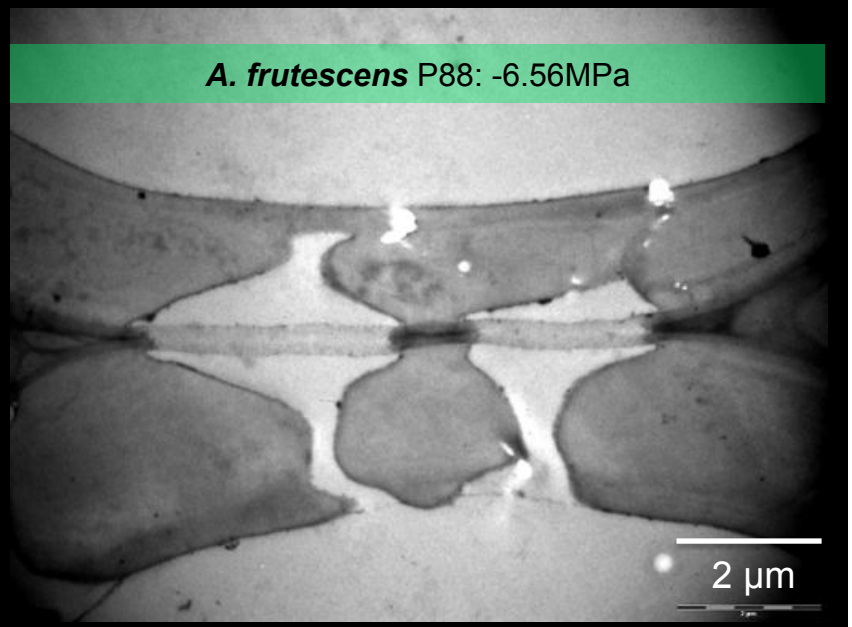


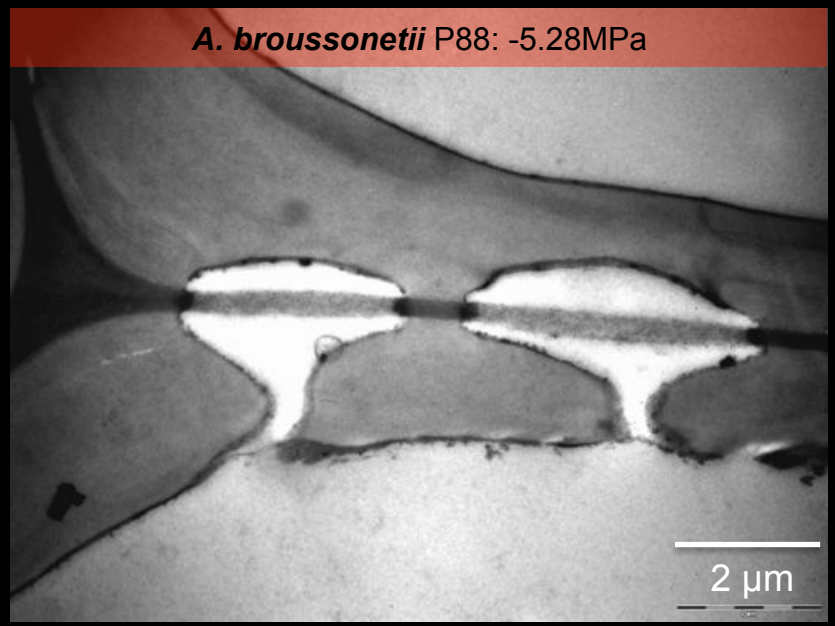
Lens et al in prep

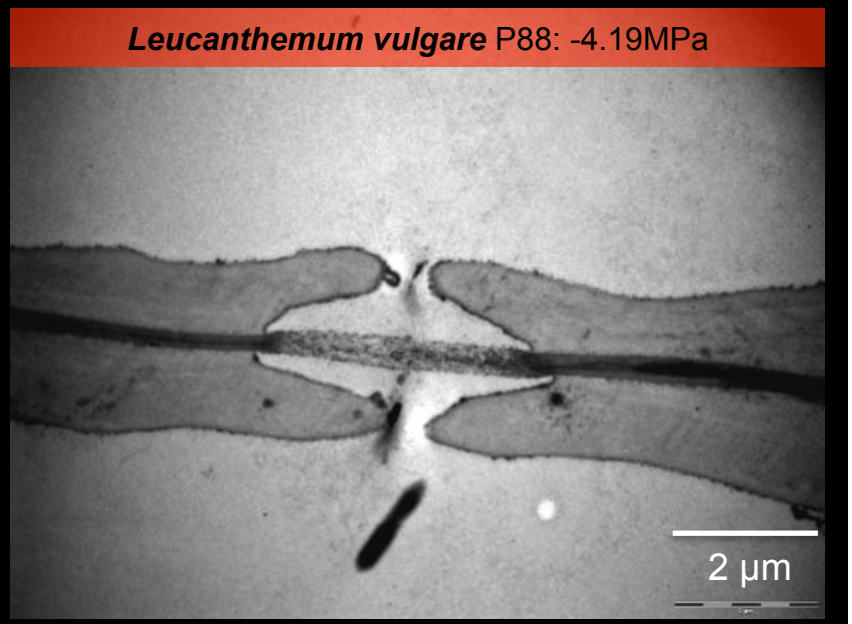
LINKING HYDRAULICS WITH ANATOMY: THE ROLE OF INTERVESSEL PITS

EMBOLISM RESISTANCE



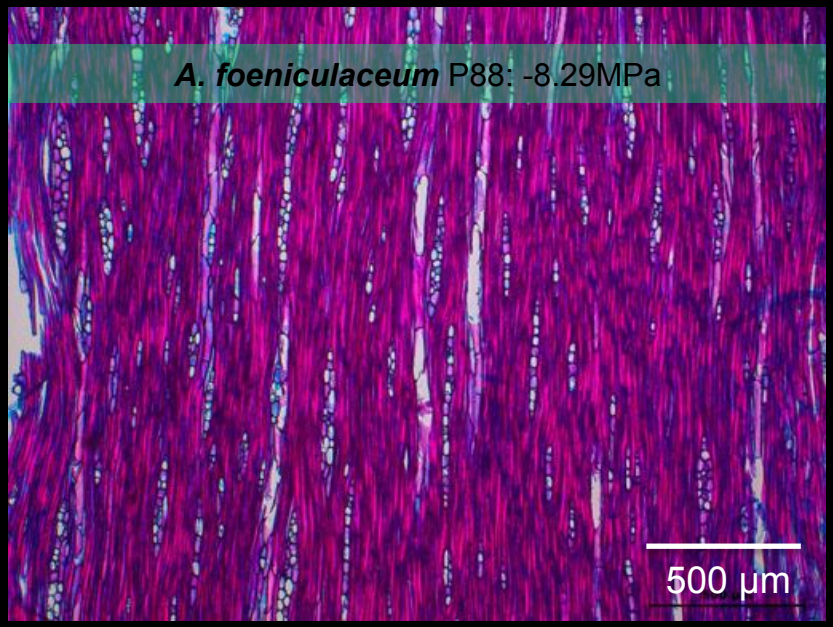


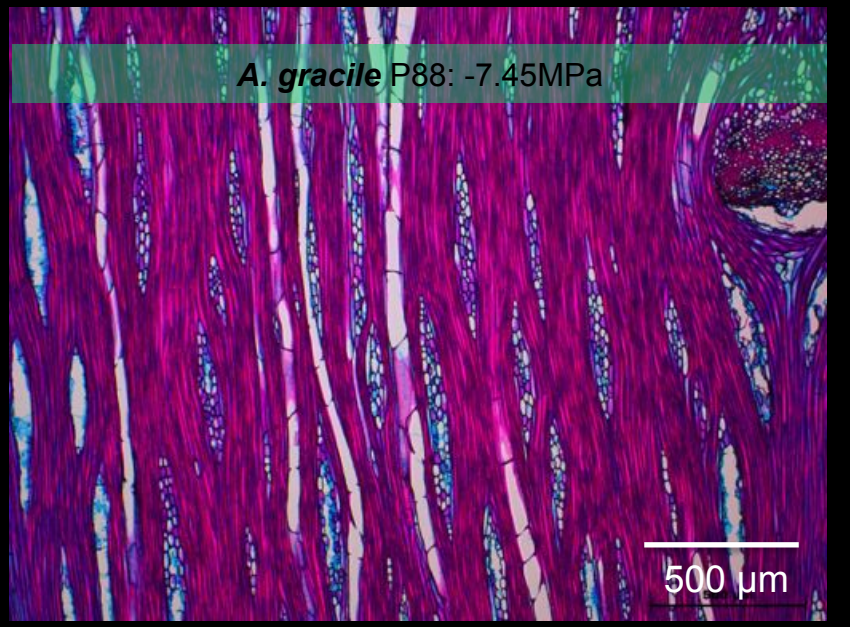


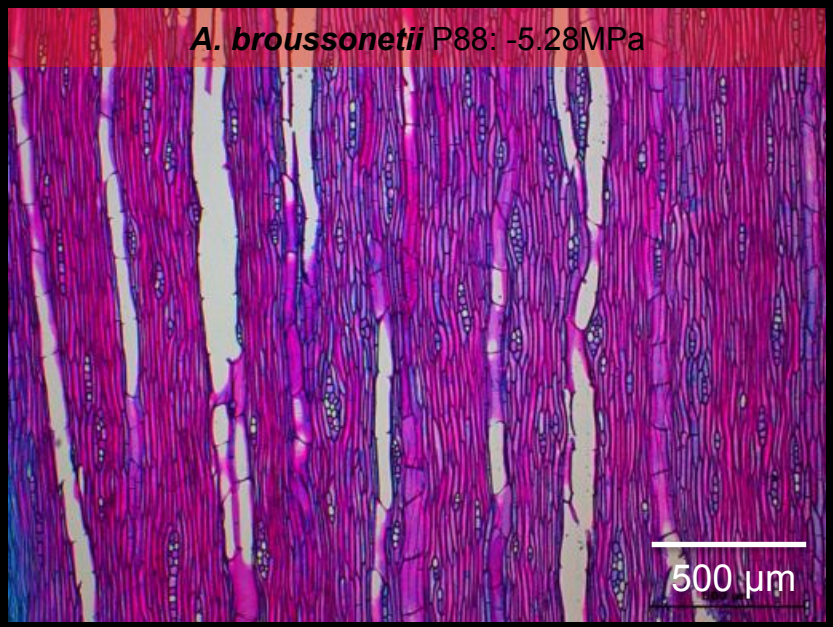


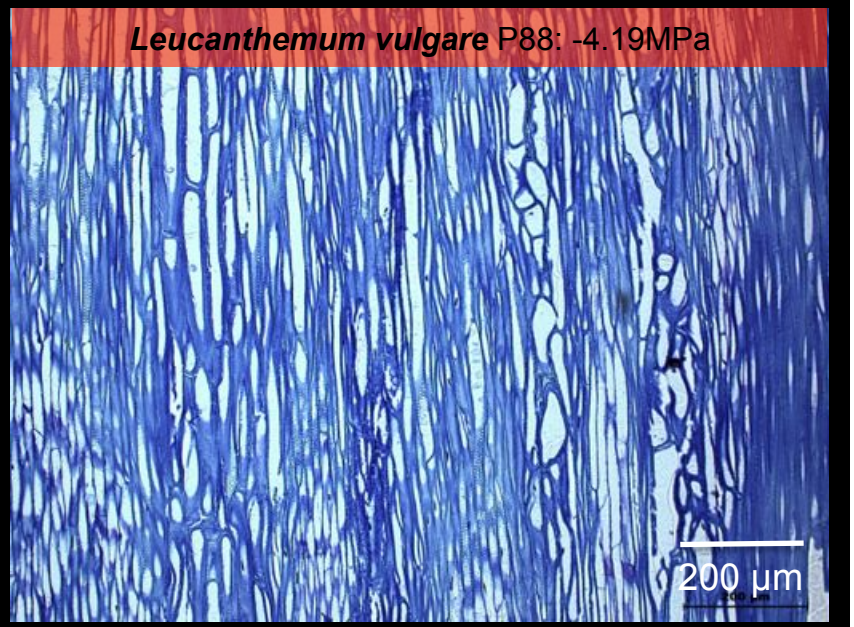
LINKING HYDRAULICS WITH ANATOMY: THE ROLE OF RAYS?

EMBOLISM RESISTANCE









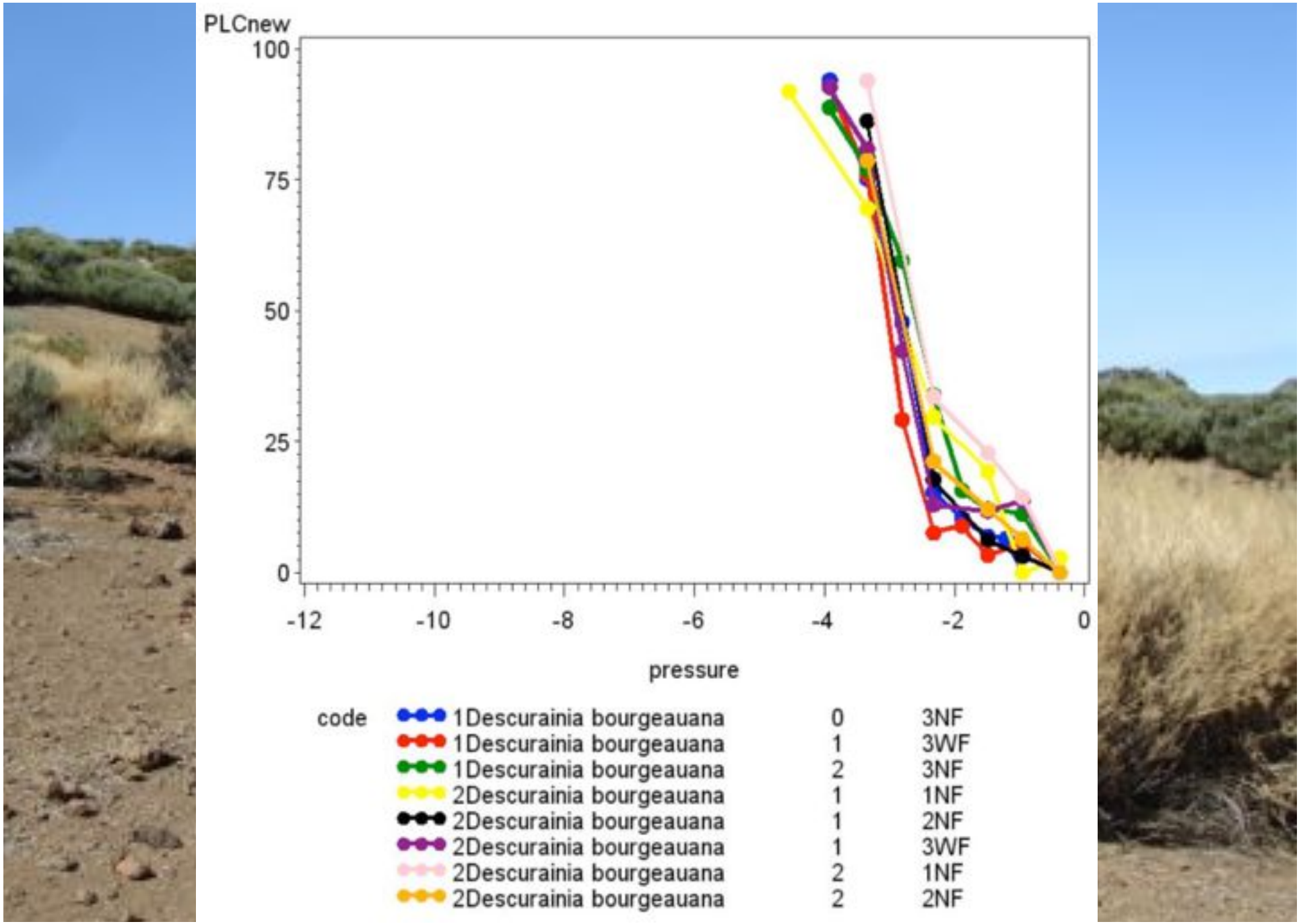
Argyranthemum foeniculaceum at end of dry summer (P88 = -8.29MPa)

Argyranthemum broussonetii endemic to wet laurel forests (P88 = -5.28MPa)

WORK IN PROGRESS: *DESCURAINIA* (BRASSICACEAE)

Descurainia bourgeauana (P88 = -3.68MPa)

Descurainia sophia (VCs to be measured)



Descurainia bourgeauana endemic to high altitude desert at 2000m asl at end of summer

WORK IN PROGRESS: *IXANTHUS-BLACKSTONIA* (GENTIANACEAE)

Ixanthus viscosus (P88 = -7.06MPa)

Blackstonia perfoliata (VCs to be measured)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