Forest biodiversity in the Mediterranean - the importance of genetic diversity

Bruno Fady

8th MFW | Mediterranean forest week
Barcelona 2024, 4 - 7 November

Working together for sustainable and resilient Mediterranean forests

Towards a collaborative roadmap

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EFI

What is biodiversity?

Biodiversity from ecosystems to genes

The Convention on Biological Diversity (CBD) is the international legal instrument for "the **conservation** of biological diversity, the **sustainable use** of its components and the fair and equitable **sharing of the benefits** arising out of the utilization of **genetic resources**“. Since 1992, it has been ratified by 196 nations.

How is biodiversity protected?

Protected areas and their focus on species

- Almost 300 000 terrestrial protected areas (including OECM) worldwide (over 16% coverage), 10% of world's forests (FAO 2020)

  => still far from the 30% of Target 3 of the Kunming-Montreal Global Biodiversity Framework (GBF).

- Less than 10 protected areas have **genetic diversity as their conservation goal**. Less than 10% protect genetic diversity by default (IUCN category I).

www.protectedplanet.net

Fady and Bou Dagher-Kharrat 2024 *Nature*

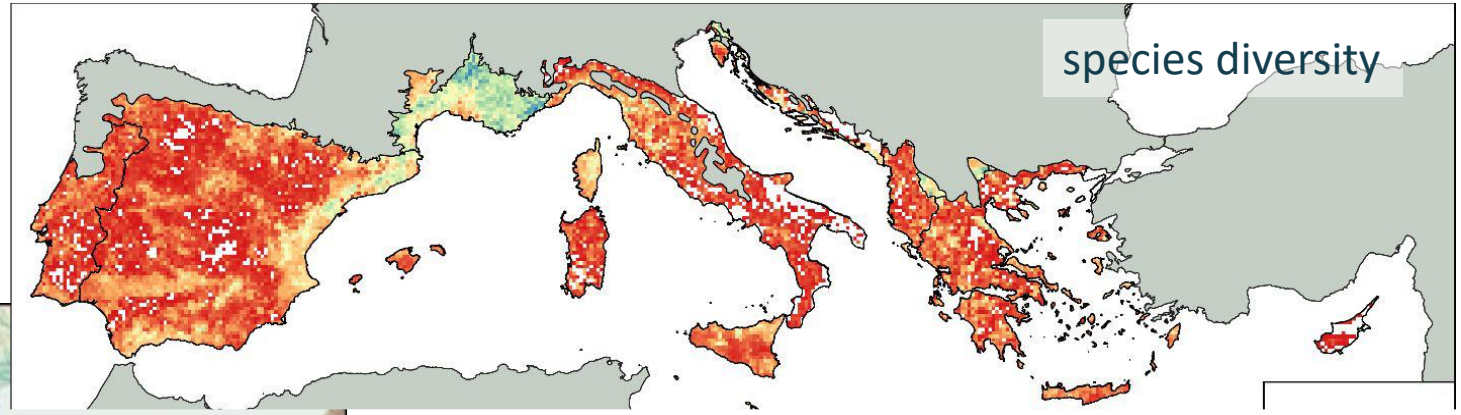
Genetic diversity as a conservation method and goal

Genetic diversity: a key element of biodiversity and the basis of resilience in the Mediterranean (MFRA 2030).

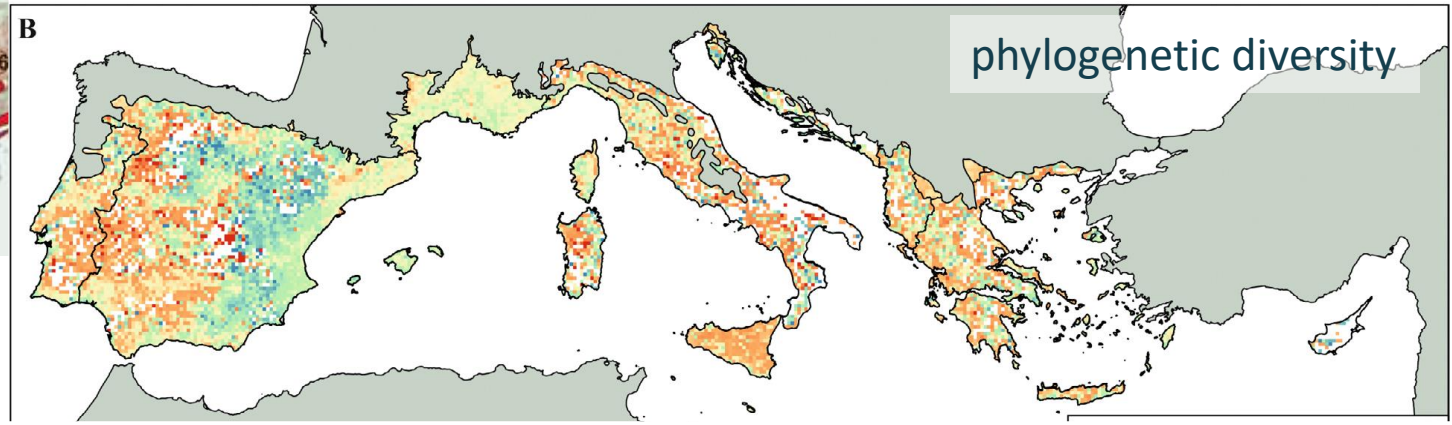
It is both a **method** to measure biodiversity and a **process** to protect and foster.

Tree species of the Northern Mediterranean: endemism, species and phylogenetic diversity

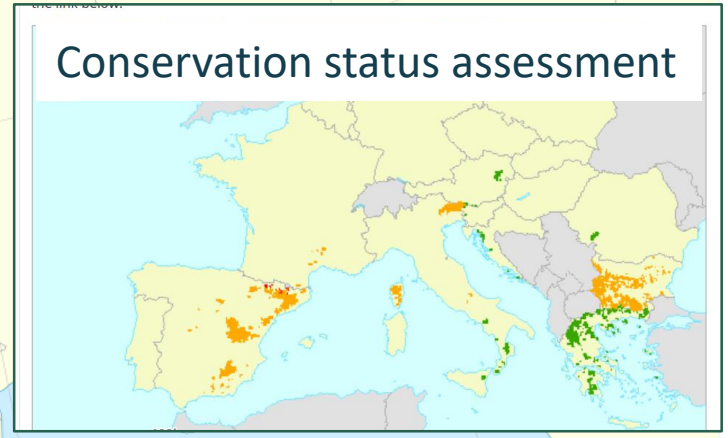
Médail and Diadema al. 2009 *J. Biogeog*



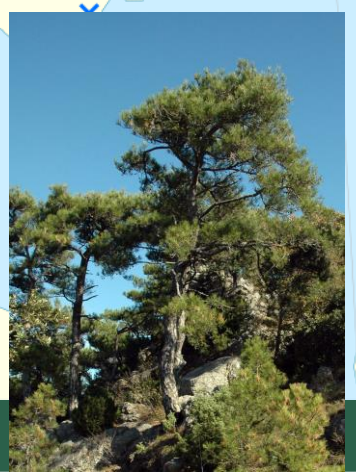
Cheick Albassatneh et al. 2023 *Plant Biol*



The natural distribution of black pines in Europe and North Africa

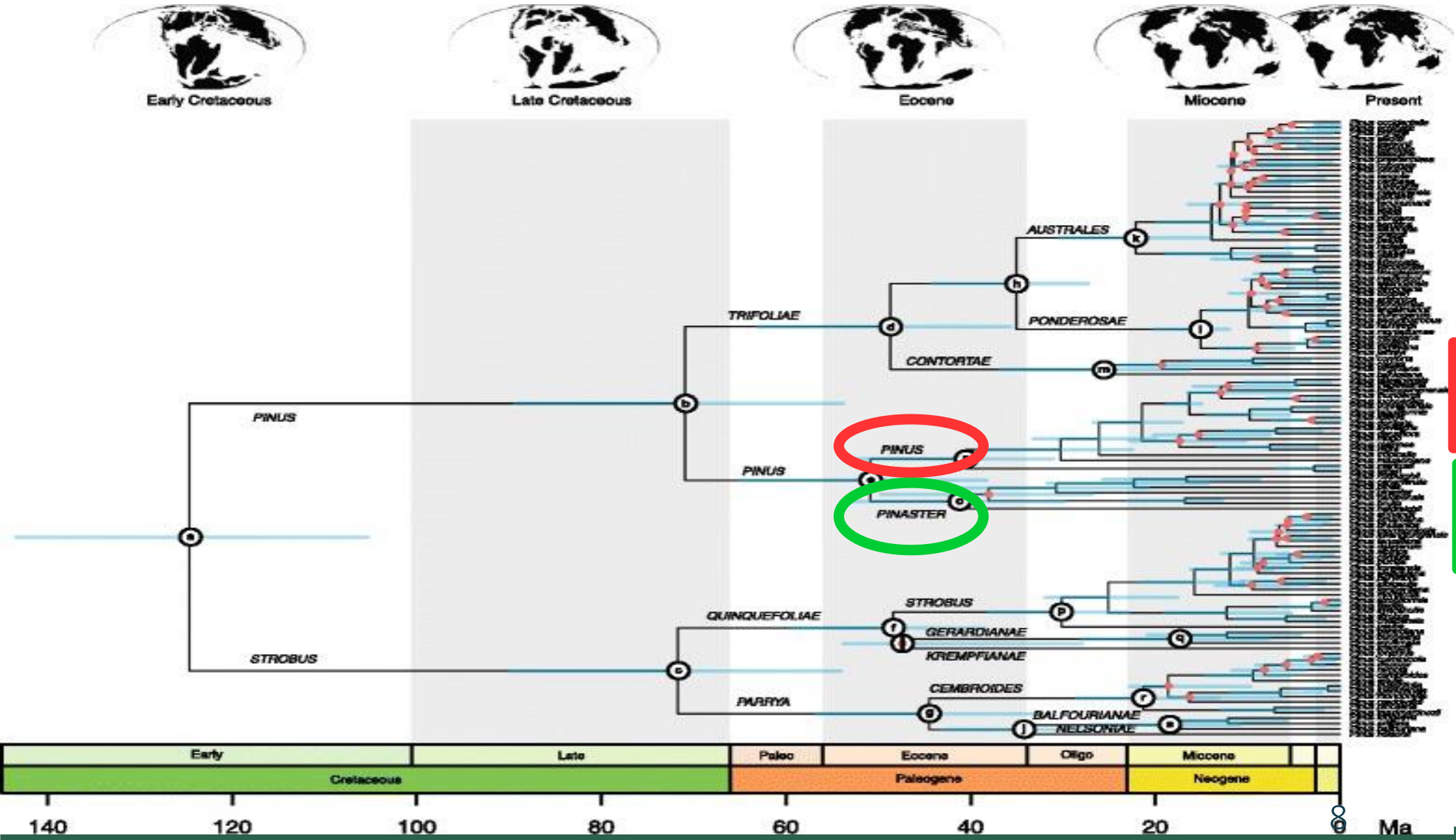


- *Pinus nigra* subsp. *salzmannii*.
- *Pinus nigra* subsp. *laricio*.
- *Pinus nigra* subsp. *nigra*.
- *Pinus nigra* subsp. *dalmatica*.
- *Pinus nigra* subsp. *pallasiana*.



Caudullo, G., Welk, E., San-Miguel-Ayanz, J., 2017. Chorological maps for the main European woody species. Data in Brief 12, 662-666. DOI: 10.1016/j.dib.2017.05.007. Data: https://doi.org/10.6084/m9.figshare.5113945

Evolutionary history of the genus Pinus

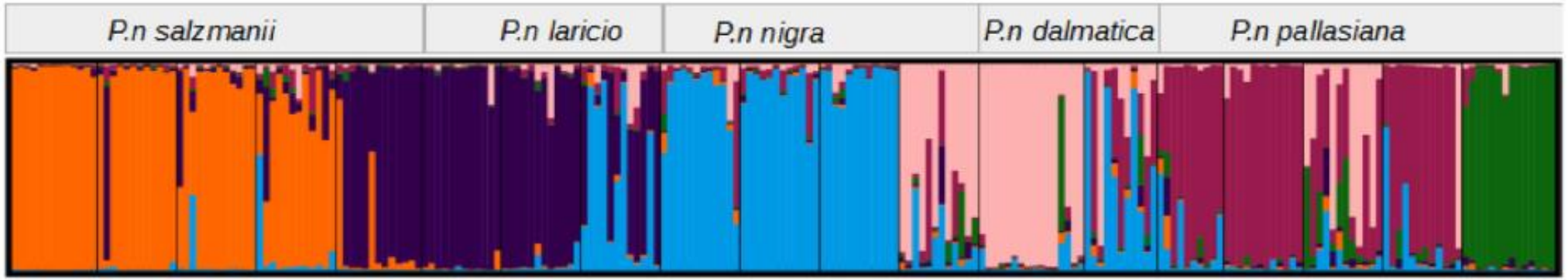


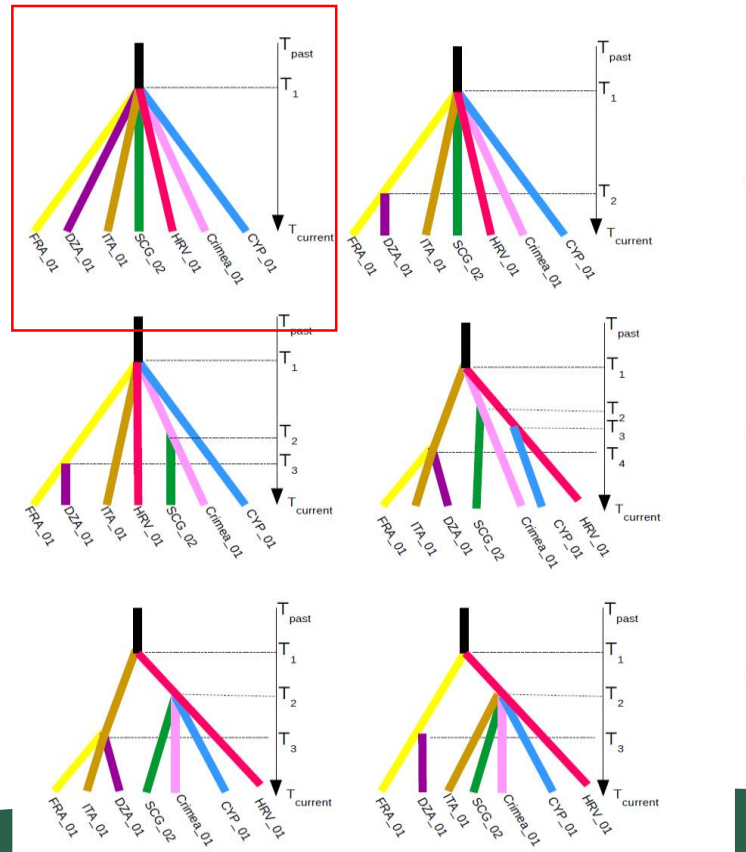
nigra, sylvestris, mugo, uncinata, resinosa, thunbergii

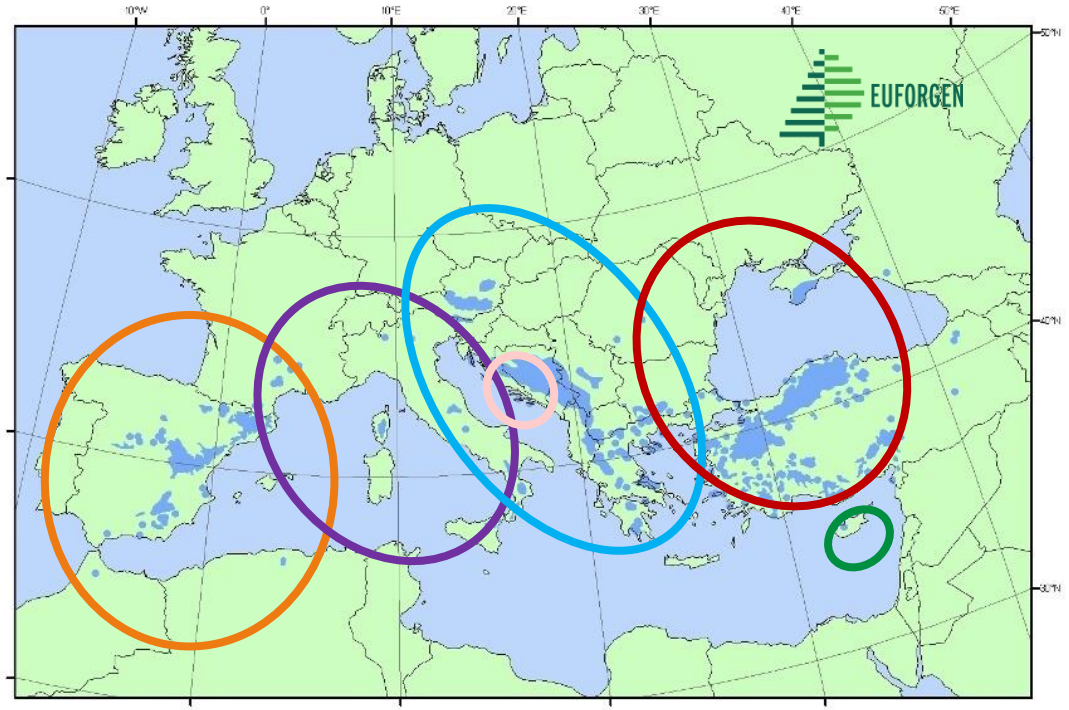
halepensis, brutia, pinaster, roxburghii, heldreichii, canariensis,

Saladin et al. 2017. BMC Evolutionary Biology.

The genetic structure and diversity of *Pinus nigra*





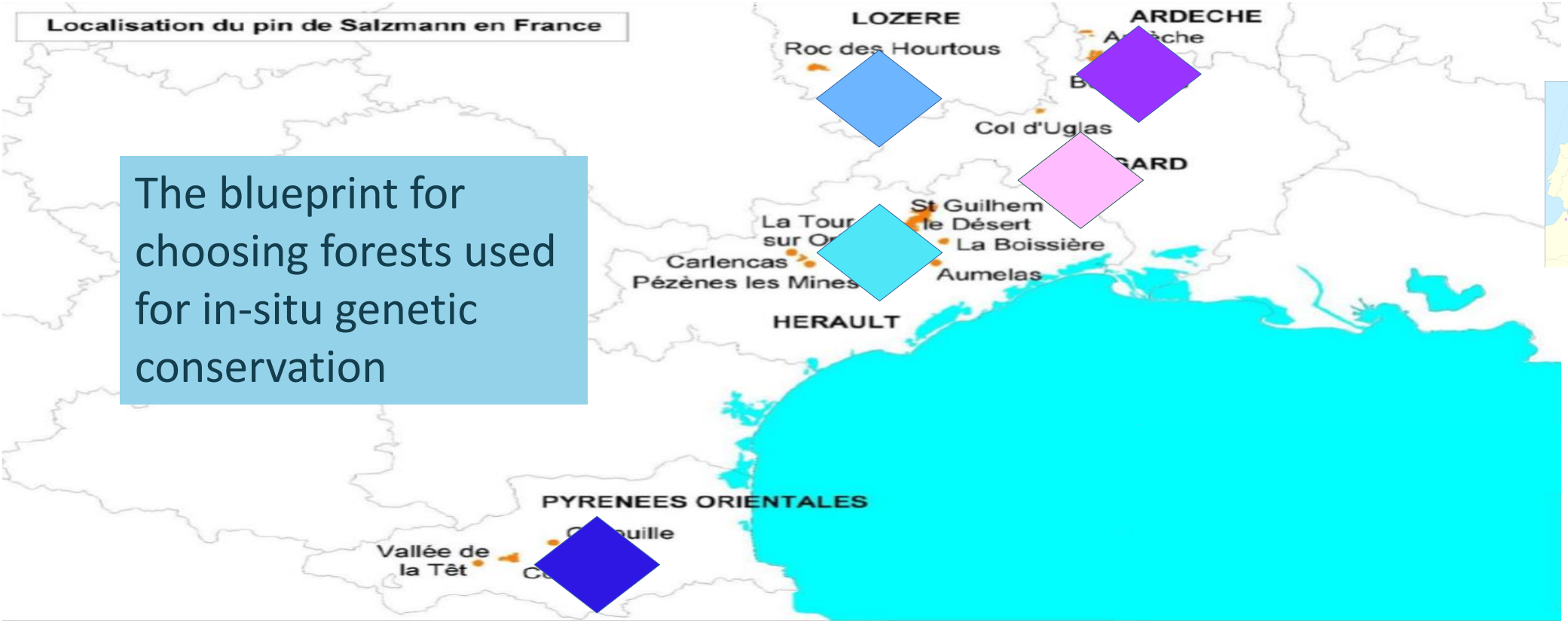


STRUCTURE and DiYABC, 13 nSSRs and 4cpSSRs

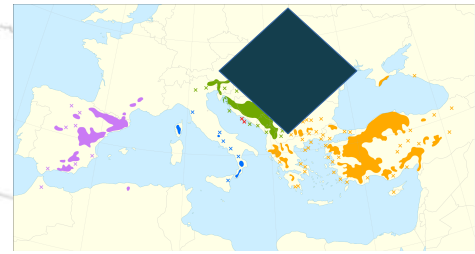
- 6 recently emerged (post LGM) genetic groups
- 5 subspecies taxonomy revision needed
- Admixture

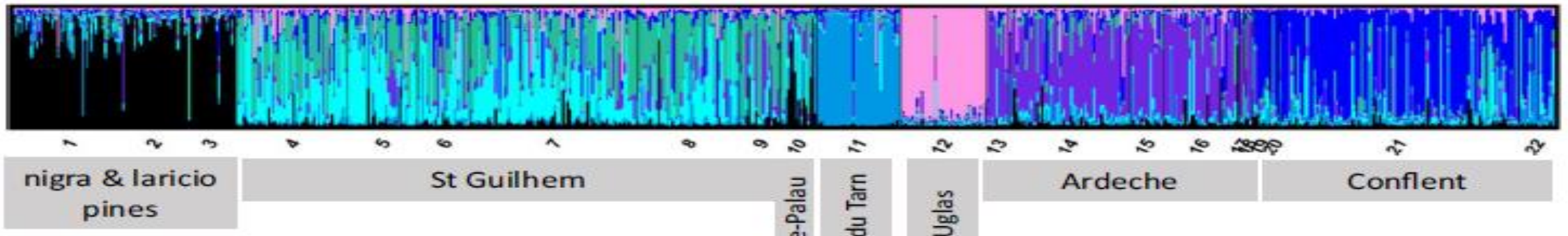
Scotti-Saintagne et al. TGG 2019

Salzmann's pine in France: 5 genetic groups



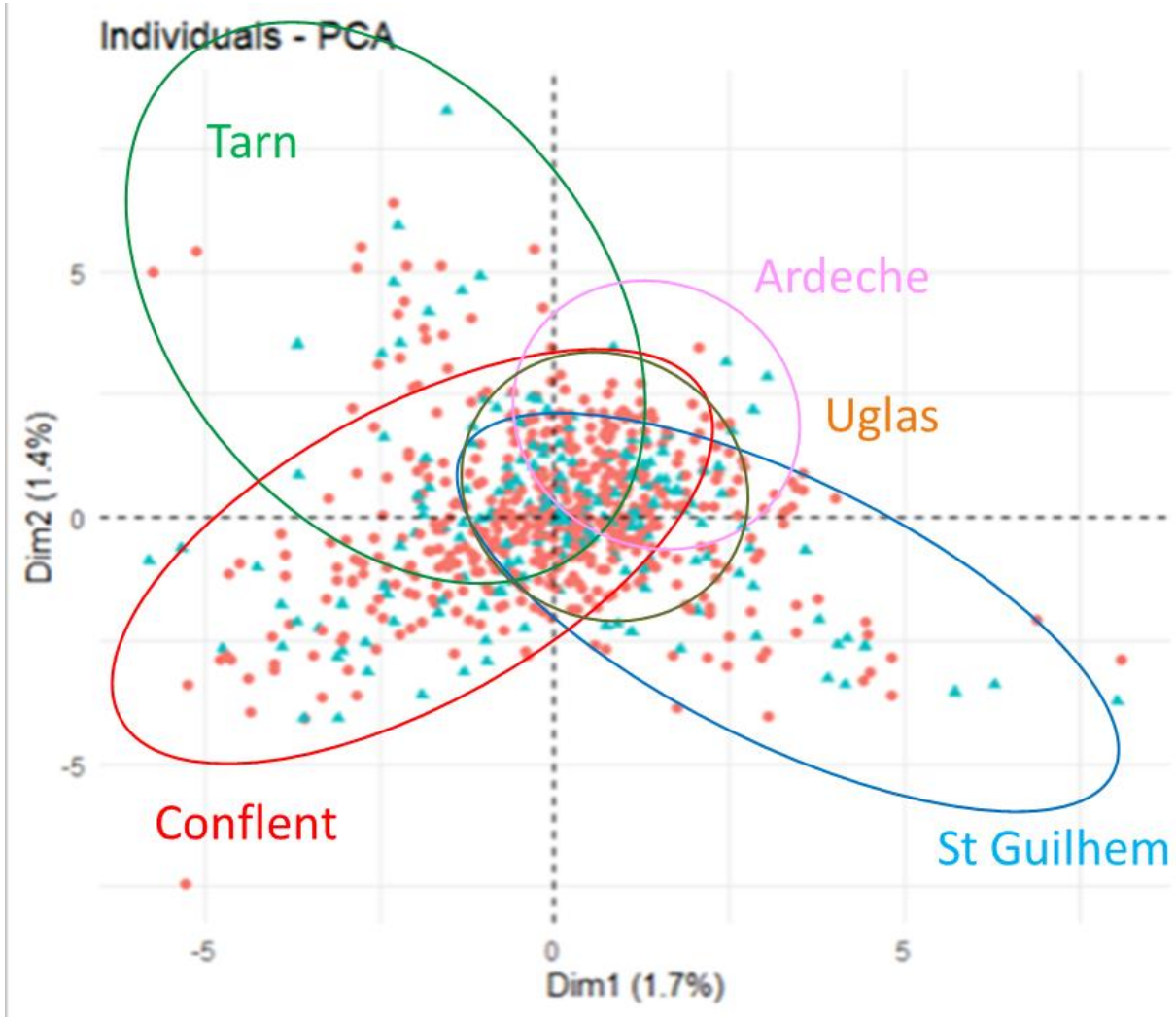
The blueprint for choosing forests used for in-situ genetic conservation





Scotti-Saintagne et al., Conservation Genetics 2024

A core-collection for Salzmann's pine: allelic coverage and structure



CoreHunter v3
(13 nSSRs, 202 alleles)

Maximization of:
- allelic coverage and
- differentiation

Ex-situ core collection = 14% of the 516 clones born before 1860 => 72 clones

Scotti-Saintagne et al. Conservation Genetics 2024

As biodiversity is declining worldwide…

2010 Biodiversity Target, Aichi 2020 Targets => not achieved!
Kunming-Montréal (GBF 2030)?

WWF's 2020 Living Planet Report: average 68% drop in mammal, bird, fish, reptile, and amphibian populations since 1970 worldwide.

IUCN 2024: More than 28% of all assessed species worldwide (+160 000) are threatened with extinction.

Forest Declaration Assessment (2024): 6.37 Mha permanently lost in 2023 (crops, livestock, mining mostly).

FAO State of Mediterranean Forest 2018: 2000 -> 2015 upward deforestation trend (~50 Hha /year), protected areas cover only 4.3% of the region's total surface area.

... The added value of the genetics approach for conservation and sustainable management

Genetics as a tool to:

- better delineate species and populations,
- understand evolutionary + demographic processes, thus adaptation and resilience, thus threats,
- in both rare and common / widespread species (and their marginal populations).

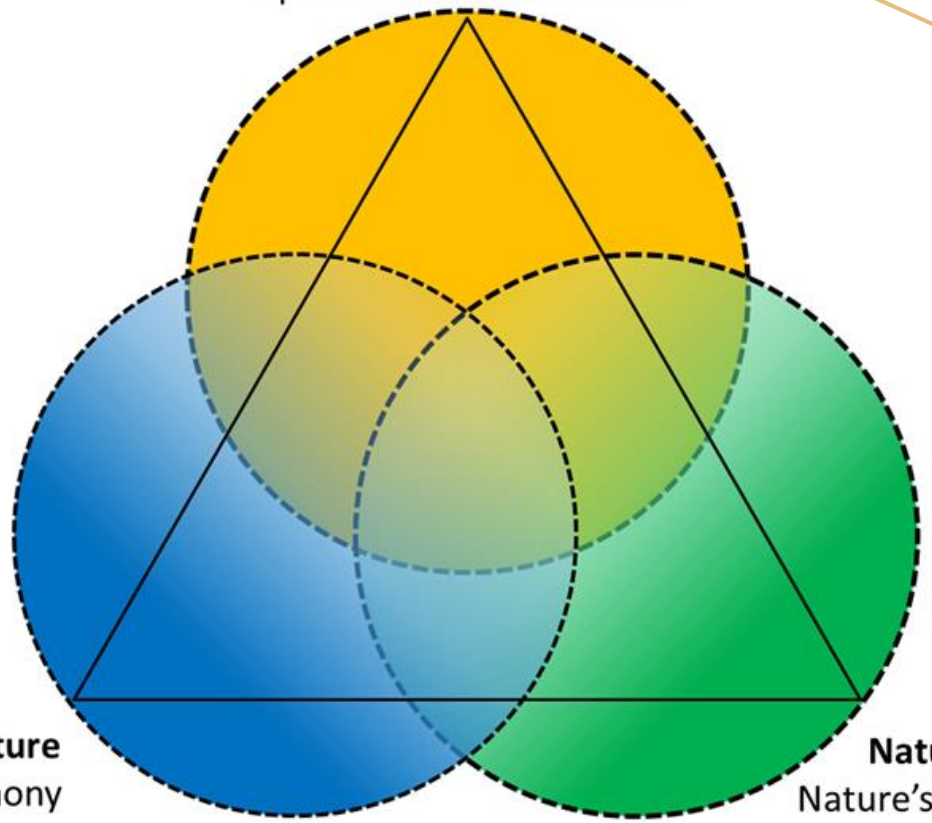
... The added value of the genetics approach for conservation and sustainable management

⇒ Better protection of natural systems, their long term persistence and evolution

⇒ Larger protected areas needed for evolutionary processes to occur

⇒ Better delineation and regulation of seed zones for plantation / restauration forestry, a more sustainable forestry

Nature Futures Framework



A change of perspective for a more efficient nature conservation considering adaptive processes

COP16: "Paz con la Naturaleza"

Pereira et al. 2020 *People Nat.*