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Forest biodiversity in the Mediterranean - the importance of genetic diversity

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8th MFW

Mediterranean forest week
Barcelona 2024, 4 - 7 November

**Working together for sustainable and resilient
Mediterranean forests**

Towards a collaborative roadmap



mediterraneanforestweek.org



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Forest biodiversity in the Mediterranean - the importance of genetic diversity

Bruno Fady

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INRAE

UR/0629
Ecologie des Forêts Méditerranéennes [URFM]



EFI

mediterraneanforestweek.org

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

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).

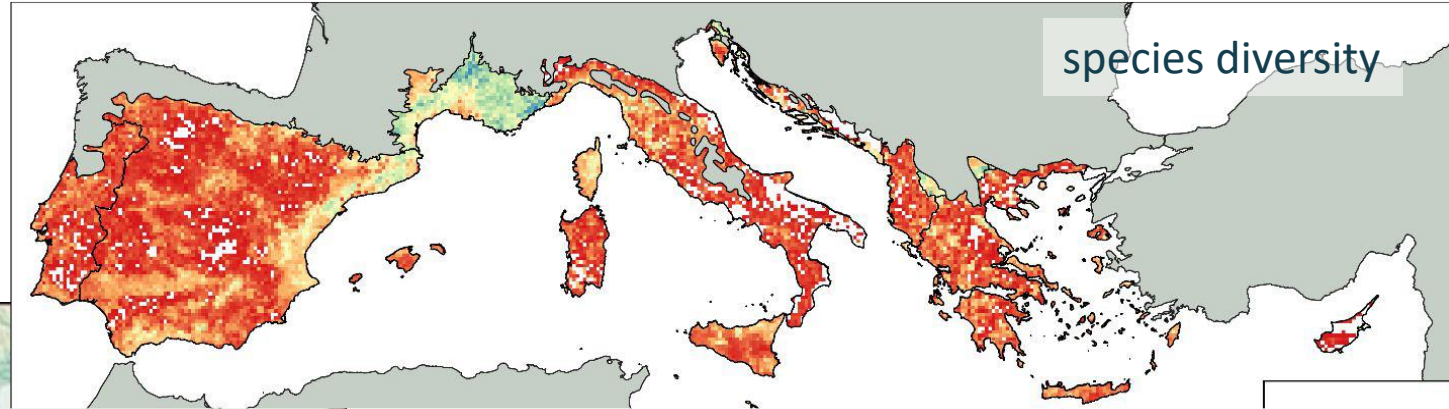
It is both a **method** to measure biodiversity and a **process** to protect and foster.

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

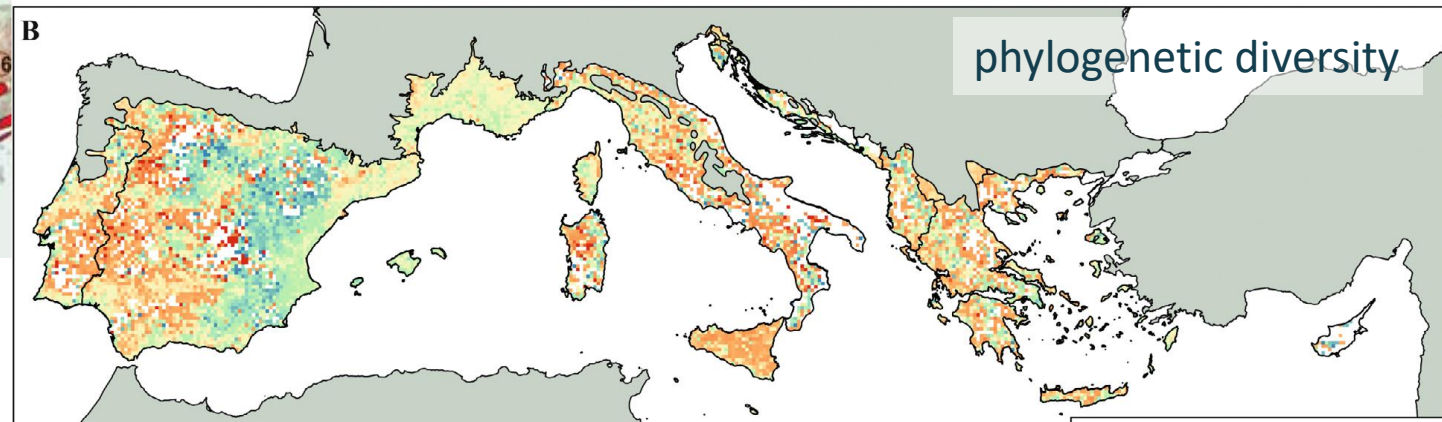
Centers of endemism



Médail and Diadema al. 2009 *J. Biogeog*

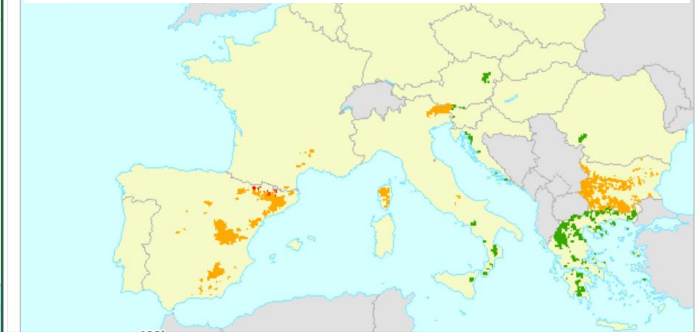







Cheick Albassatneh et al. 2023 *Plant Biol*



The natural distribution of black pines in Europe and North Africa

Conservation status assessment

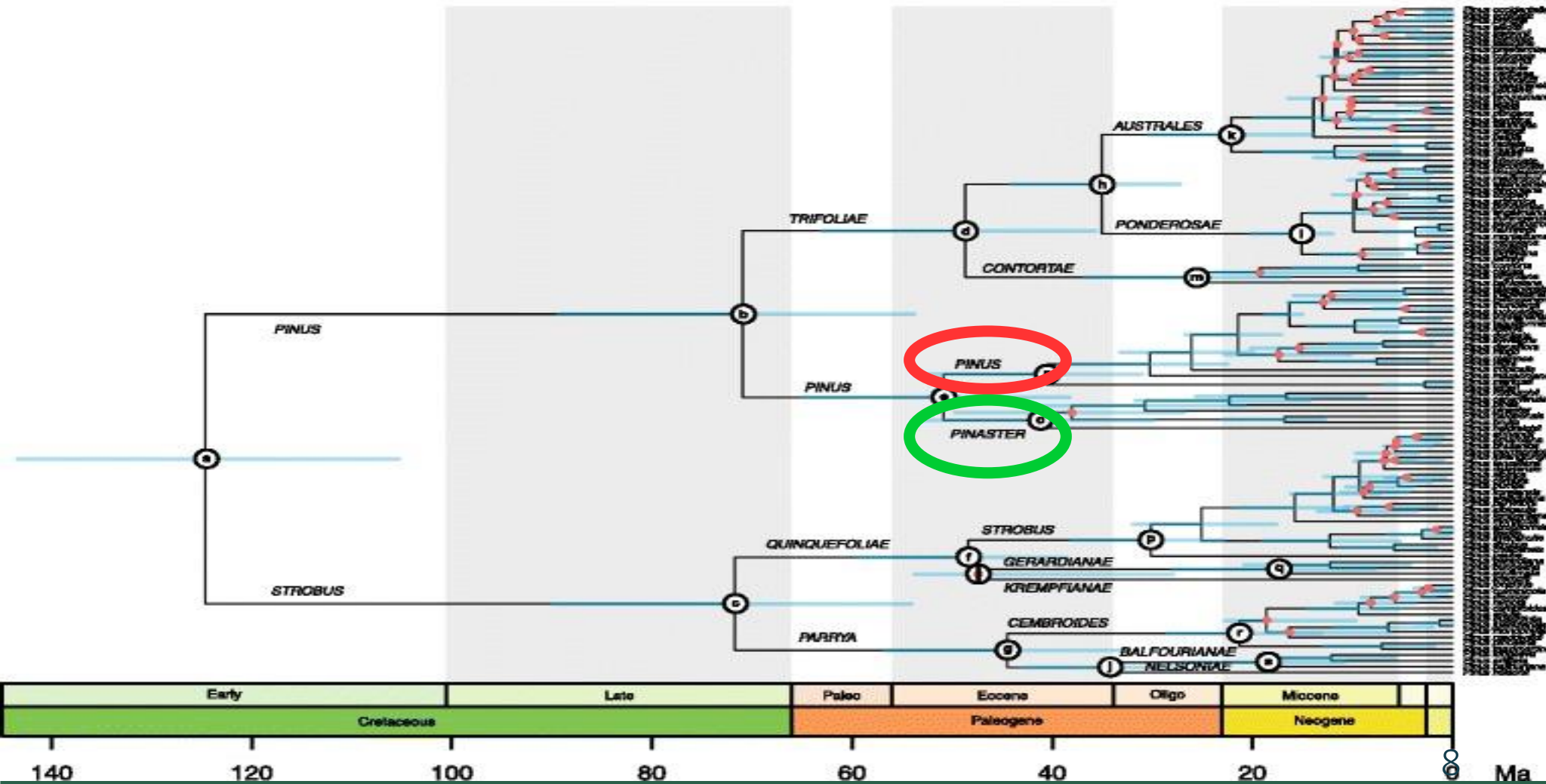


-  *Pinus nigra* subsp. *salzmannii*.
-  *Pinus nigra* subsp. *laricio*.
-  *Pinus nigra* subsp. *nigra*.
-  *Pinus nigra* subsp. *dalmatica*.
-  *Pinus nigra* subsp. *pallasiana*.



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>

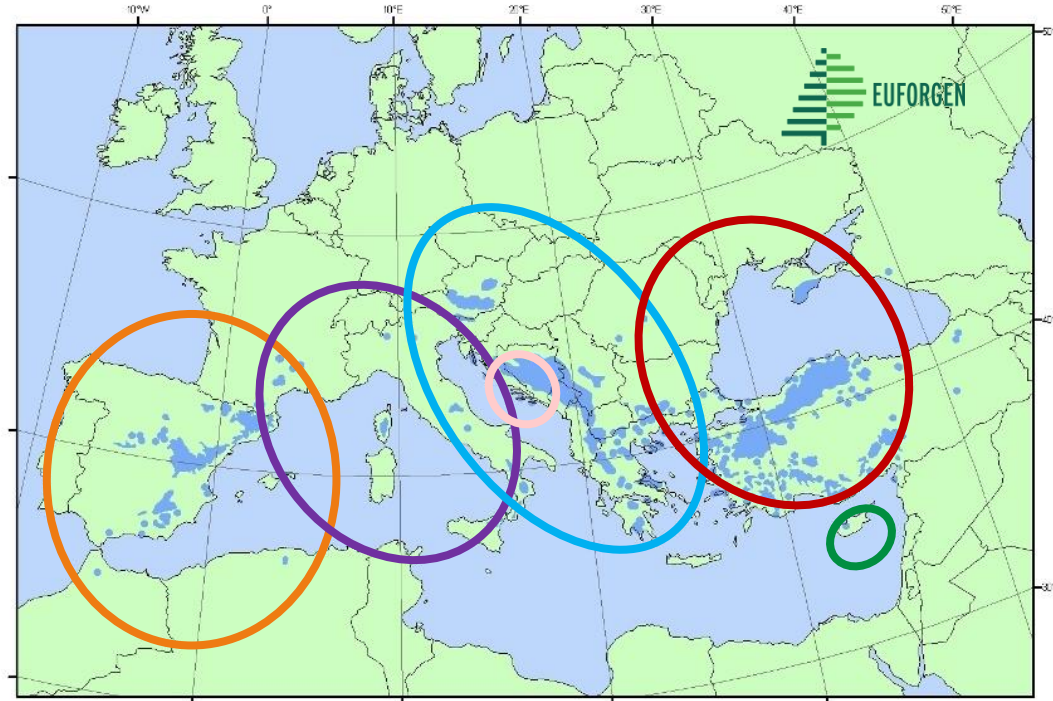
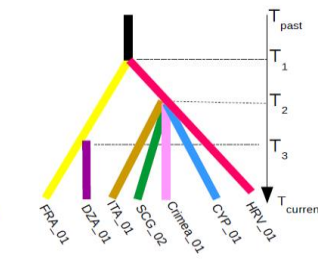
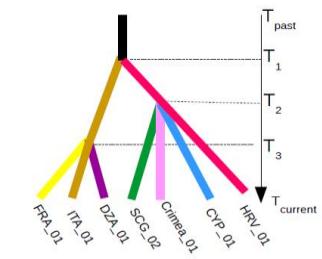
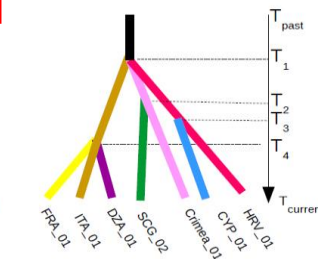
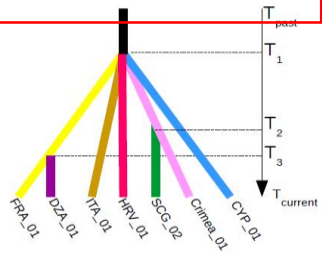
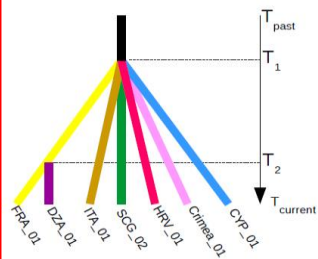
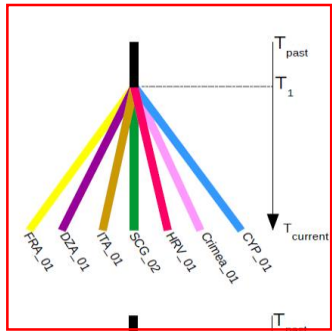
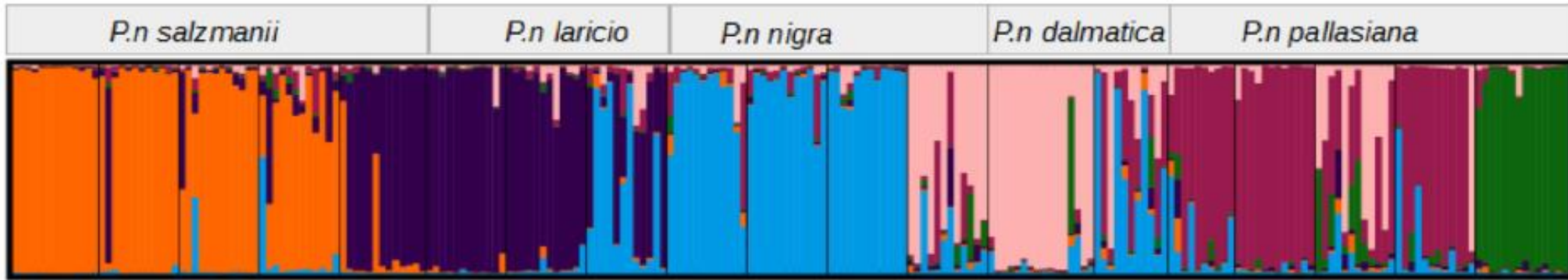
Evolutionary history of the genus *Pinus*



nigra, sylvestris, mugo,
uncinata, resinosa,
thunbergii

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

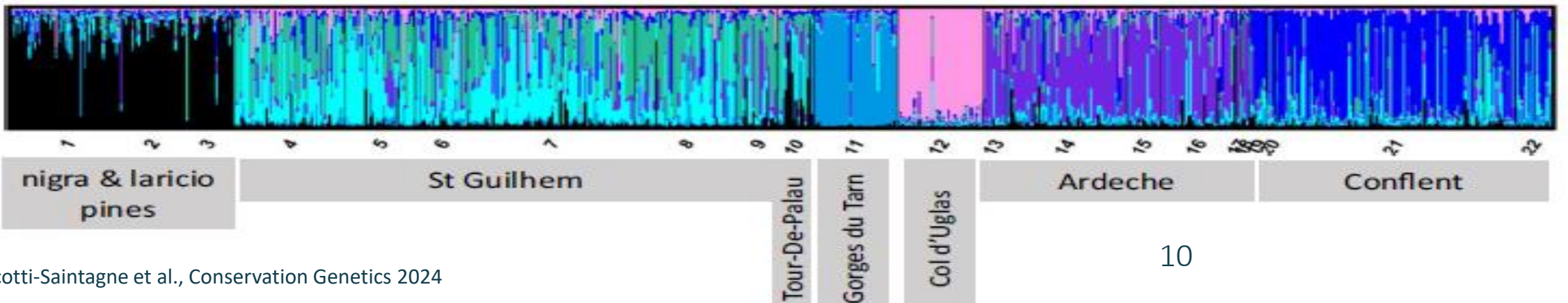
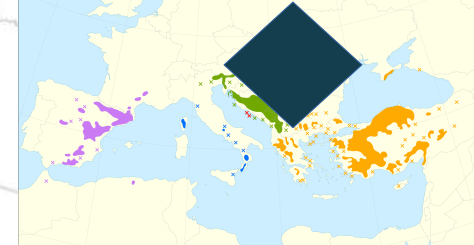
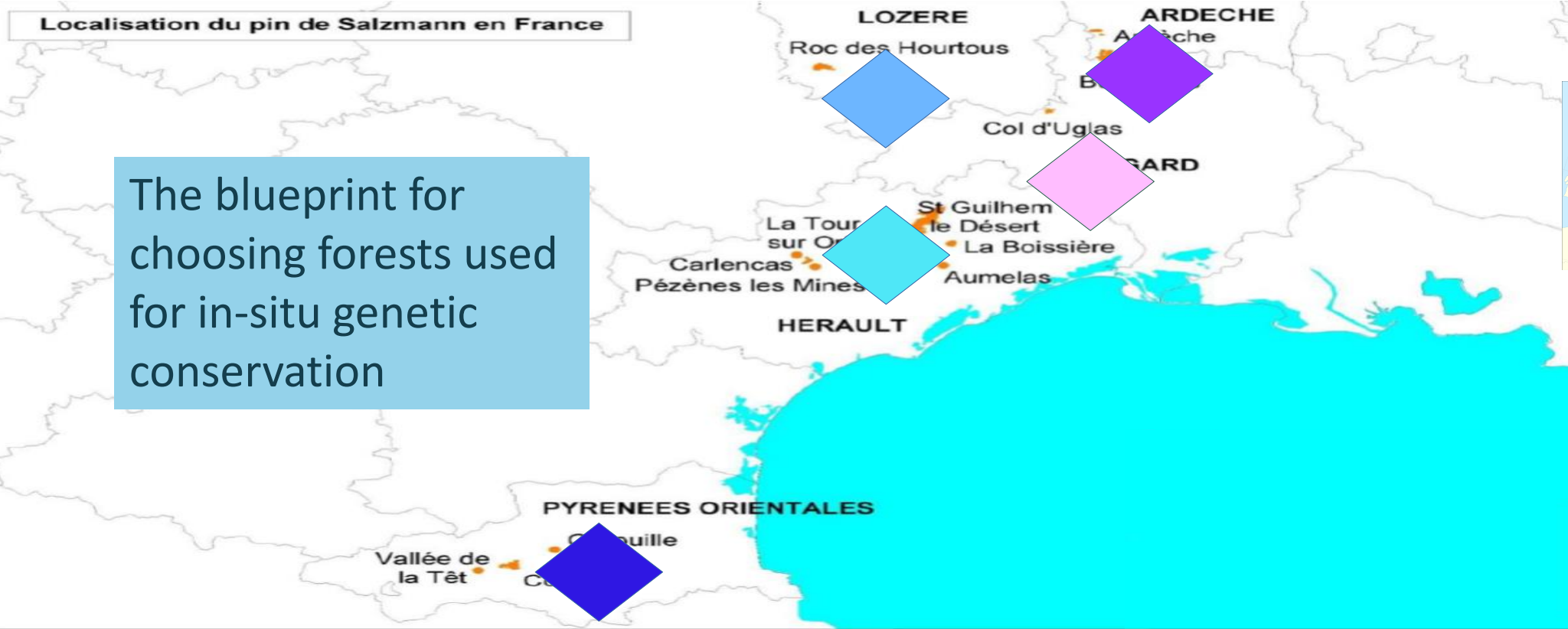
The genetic structure and diversity of *Pinus nigra*



STRUCTURE and DiYABC, 13 nSSRs and 4cpSSRs

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

Salzmann's pine in France: 5 genetic groups

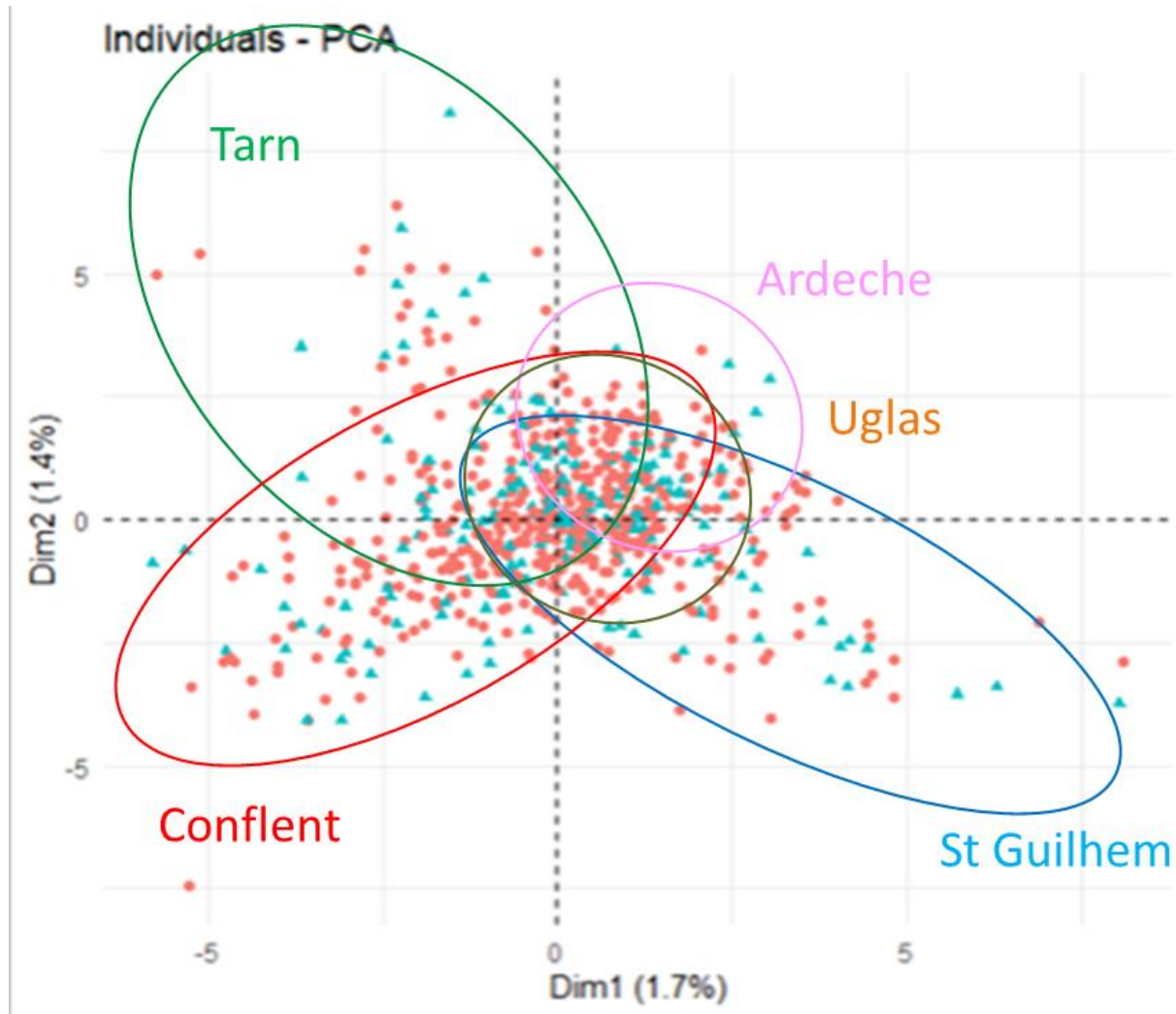


A core-collection for Salzmänn's pine: allelic coverage and structure

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**

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).

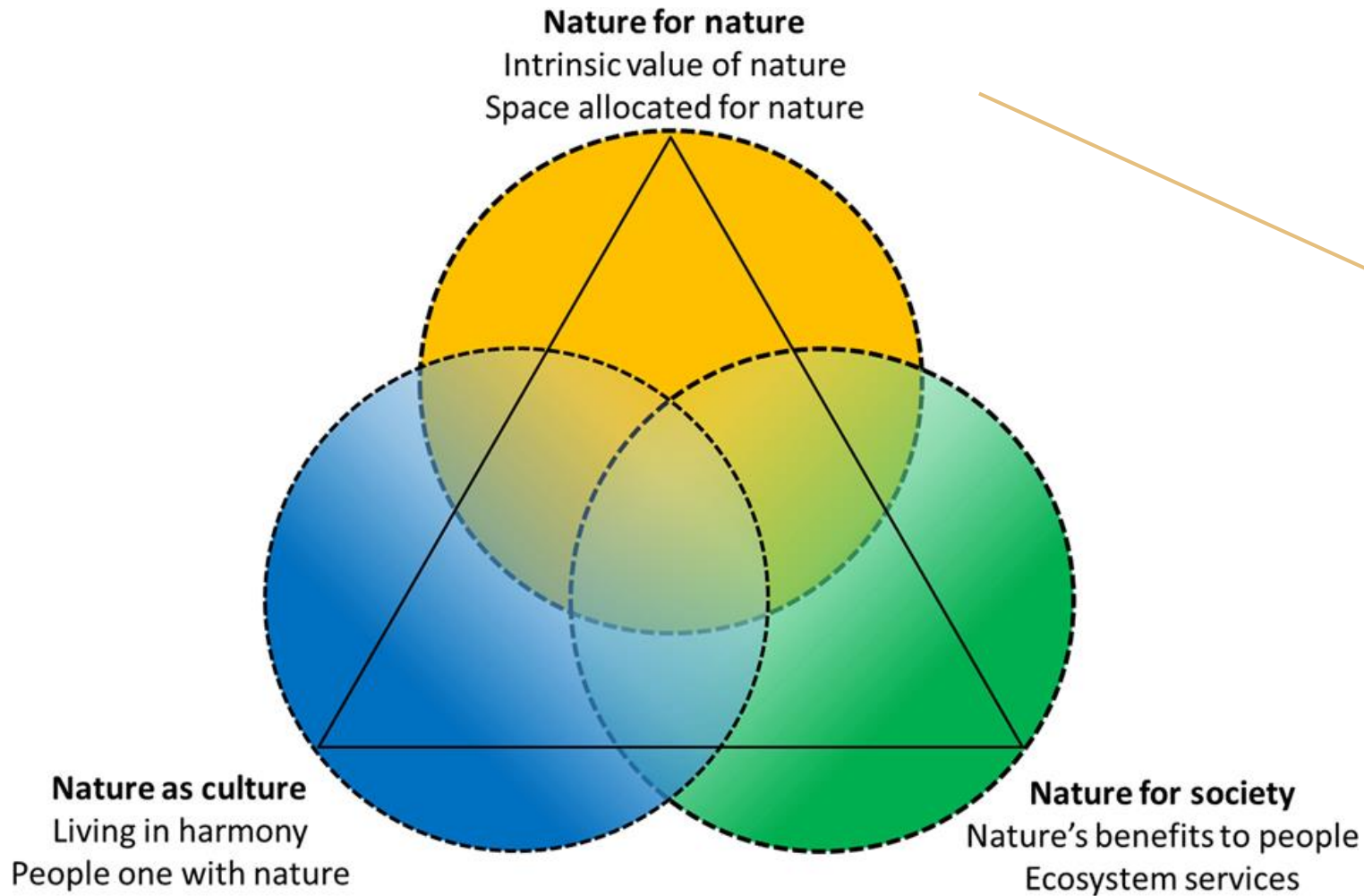


... The added value of the genetics approach for conservation and sustainable management

- ⇒ 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 / restoration forestry, a more sustainable forestry



Nature Futures Framework



Pereira et al. 2020 *People Nat.*

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

COP16: “Paz con la Naturaleza”