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NATIONAL BIODIVERSITY FUTURE CENTER

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CHINESE ACADEMY OF SCIENCES

第一届关于生物多样性的中意大会
2024年3月26日至28日 罗马

1st Sino-Italian Biodiversity Conference
Rome, March 26-28, 2024

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DEPARTMENT OF BIOLOGICAL, GEOLOGICAL, AND ENVIRONMENTAL SCIENCES

Biodiversity & Macroecology BIOMELab
UNIVERSITY OF BOLOGNA

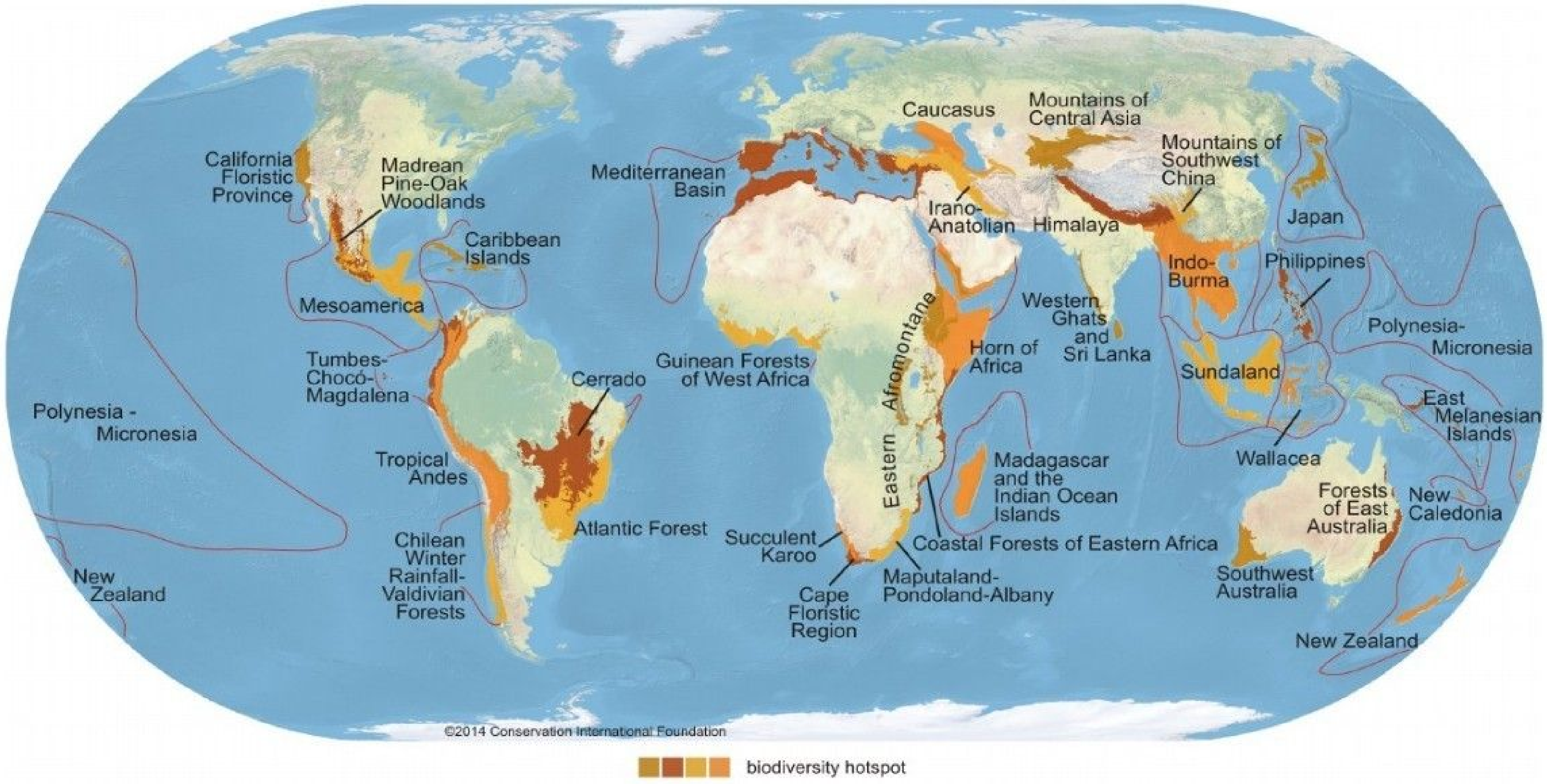
LifeWatch ITALY

Plant diversity in Italy across biogeographical gradients and human history

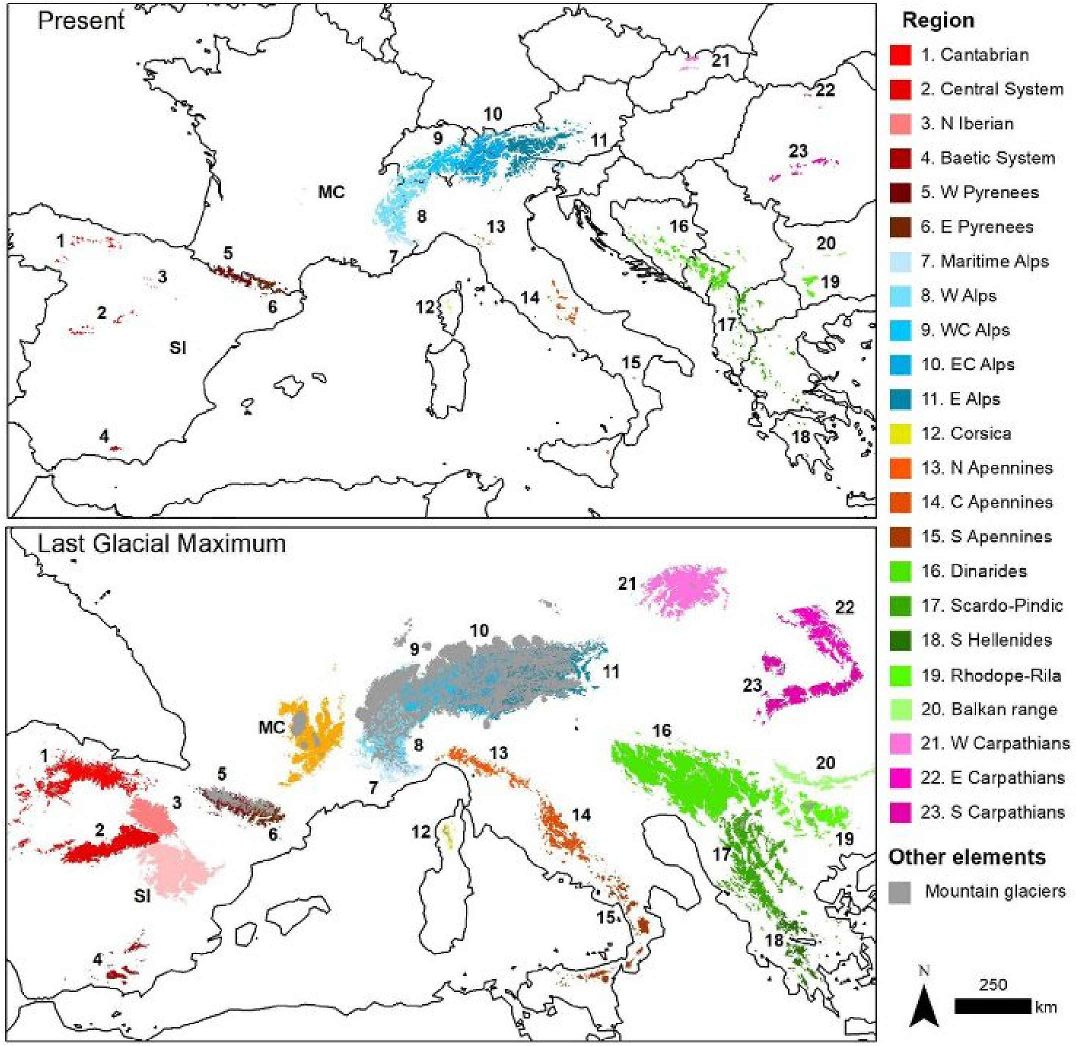
Alessandro Chiarucci

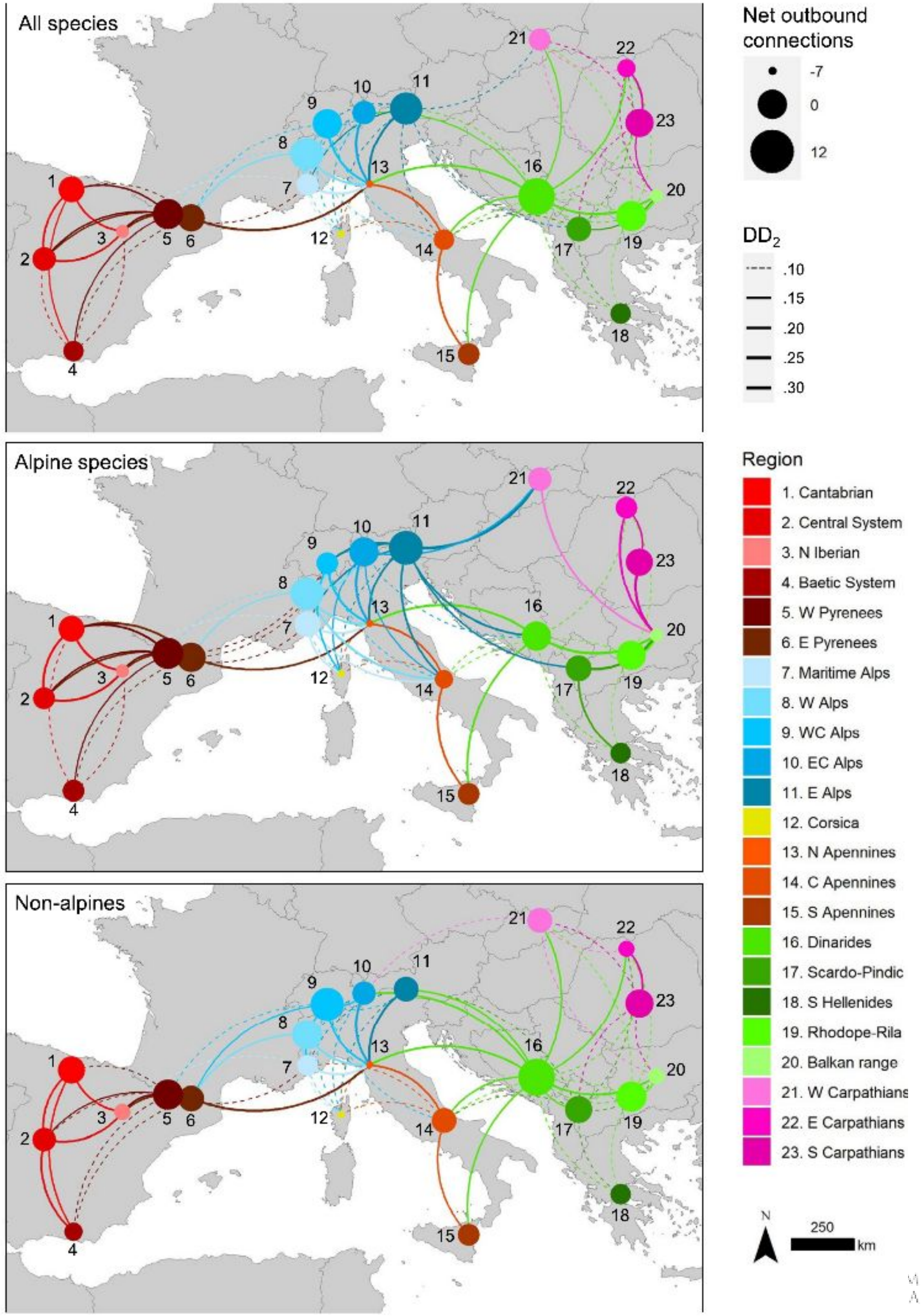
BIOME Lab
Alma Mater Studiorum - University of Bologna, Bologna, Italy
alessandro.chiarucci@unibo.it

Biodiversity hotspots



Mountain grasslands





Jiménez-Alfaro, B. et al. (2021).
Global Ecology and Biogeography, 30, 1101–1115.

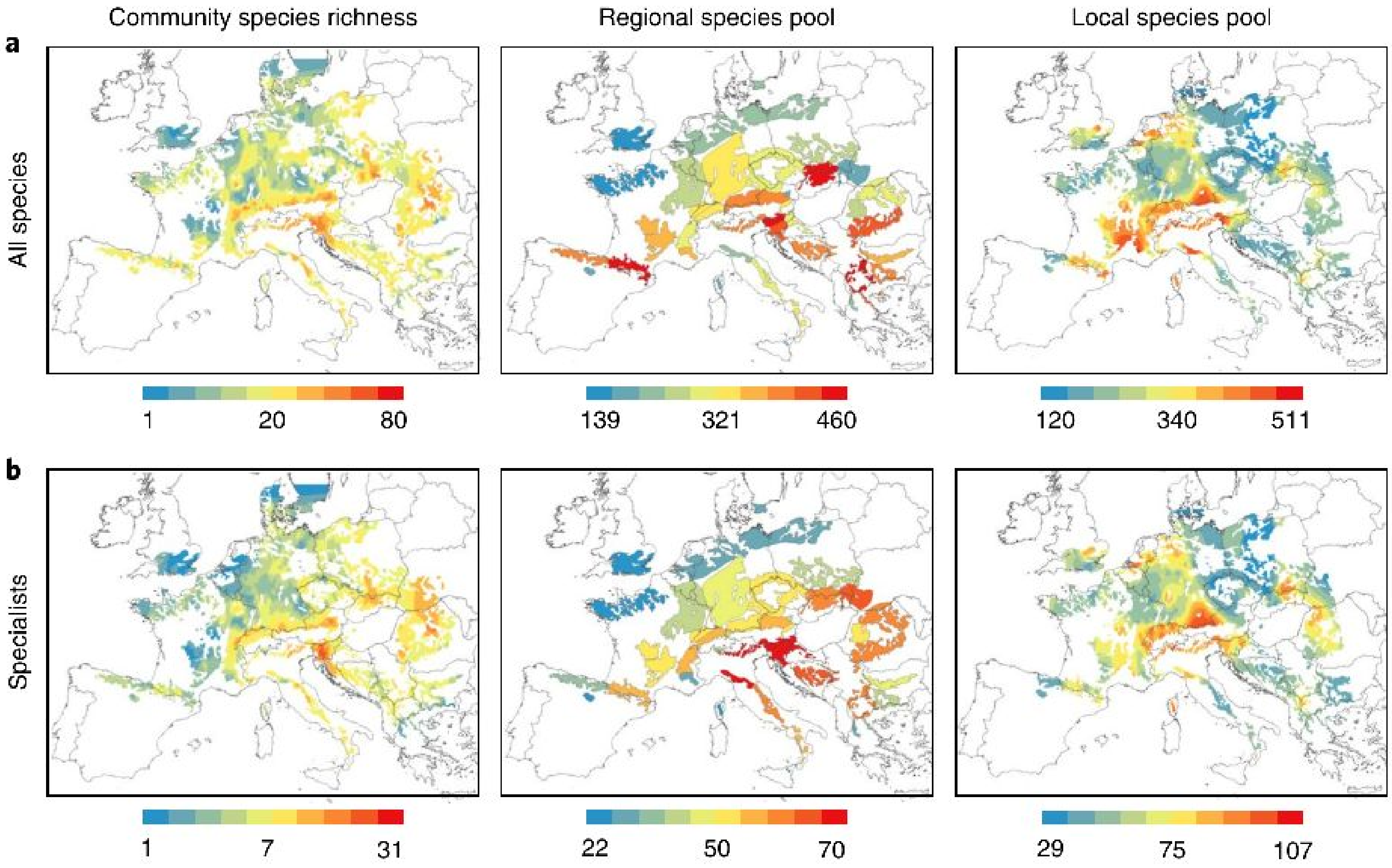
Beech forests

The number of plant species in European beech forests.

a) Species number (colour bars) for whole communities.

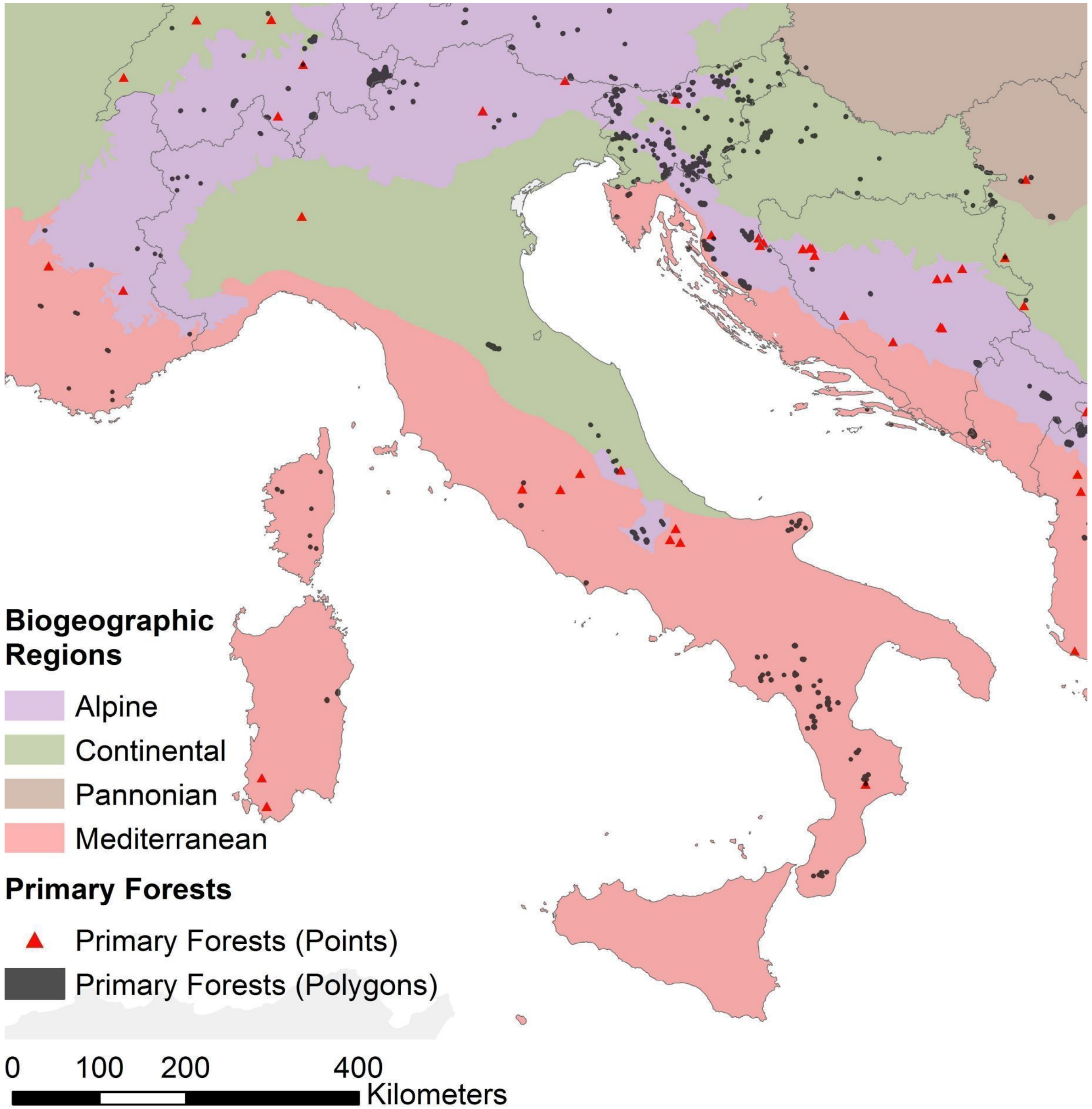
b) Species number for beech forest plant specialists only.

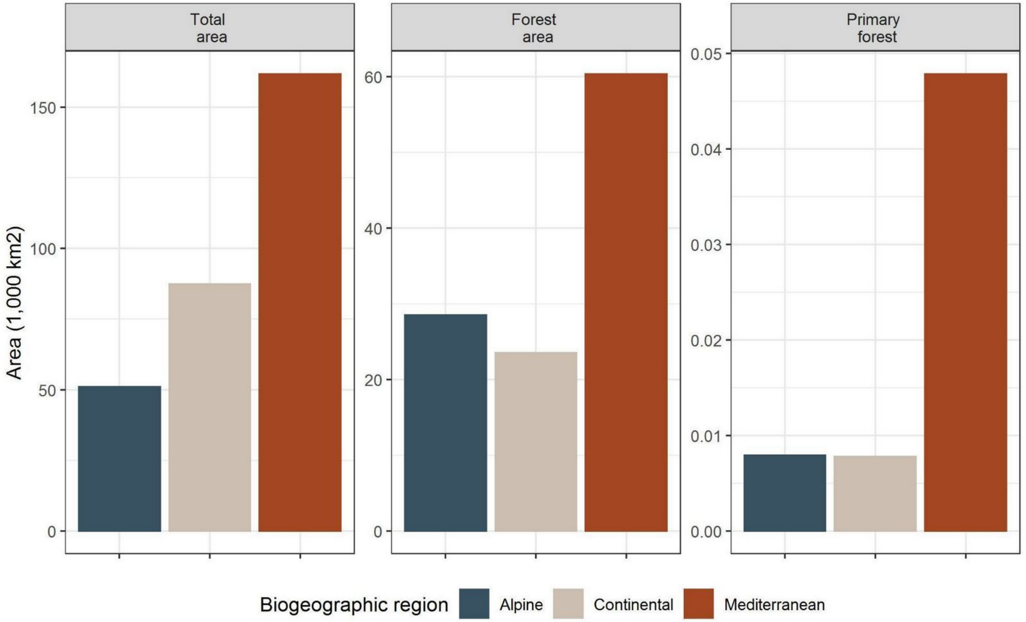
Community species richness was interpolated by kriging using plots where beech is the dominant species. Regional species pools were calculated for biogeographical regions and local species pools for grid cells of 1 km2, and then interpolated by kriging. All maps are masked to the distribution range of beech in Europe as provided by http://www.euforgen.org.



Jiménez-Alfaro, B. et al. (2018).
Nature Ecology & Evolution, 2, 483–490.

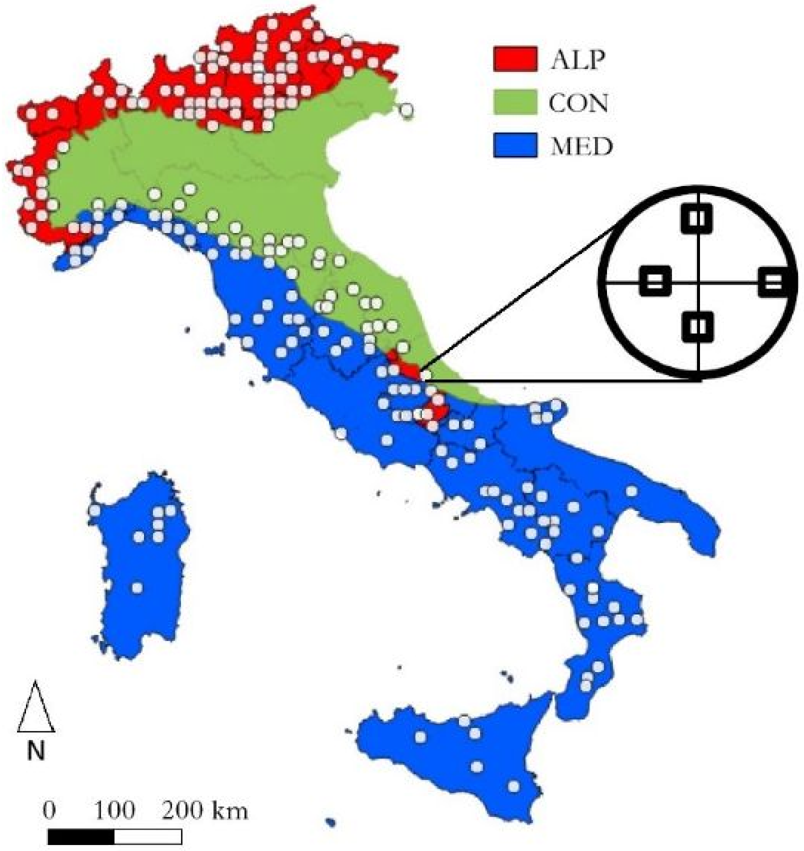
Primary and ancient forests

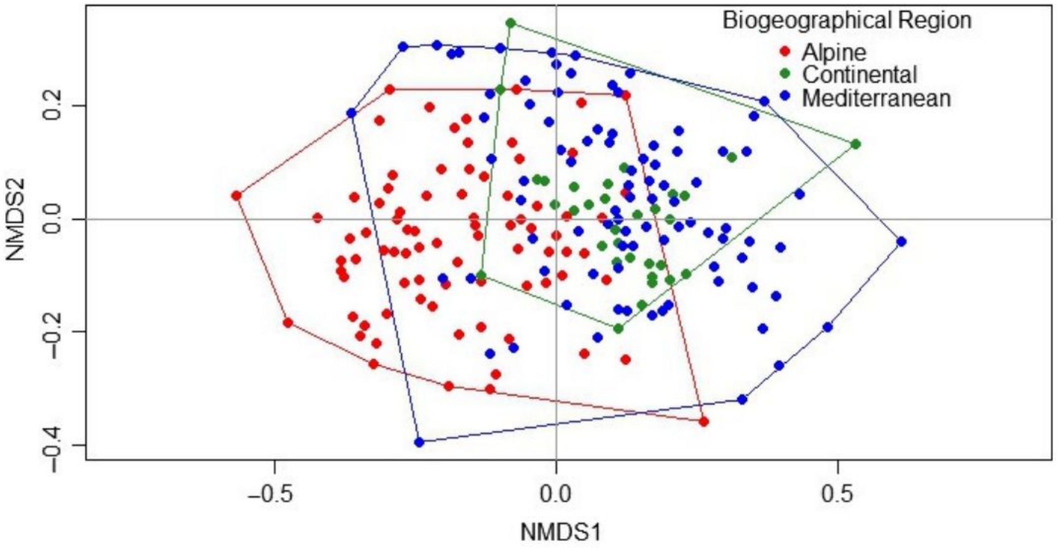


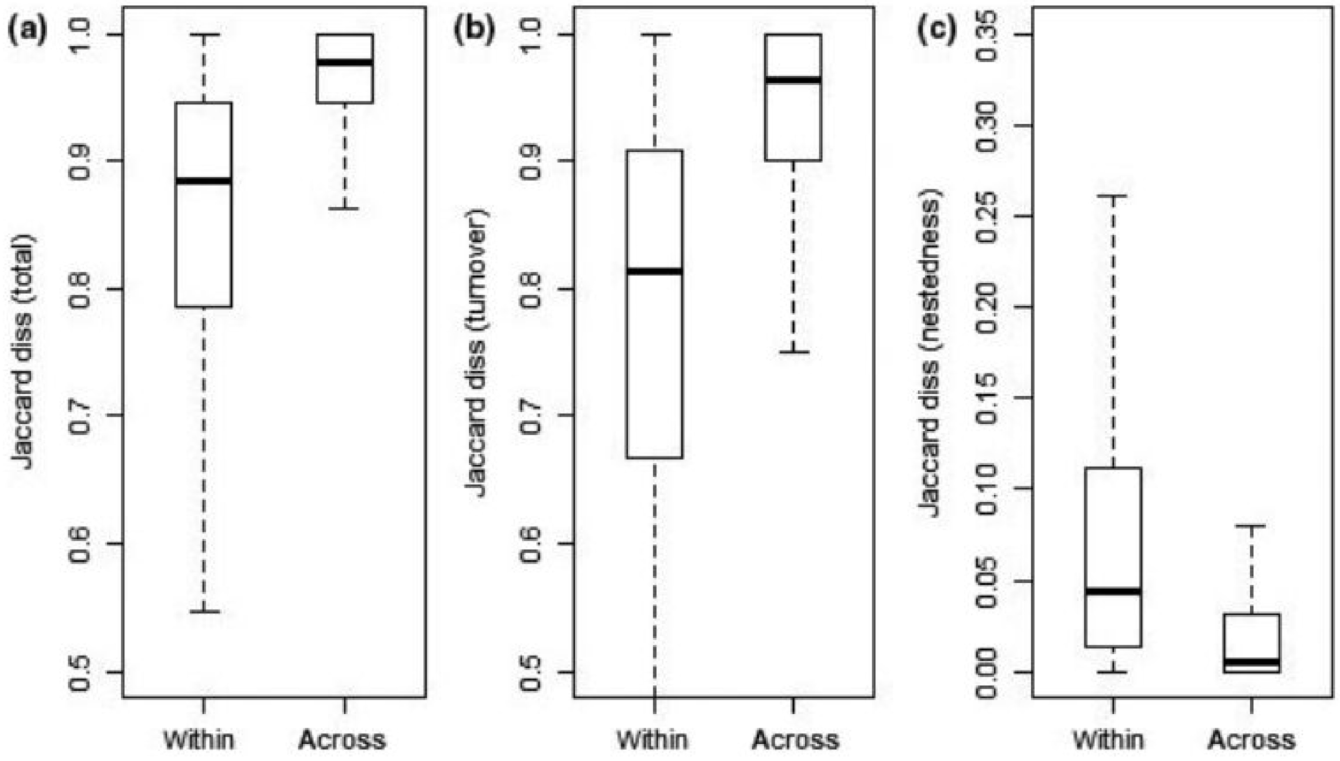


Sabatini, F. Et al. (2021). European primary forest database v2.0. Scientific Data, 8(1), 220. https://doi.org/10.1038/s41597-021-00988-7

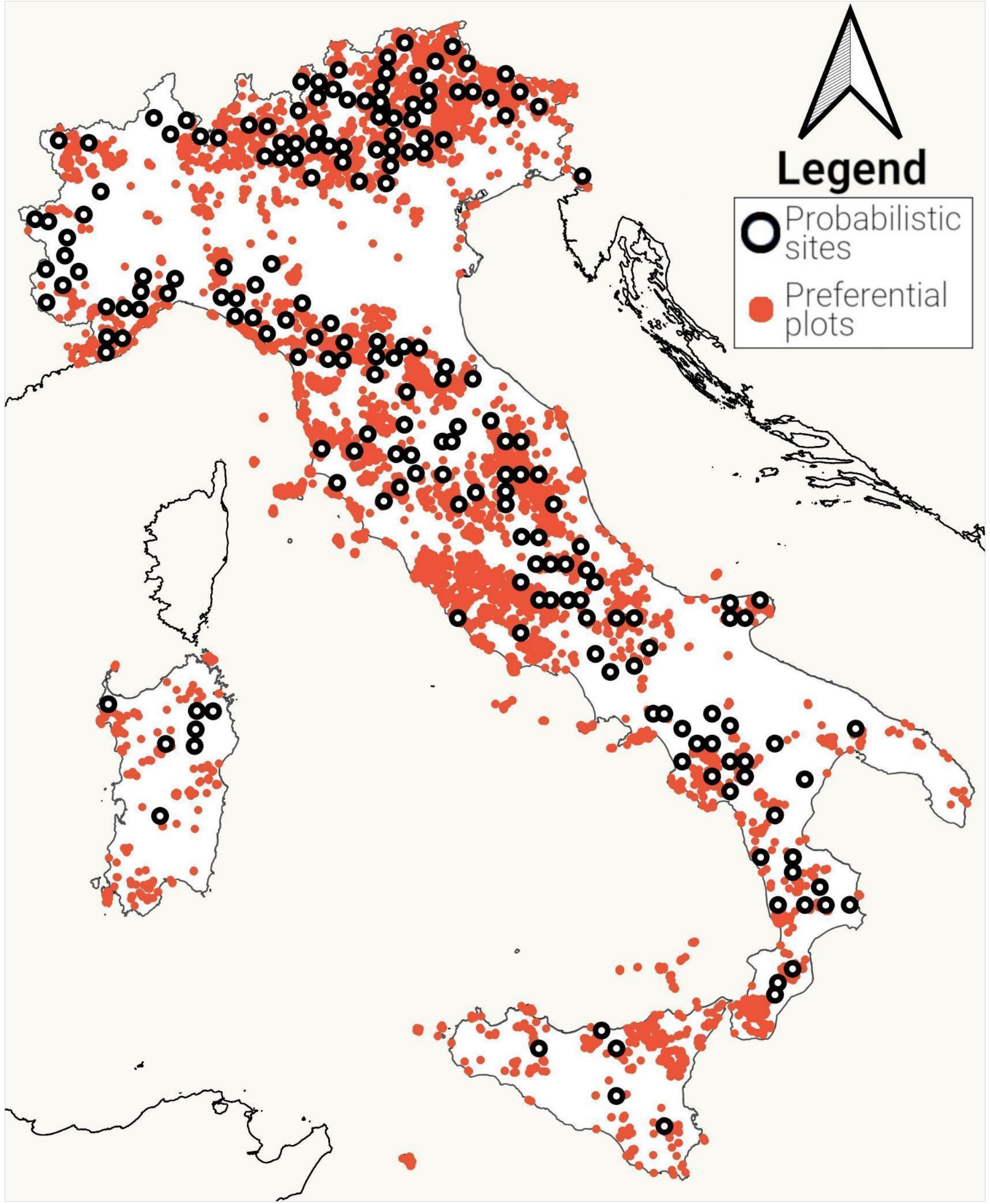
Biogeographical signal







Chiarucci, A. et al. (2019).
Ecology and Evolution, 9, 11716–11723.



Data Set
Italian Forest Vegetation

51,529 vegetation plots

ICP-Forest; VPD-Sapienza; AMS-VegBank; HabItAlp
Museum of Nature South Tyrol Bolzano

18,791 forest vegetation plots
3098 recorded species

444,184 occurrence data of forest plant species

Probabilistic Component

ICP-Forest: 201 sites (804 plots)
Used to quantify the diversity of zonal vegetation types

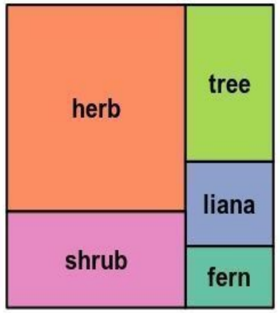
Preferenial Component

17,987 plots
Used to quantify utilizzati per qualificare la
Used to quantify the diversity of zonal azonal and extrazonal vegetation types

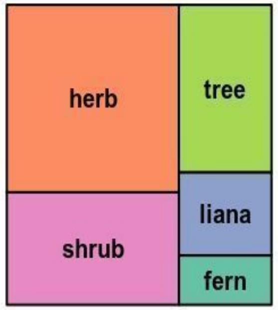
Alessi, N. .... Chiarucci, A. (2023).
Journal of Vegetation Science, jvs.13175

Italian forest vegetation: average species composition

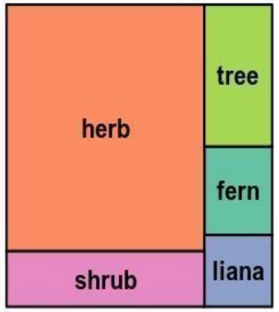
Forest Data Set
24.7 species



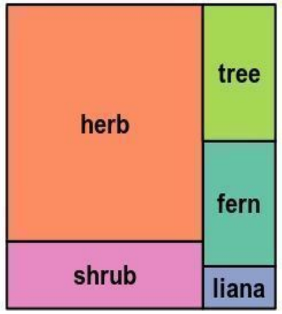
Warm Temperate Forest
25.7 species



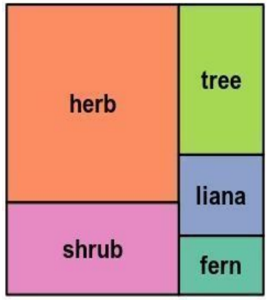
Cool Temperate Forest
23.4 species



Cold Temperate Forest
26.9 species

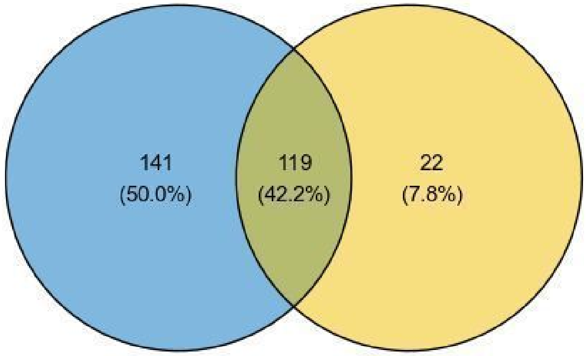


Azonal Forest
20.0 species



Specie esclusive:
Frangula rupestris
Rhamnnus catartica
Salix purpurea
Salix eleagnos
Cotoneaster nebrodensis
Genista aetnensis
Vaccinium uliginosum
Malus florentina
...

Plant Data Set



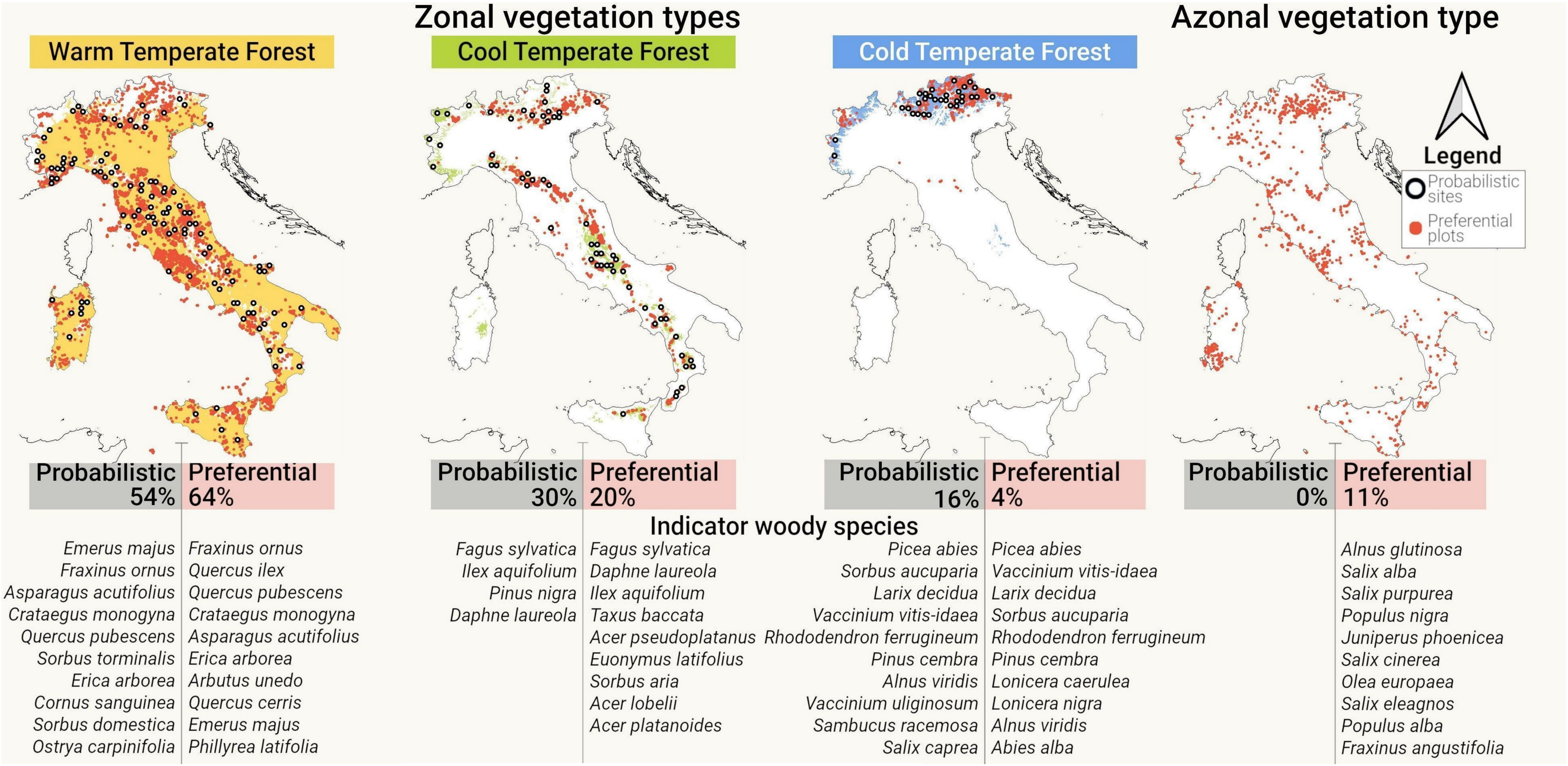
National Forest Inventory

Corpo Forestale dello Stato, CREA Unità di ricerca per il Monitoraggio e la Pianificazione Forestale (2005) - Inventario Nazionale delle Foreste e dei serbatoi forestali di Carbonio - INFC. www.inventarioforestale.org

Specie esclusive:
Broussonetia papyrifera
Catalpa bignonioides
Cinnamomum camphora
Cryptomeria japonica
Hibiscus syriacus
Larix kaempferi (L. leptolepis)
Lembotropis nigricans
Liriodendron tulipifera
Maclura pomifera
Paulownia tomentosa
Pinus brutia
Pinus pumilio
Platanus hybrida
Populus xcanadensis
Sequoia sempervirens
Yucca aloifolia

Alessi, N. .... Chiarucci, A. (2023).
Journal of Vegetation Science, jvs.13175

Diversity of Italian Forests: zonal and azonal vegetation



Alessi, N. .... Chiarucci, A. (2023).
Journal of Vegetation Science, jvs.13175

Ambio 2016, 45:468–479
DOI 10.1007/s13280-015-0738-5

REPORT

Shrines in Central Italy conserve plant diversity and large trees

Fabrizio Frascaroli, Shonil Bhagwat,
Riccardo Guarino, Alessandro Chiarucci,
Bernhard Schmid

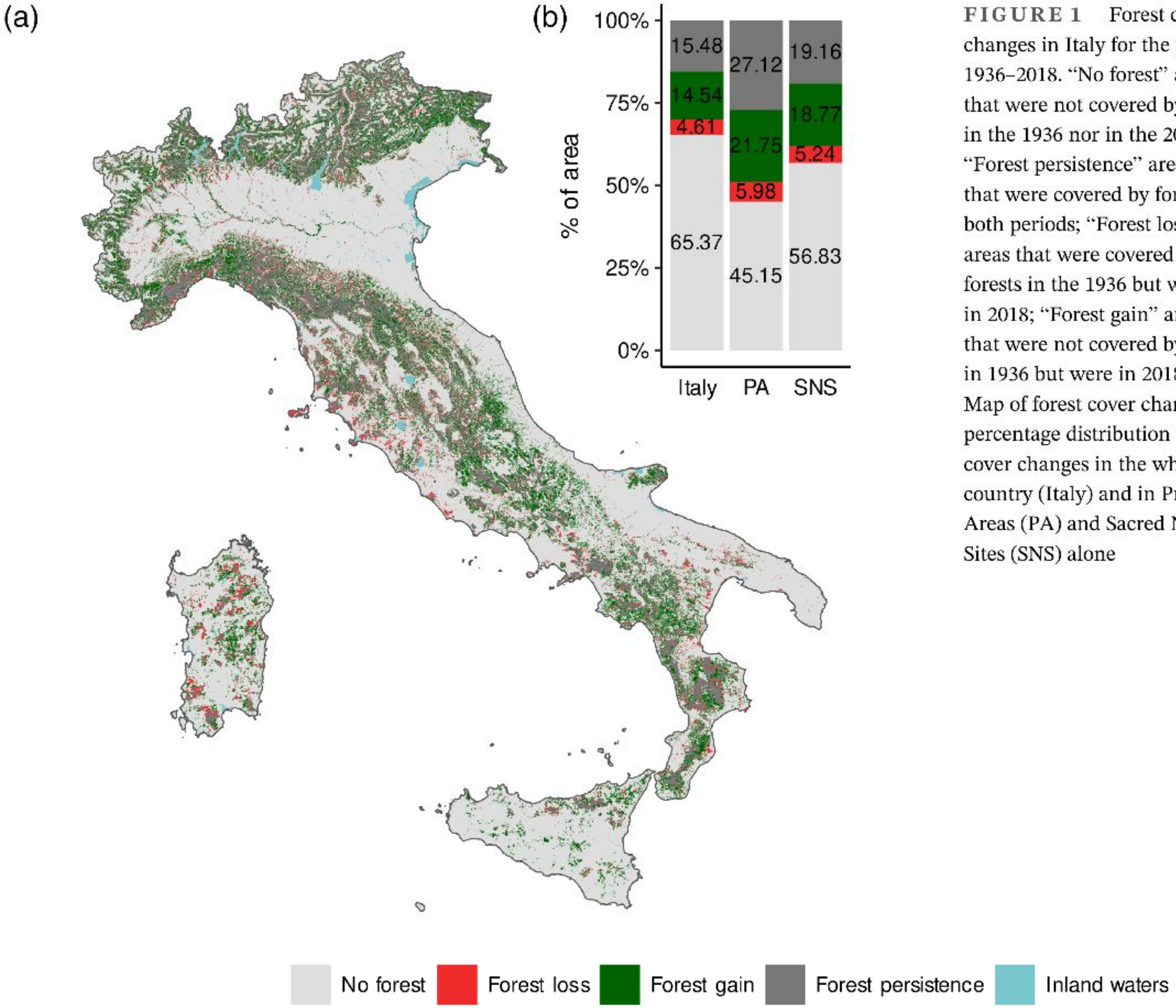


FIGURE 1 Forest cover changes in Italy for the period 1936–2018. "No forest" are areas that were not covered by forests in the 1936 nor in the 2018; "Forest persistence" are areas that were covered by forests in both periods; "Forest loss" are areas that were covered by forests in the 1936 but were not in 2018; "Forest gain" are areas that were not covered by forests in 1936 but were in 2018. a) Map of forest cover changes; b) percentage distribution of forest cover changes in the whole country (Italy) and in Protected Areas (PA) and Sacred Natural Sites (SNS) alone

Zannini, P. .... Chiarucci, A. (2022).
Conservation Science and Practice, 4, 1–13.

Journal of Biogeography (J. Biogeogr.) (2013) 40, 2335–2347

ORIGINAL ARTICLE

Influence of secondary forest succession on plant diversity patterns in a Mediterranean landscape

Valerio Amici[1*], Elisa Santi[2], Goffredo Filibeck[3], Martin Diekmann[4], Francesco Geri[1], Sara Landi[1], Anna Scoppola[3] and Alessandro Chiarucci[1]

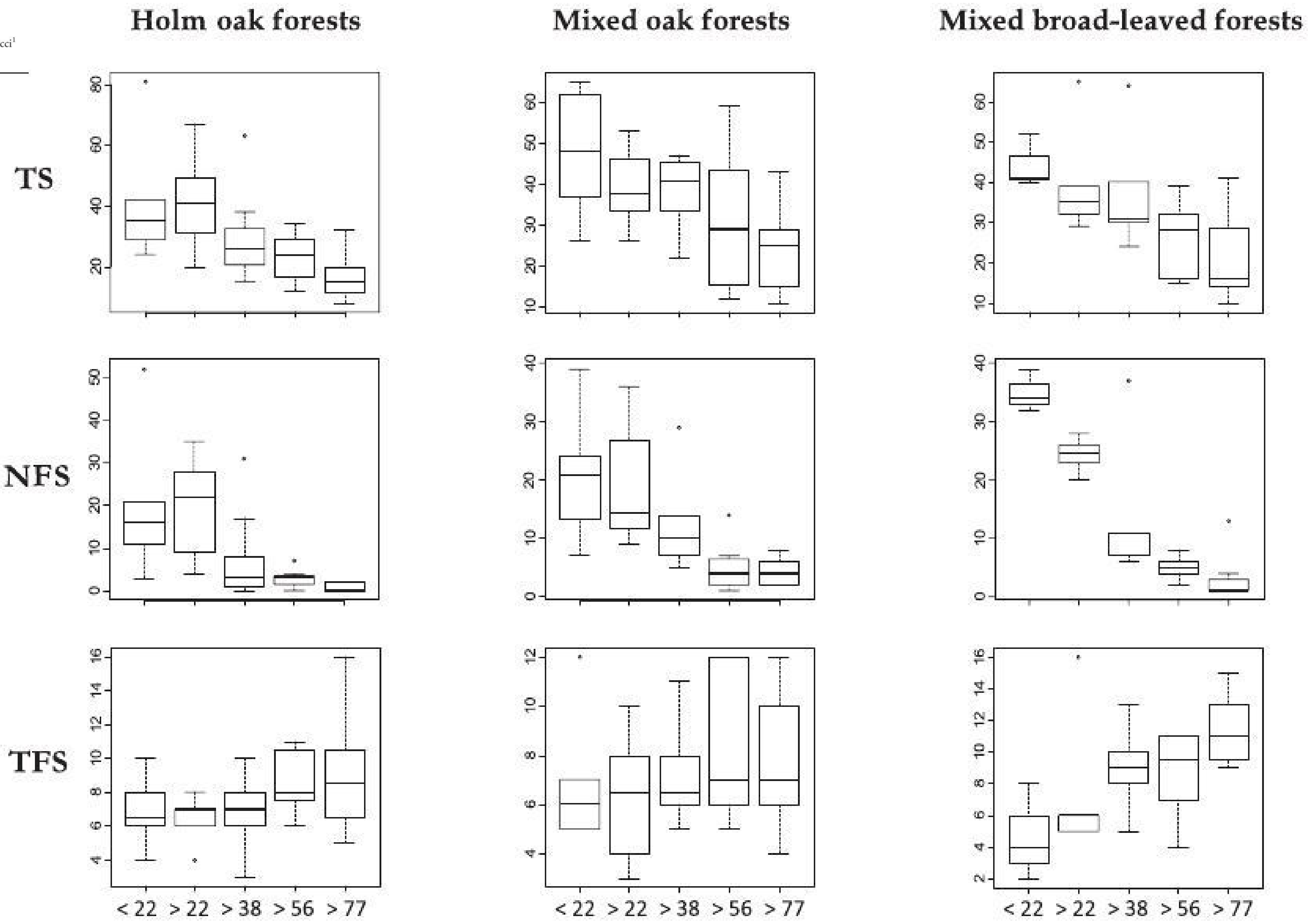
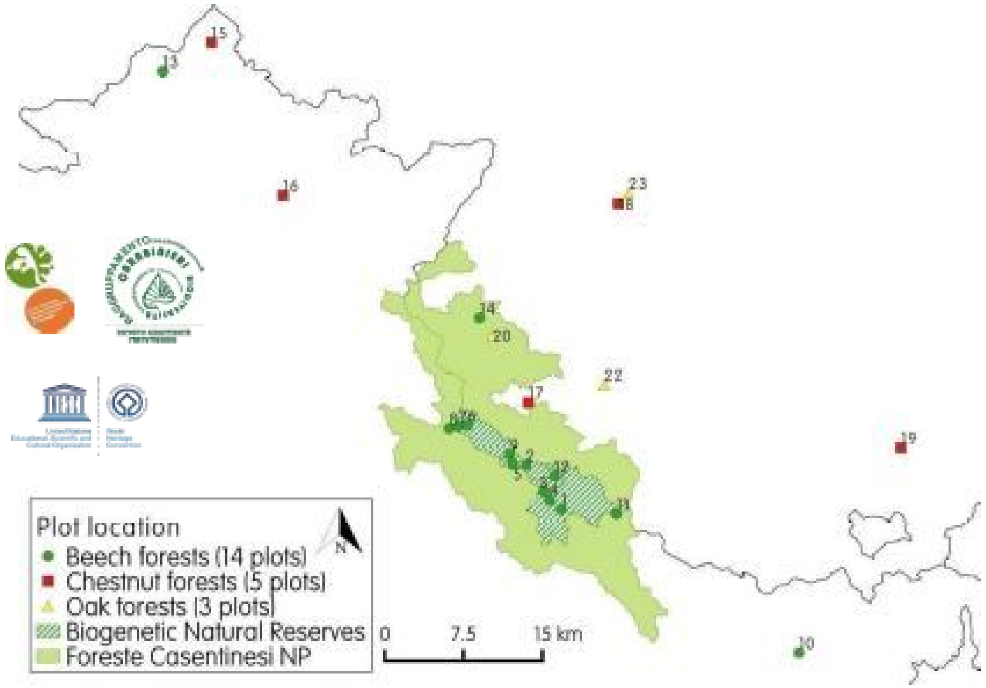


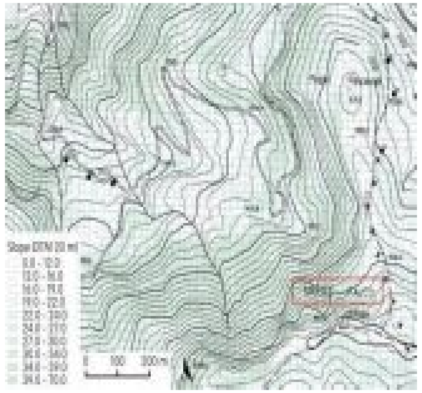
Figure 2 Differences in the number of **total species** (TS), **non-forest species** (NFS) and **true forest species** (TFS) between different classes of forest successional age (years), given separately for the three forest types analysed in the Province of Siena. A Kruskal–Wallis test showed significant differences between classes (< 0.01) for all diversity measures and forest types. The boxplots show median, interquartile range and outliers.

Resurvey of Romagna Forests



22 original plots (years 1934 – 1961)

66 resurveyed plots (2018)
3 replicates per each original plot

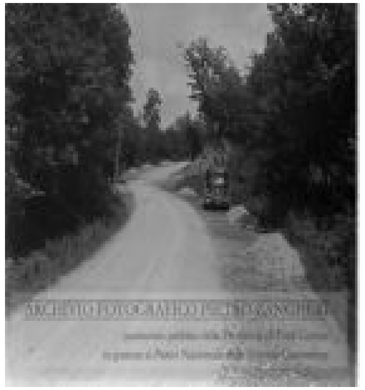


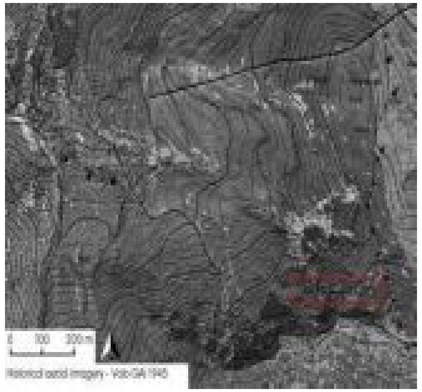

SERIE Ka N. 18 Staz. 10 n. 18

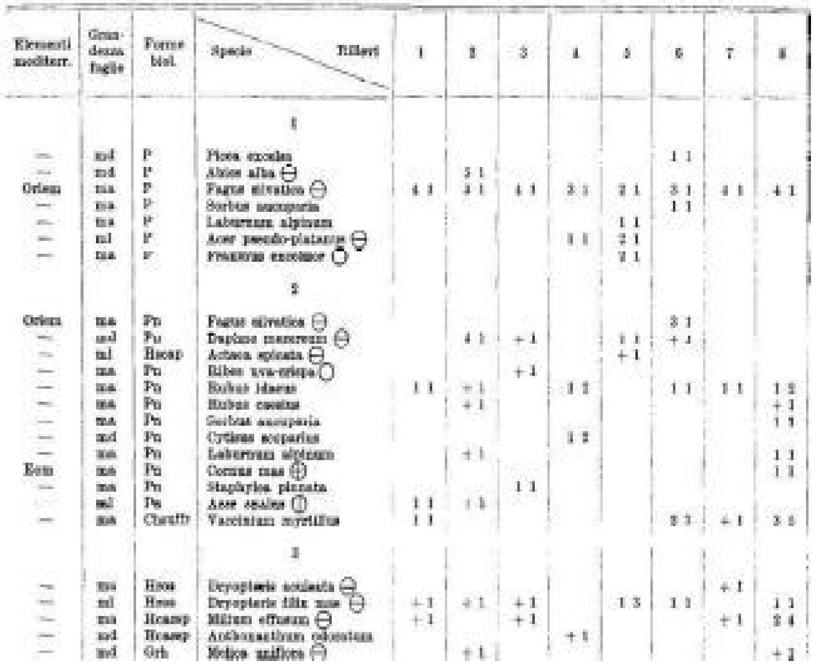
Lungo la strada da Pertecara a S. Agata Feltria.

Fotogr. eseguita il 7 Agosto 1938

COLLEZ. ZANGHERI (Negativo n. 872)







Elementi mediterr.	Grandezza foglie	Forme biol.	Specie / Rilievi	1	2	3	4	5	6	7	8
			1								
—	md	P	Picea excelsa						1 1		
—	md	P	Abies alba ⊖		2 1						
Orien	ma	P	Fagus silvatica ⊖	4 1	4 1	4 1	3 1	2 1	3 1	4 1	4 1
—	ma	P	Sorbus aucuparia						1 1		
—	ma	P	Laburnum alpinum					1 1			
—	ml	P	Acer pseudo-platanus ⊖				1 1	2 1			
—	ma	P	Fraxinus excelsior ◯					2 1			
			2								
Orien	ma	Pn	Fagus silvatica ⊖						3 1		
—	md	Pn	Daphne mezereum ⊖		4 1	+ 1		1 1	+ 1		
—	ml	Hscap	Actaea spicata ⊖					+ 1			
—	ma	Pn	Ribes uva-crispa ◯			+ 1					
—	ma	Pn	Rubus idaeus	1 1	+ 1		1 2		1 1	1 1	1 2
—	ma	Pn	Rubus caesius		+ 1						+ 1
—	ma	Pn	Sorbus aucuparia								1 1
—	md	Pn	Cytisus scoparius				1 2				
—	ma	Pn	Laburnum alpinum		+ 1						1 1
Euro	ma	Pn	Cornus mas ⊕								1 1
—	ma	Pn	Staphylea pinnata			1 1					
—	ml	Pn	Acer opalus ◯	1 1	+ 1						
—	ma	Champh	Vaccinium myrtillus	1 1					2 1	+ 1	2 1
			3								
—	ma	Hros	Dryopteris aculeata ⊖							+ 1	
—	ml	Hros	Dryopteris filix mas ⊖	+ 1	+ 1	+ 1		1 3	1 1		1 1
—	ma	Hcaesp	Milium effusum ⊖	+ 1		+ 1				+ 1	2 4
—	md	Hcaesp	Anthoxanthum odoratum				+ 1				
—	md	Grh	Melica uniflora ⊖		+ 1						+ 2

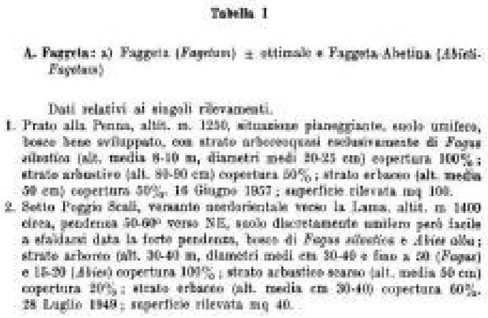


Tabella 1

A. Faggeta: a) Faggeta (*Fagetum*) ± ottimale e Faggeta-Abetina (*Abieti-Fagetum*)

Dati relativi ai singoli rilevamenti.

1. Prato alla Penna, altit. m. 1250, situazione pianeggiante, suolo umifero, bosco bene sviluppato, con strato arboreo quasi esclusivamente di *Fagus silvatica* (alt. media 8-10 m, diametri medi 20-25 cm) copertura 100%; strato arbustivo (alt. 80-90 cm) copertura 50%; strato erbaceo (alt. media 30 cm) copertura 50%, 16 Giugno 1957; superficie rilevata mq 100.
2. Sotto Poggio Scali, versante nordorientale verso la Lama, altit. m 1400 circa, pendenza 50-60° verso NE, suolo discretamente umifero però facile a sfaldarsi data la forte pendenza, bosco di *Fagus silvatica* e *Abies alba*; strato arboreo (alt. 30-40 m, diametri medi cm 30-40 e fino a 50 (*Fagus*) e 15-20 (*Abies*) copertura 100%; strato arbustivo scarso (alt. media 50 cm) copertura 20%; strato erbaceo (alt. media cm 30-40) copertura 60%. 28 Luglio 1949; superficie rilevata mq 40.

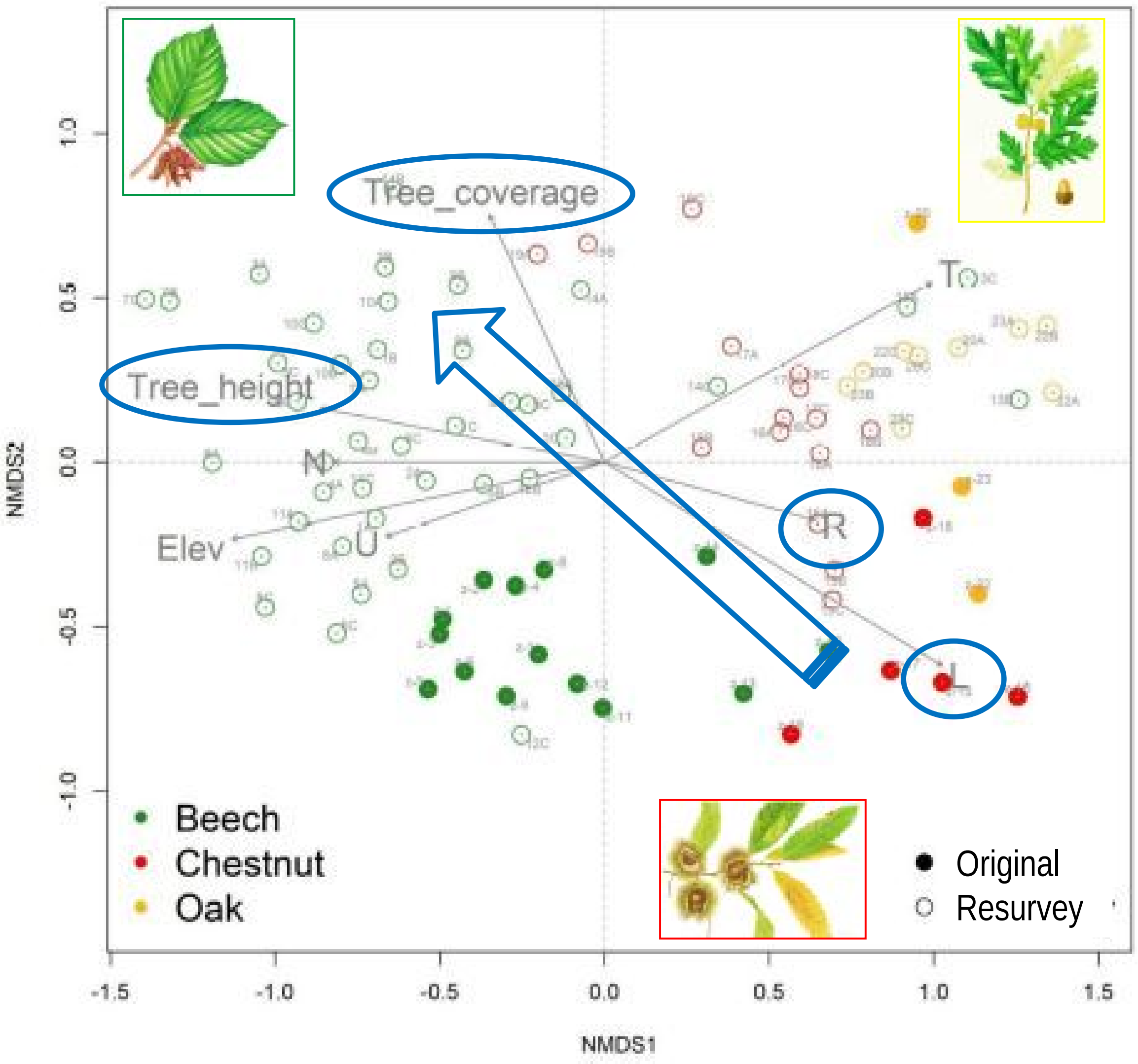
Species richness changes

Observed decrese of species richness
(especially in herb and shrub layer)

		SR tot	Herb layer	Shrub layer	Tree layer
Total data set	Original	284	235	40	11
	Resurvey	239	227	36	25
All plots	Original	38.8 ± 10.9	30.9 ± 9.3	6.1 ± 4.4	1.7 ± 0.9
	Resurvey	22.7 ± 12.8	18.8 ± 11.7	2.6 ± 3.1	2.4 ± 1.4
Beech plots	Original	35.4 ± 6.0	29.6 ± 5.6	4.0 ± 1.8	1.8 ± 1.0
	Resurvey	17.1 ± 7.1	6.6 ± 4.6	1.2 ± 2.0	1.9 ± 0.9
Chestnut plots	Original	47.8 ± 10.9	38.8 ± 11.2	7.6 ± 2.6	1.0 ± 0.0
	Resurvey	35.3 ± 16.7	29.5 ± 17.2	4.6 ± 3.7	2.7 ± 2.0
Oak plots	Original	39.3 ± 21.9	24.0 ± 14.8	13.6 ± 6.8	2.0 ± 1.0
	Resurvey	27.7 ± 9.5	20.5 ± 8.0	5.5 ± 2.4	4.0 ± 0.9

Lelli, C. …… Chiarucci, A. (2021).
Journal of Vegetation Science, 32, e12939.

Changes in species compositon



Lelli, C. …… Chiarucci, A. (2021).
Journal of Vegetation Science, 32, e12939.

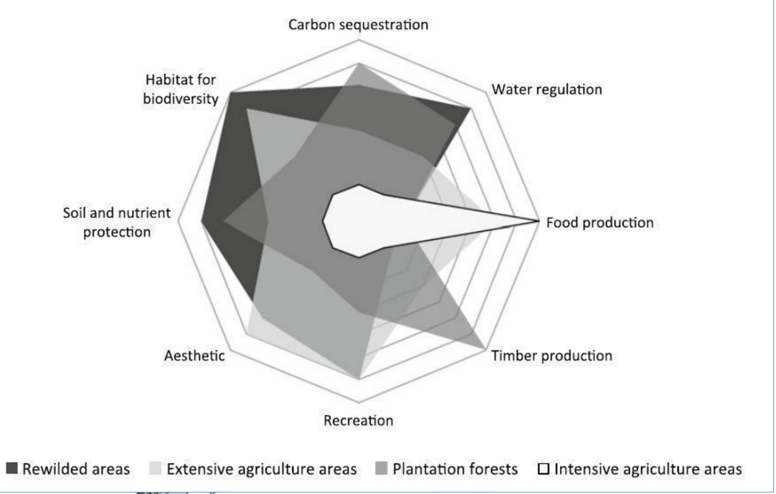
Elev = elevation
Tree_height = Average height of tree layer
Tree_coverage = Canopy closure

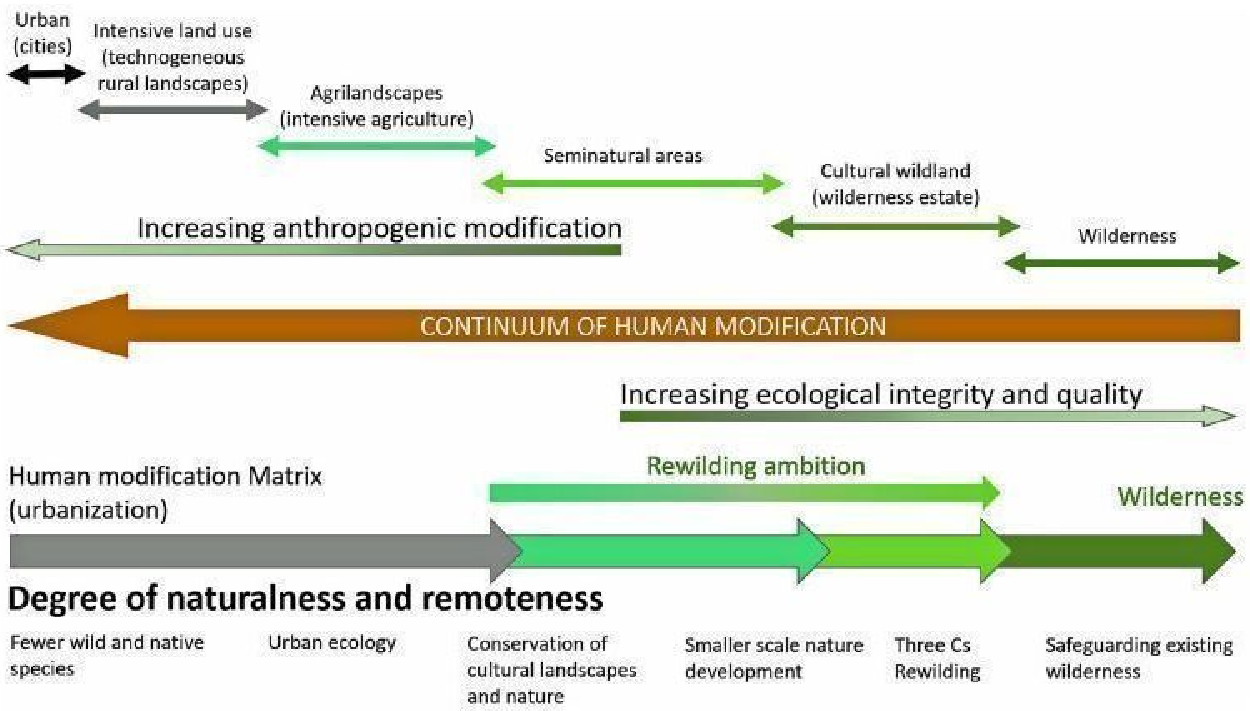
Ecological indicator values (Pignatti-Ellenberg)
L = Light
N = Soil nutrients
R = Soil reaction (pH)
T = Temperature
U = Soil moisture

Rewilding

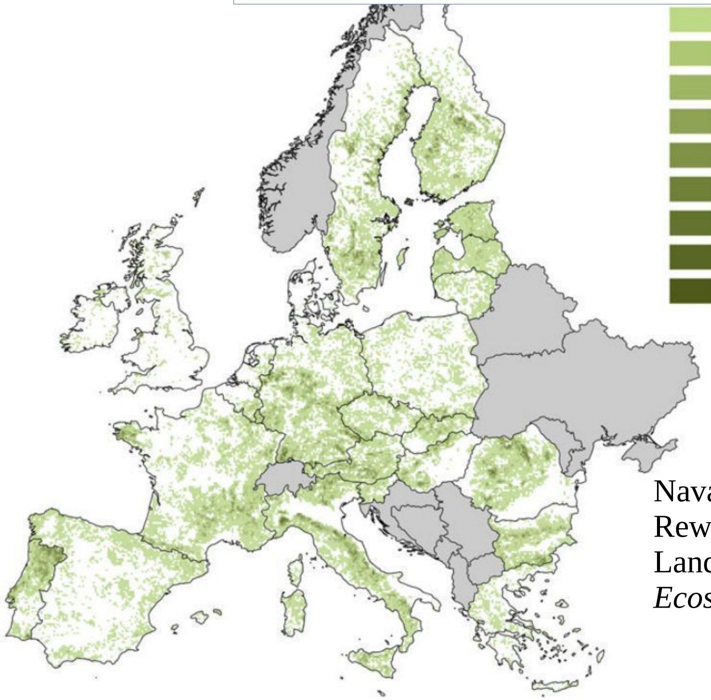
A form of ecological restoration with an emphasis on humans stepping back and leaving role to **natural processes**, as opposed to more active forms of management. Rewilding efforts aim to create ecosystems requiring **passive management**.

ONU listed re-wilding as one of the methods needed to achieve massive scale restoration of natural ecosystems by 2030.





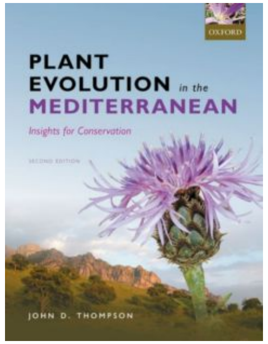
Carver et al. (2021). Guiding principles for rewilding. *Conservation Biology*, October 2020, cobi.13730.

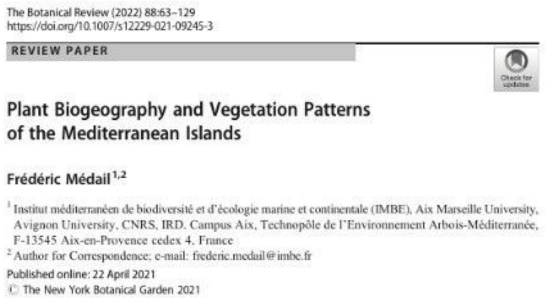


Navarro & Pereira (2012). Rewilding Abandoned Landscapes in Europe. *Ecosystems*, 15, 900–912.

Figure 4. Localization of the hotspots of abandonment and rewilding in Europe. Those hotspots are areas categorized as ''agriculture'' in 2000 that are projected to become rewilded or afforested in 2030 and that are common to all four scenarios of the CLUE model (Verburg and Overmars 2009). Hotspots are expressed as a percentage of each 10-km^2 grid cell. Agricultural areas correspond to ''arable land (non-irrigated)'', ''pasture'', ''irrigated arable land'' and ''permanent crops''. Rewilded and afforested areas correspond to ''(semi)-natural vegetation'', ''forest'', ''recently abandoned arable land'' and ''recently abandoned pasture land''. Countries in *grey* have no data.

Mediterranean Islands




The Botanical Review (2022) 88:63–129
https://doi.org/10.1007/s12229-021-09245-3

REVIEW PAPER

Plant Biogeography and Vegetation Patterns of the Mediterranean Islands

Frédéric Médail[1,2]

[1] Institut méditerranéen de biodiversité et d'écologie marine et continentale (IMBE), Aix Marseille University, Avignon University, CNRS, IRD, Campus Aix, Technopôle de l'Environnement Arbois-Méditerranée, F-13545 Aix-en-Provence cedex 4, France
[2] Author for Correspondence; e-mail: frederic.medail@imbe.fr

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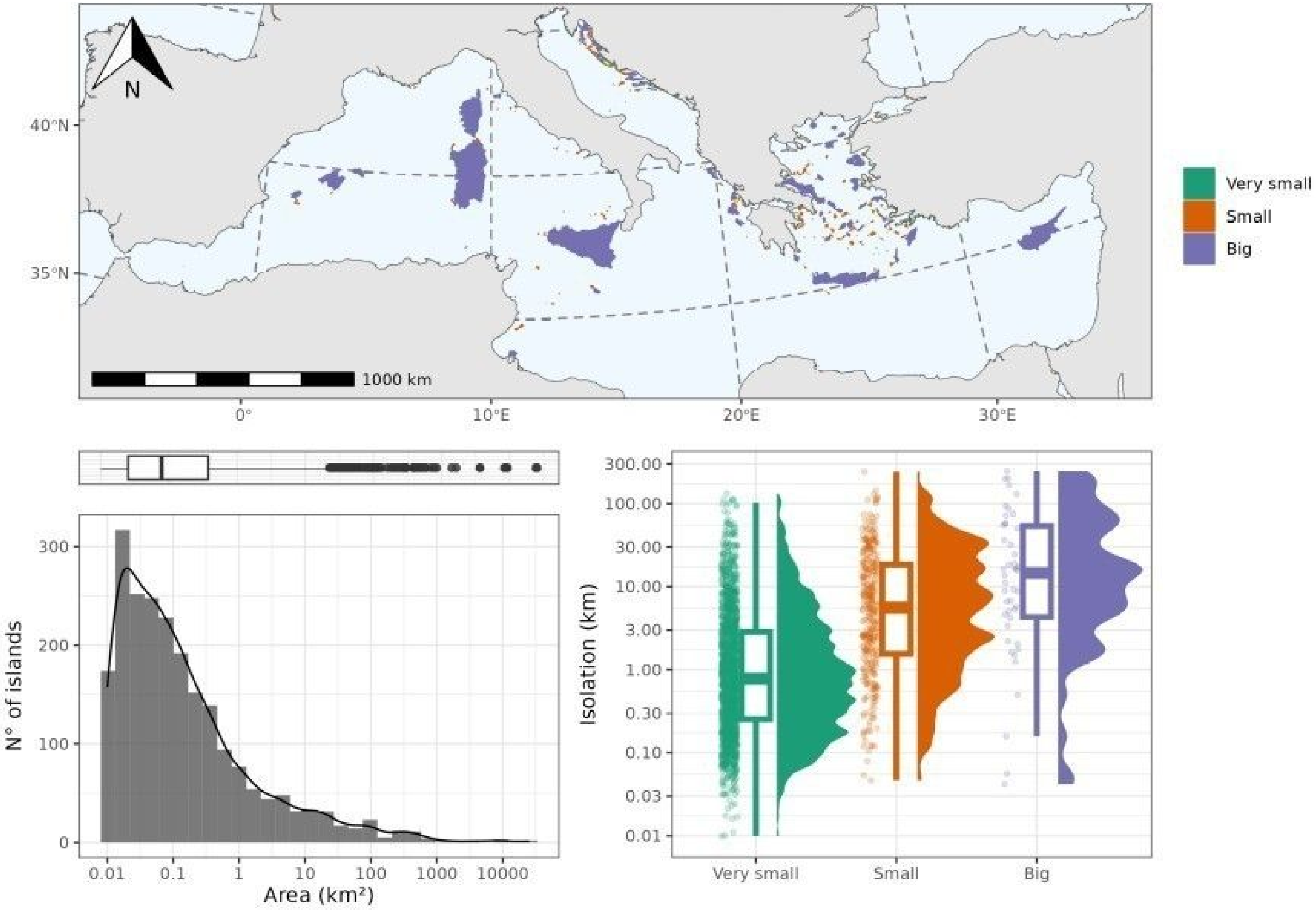
Geographic database:

- 2214 islands > 1ha
- 35 variables
  - Geography
  - Environment
  - Land use
- Public available

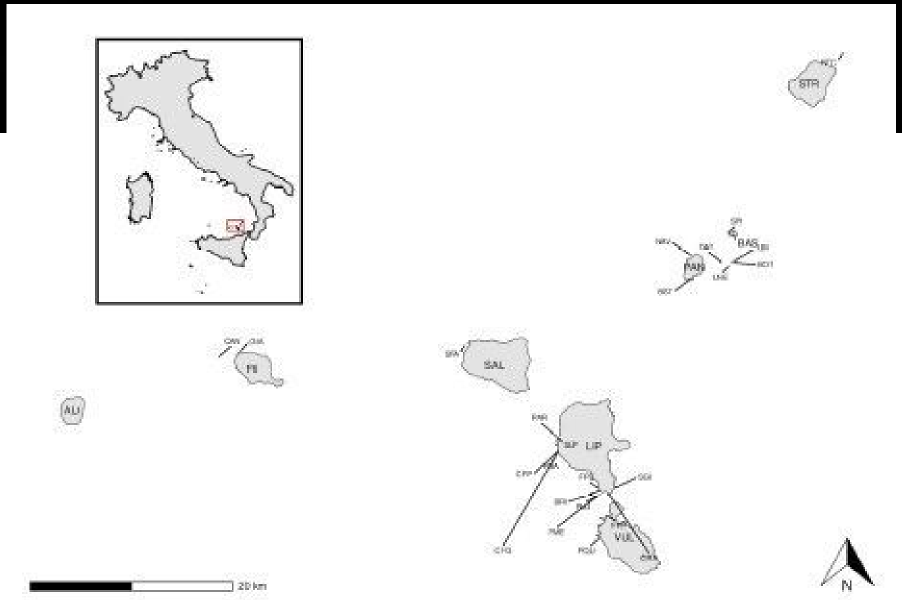
  https://doi.org/10.48372/98EH-F935



83 % of the islands are very small
(1 ha – 1 km^2)

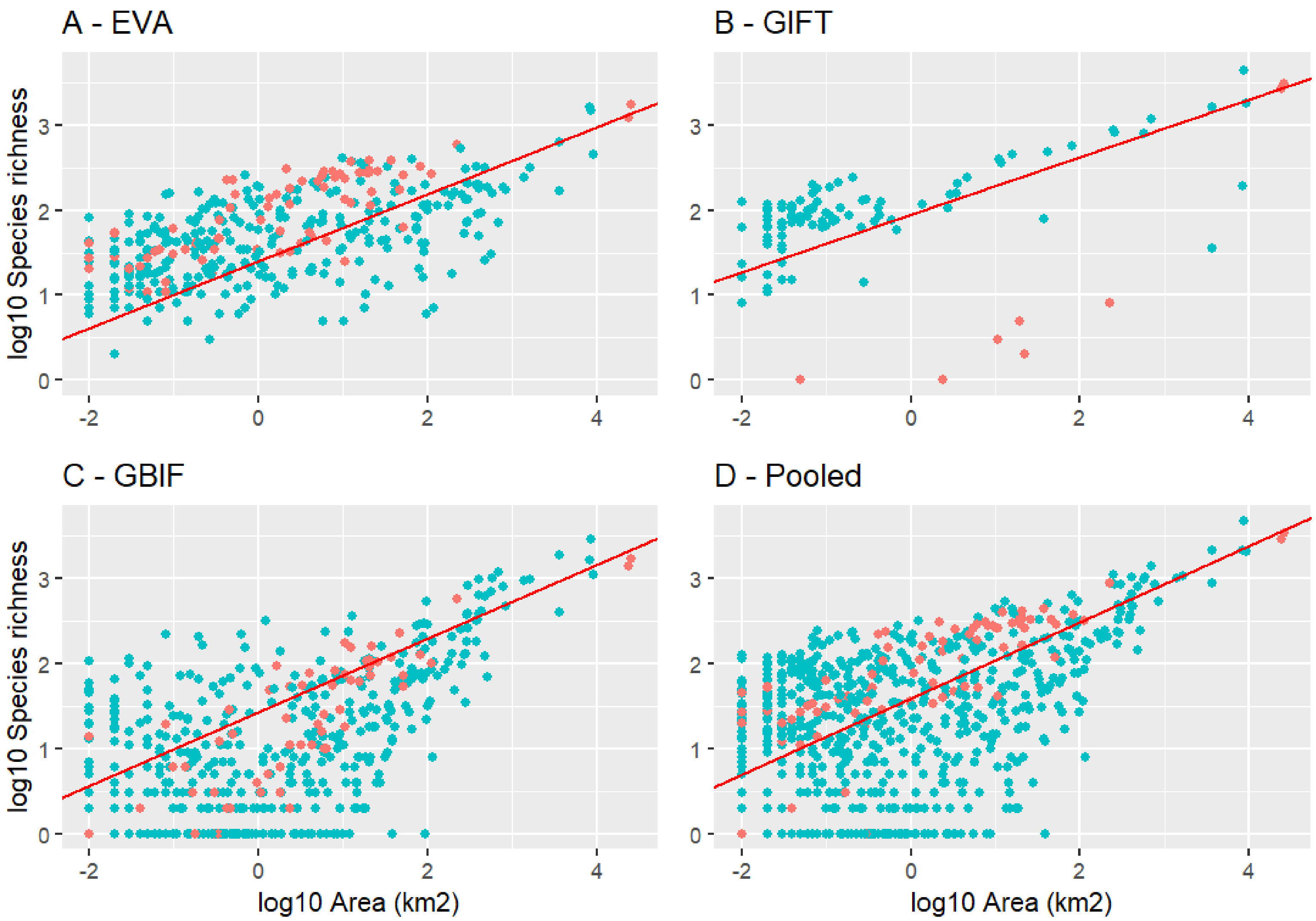
Santi, F., Zannini, P.,…… Chiarucci A., under review. MEDIS - A comprehensive database on Mediterranean islands for biogeographical and evolutionary research

Active volcanos



A view of the craters of Vulcano and Stromboli
(Photo by A. Chiarucci and J.M. Fernandéz-Palacios)

Species richness depends on area….



Island species–area relationship (ISAR) for native species in islands >0.01 km^2 of Mediterranean islands, based on three different datasets:

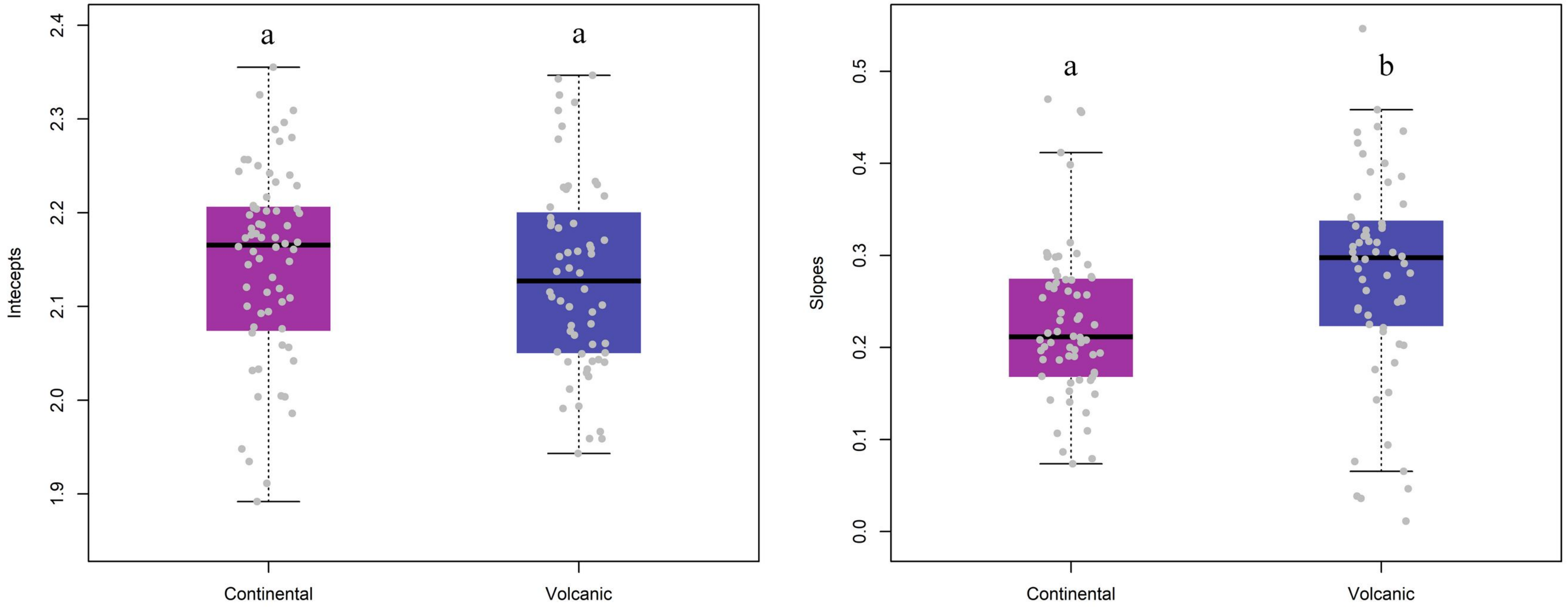
- European Vegetation Archive
- Global Inventory of Floras and Traits
- Global Biodiversity Information Facility

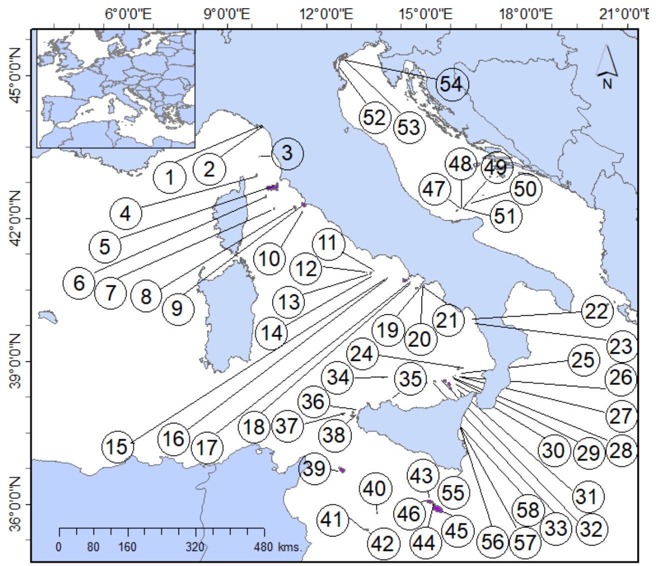
Model fitted on Arrhenius power function ($S = c{\cdot}A^z$); Graphs plotted on a log-log scales.

- 738 Islands
- 8556 species

Santi F. … Chiarucci, A. (in prep).

Island origin controls species richness

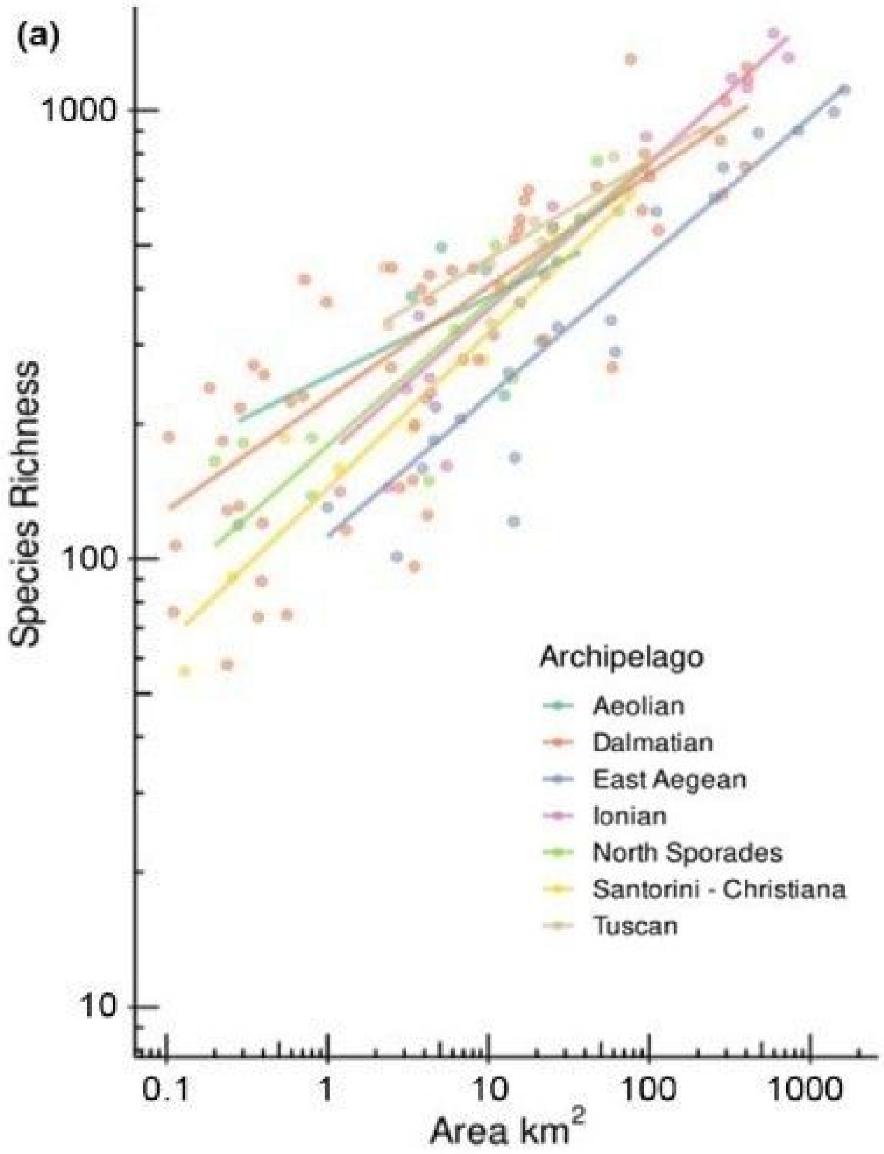




Contrasting patterns of the *c* and *z* parameters of the Arrhenius model ($S = c \cdot A^z$) fitted in Mediterranean islands of different geological origin. Blue colour is volcanic islands; purple colour is for continental islands.

Cáceres Polgrossi L., …. Chiarucci A., in press. Community Ecology

Comparing volcanic *vs.* continental archipelagos



Island species–area relationship (ISAR) for native species in islands >0.01 km^2 of seven Mediterranean archipelagos. Models fitted on Arrhenius power function ($S = c \cdot A^z$);

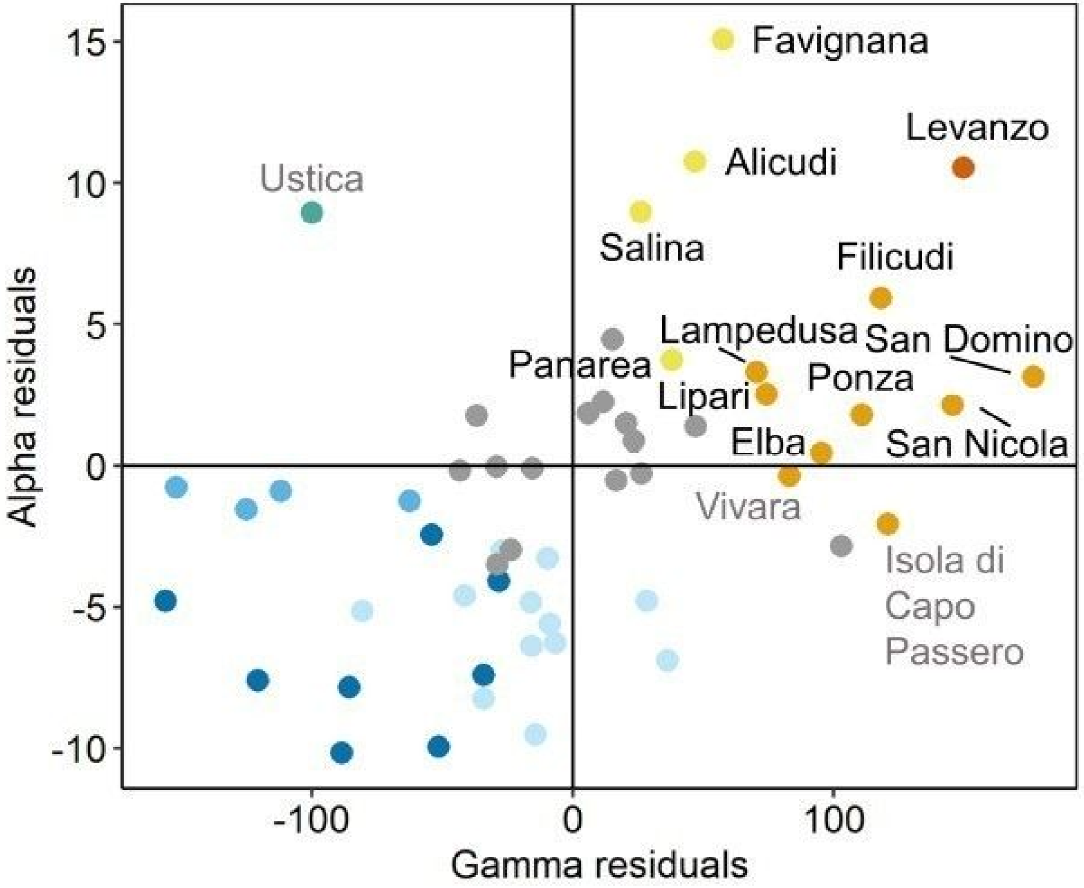
Chiarucci A. … Zannini P. (2021). Journal of Biogeography, 48, 2919–2931.

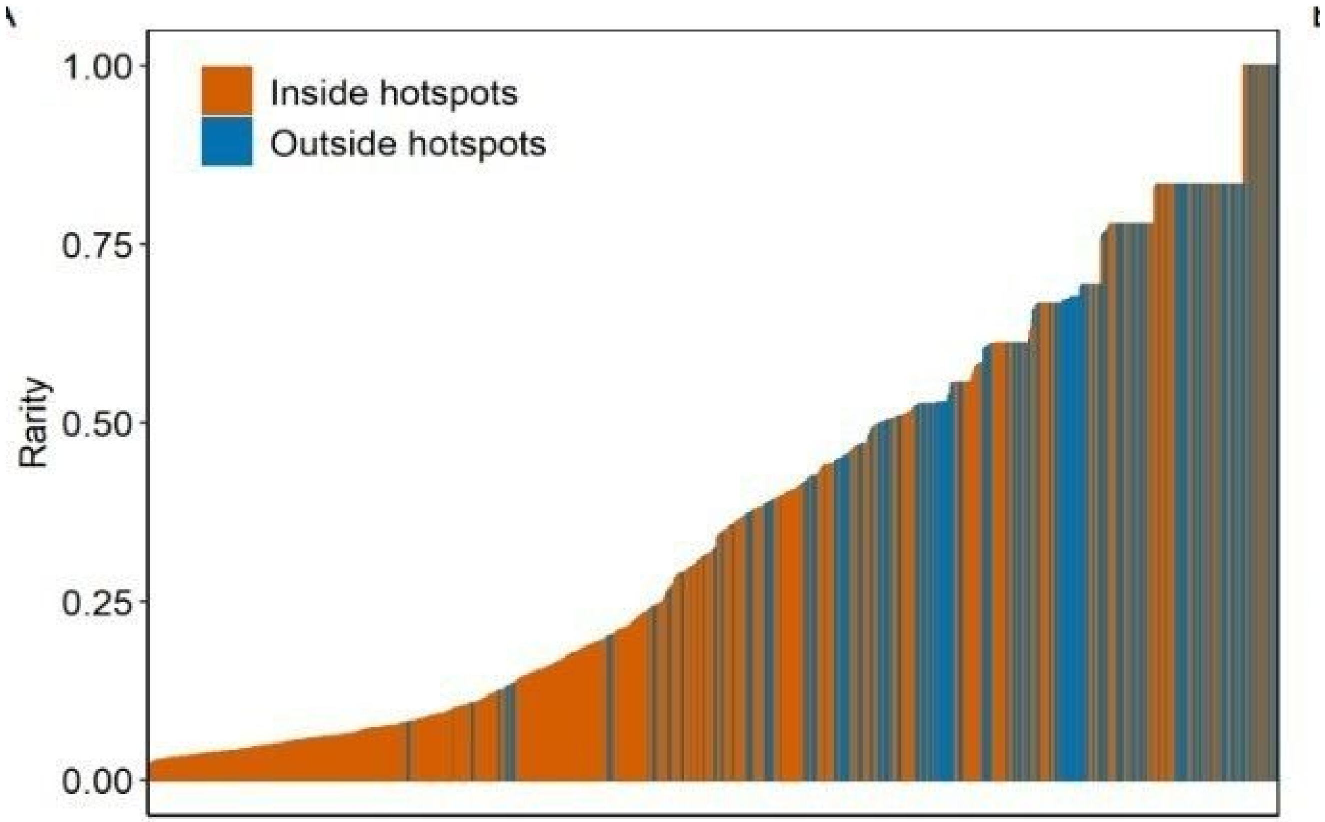
Gamma and Alpha hotspots

JSE Journal of Systematics and Evolution
doi: 10.1111/jse.13034
Research Article

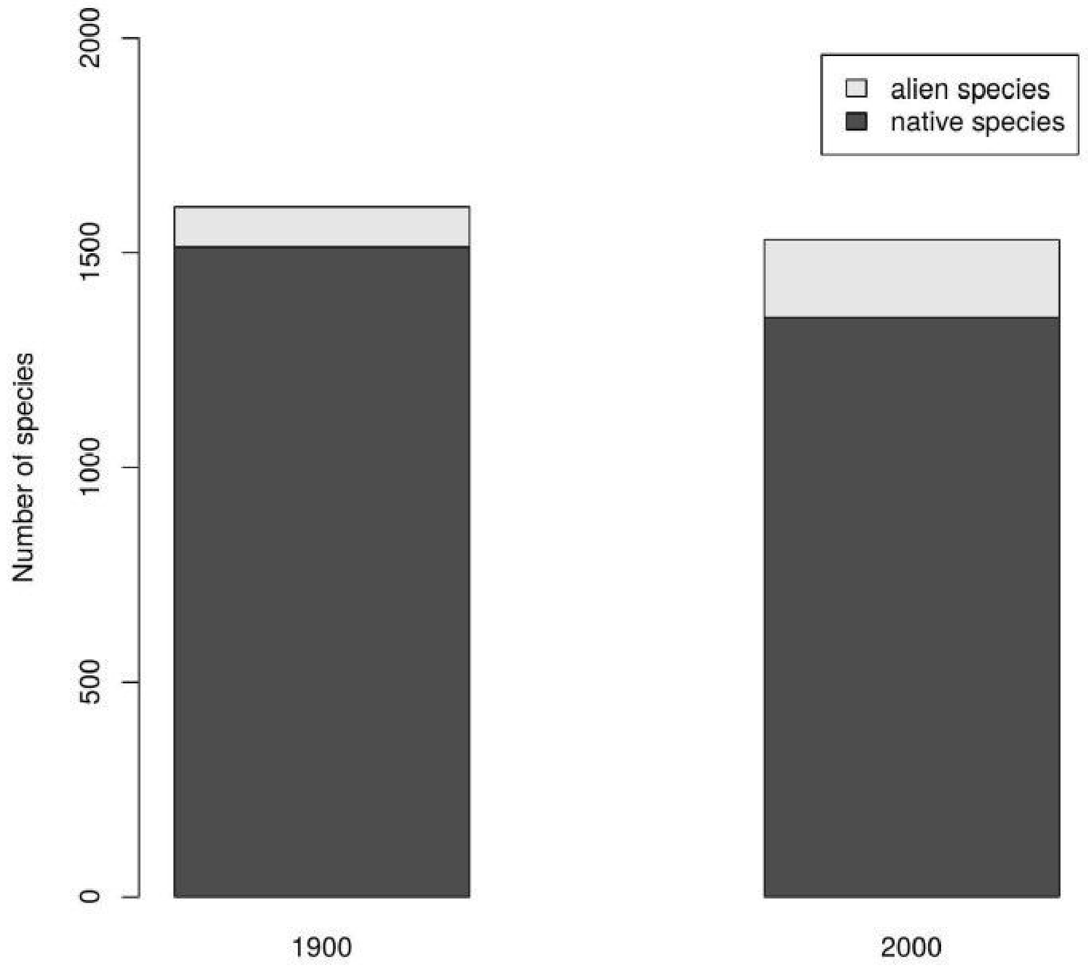
Plant species richness hotspots and related drivers across spatial scales in small Mediterranean islands

Riccardo Testolin[1,2,3*], Fabio Attorre[4], Vanessa Bruzzaniti[1,2,3], Riccardo Guarino[5], Borja Jiménez-Alfaro[6], Michele Lussu[1,2,3], Stefano Martellos[2,7], Michele Di Musciano[1,8], Salvatore Pasta[9], Francesco Maria Sabatini[1,10], Francesco Santi[1], Piero Zannini[1,2,3], and Alessandro Chiarucci[1]





Floras of Tuscan Archipelago1900 *vs.* 2000

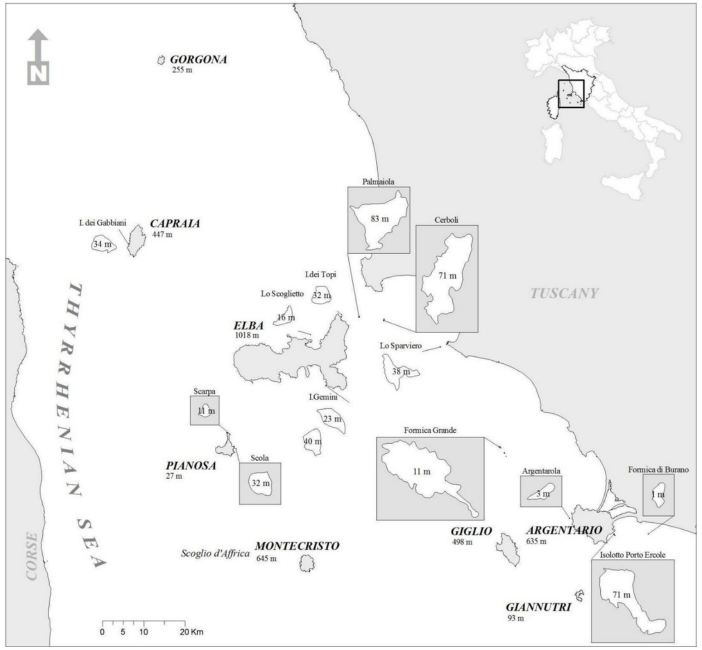


10,892 species x island occurrences

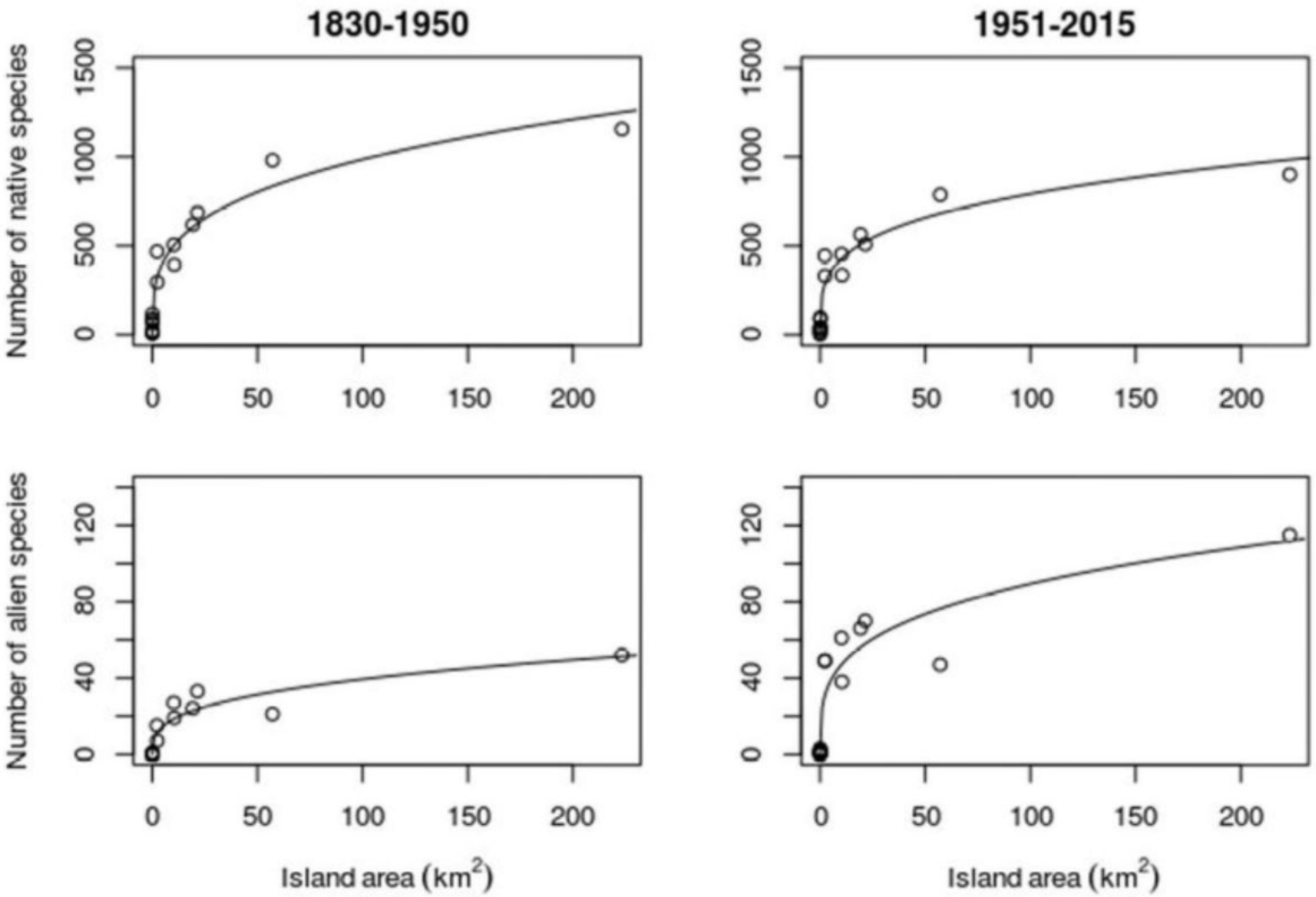
1,831 species in total

- 1,601 species in 1900
- 1,541 species in 2000 (-3.7%)
- 78 alien species in 1900 (4.9%)
- 181 alien species in 2000 (11.7%)

1,311 species shared 1900 - 2000
(Sim$_{Jacc}$ = *0.72*)



Species richness depends on area….



Group of species	Year	Model fitting and parameters			
		c	z	Achieved convergence tolerance	F
Native plants	1830–1950	252.2***	0.296***	2.00E-006	94364.8
	1951–2015	229.3***	0.269***	7.97E-006	83223.3
Alien plants	1830–1950	8.5***	0.332***	4.17E-006	397.1
	1951–2015	24.4***	0.282***	9.03E-006	2660.4

Chiarucci A. …… Simberloff D. (2017). Plant recording across two centuries reveals dramatic changes in species diversity of a Mediterranean archipelago. Scientific Reports, 71, 5415.

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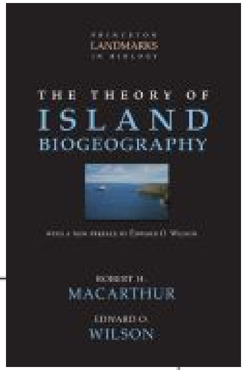
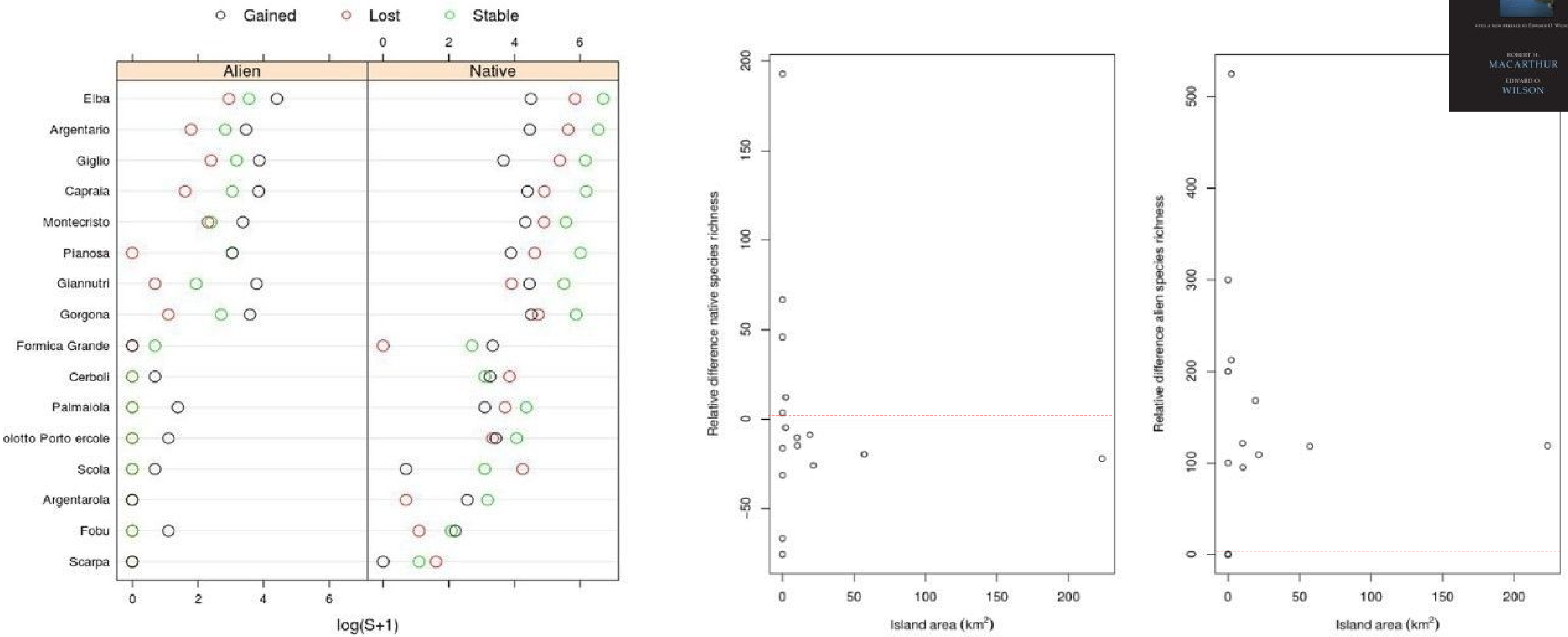
… but species composition changes with time





Chiarucci A. …… Simberloff D. (2017). Plant recording across two centuries reveals dramatic changes in species diversity of a Mediterranean archipelago. Scientific Reports, 71, 5415.

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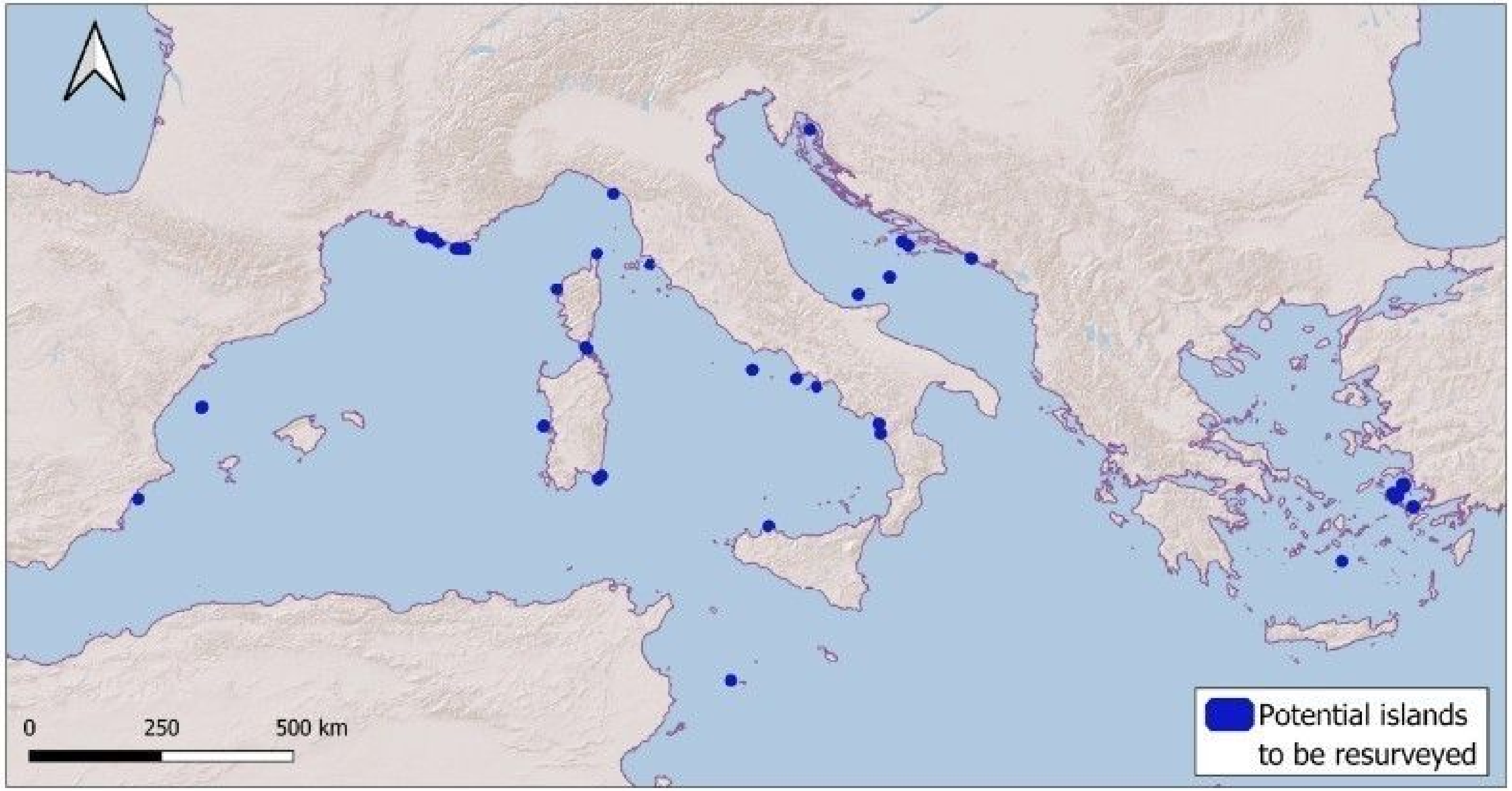
Resurvey of small Mediterranean islands

Started on Spring 2024 on islands a set of 76 islands matching the following criteria:

- Size 0.01 - 1 km^2
- Vegetation plots with at least 30 years
- Absence of permanent human presence



Santi F. … Chiarucci, A. (in prep).

EU Biodiversity Strategy for 2030

"Making nature healthy again is key to our physical and mental wellbeing and is an ally in the fight against climate change and disease outbreaks. It is at the heart of our growth strategy, the European Green Deal, and is part of a European recovery that gives more back to the planet than it takes away."

Ursula von der Leyen, President of the European Commission

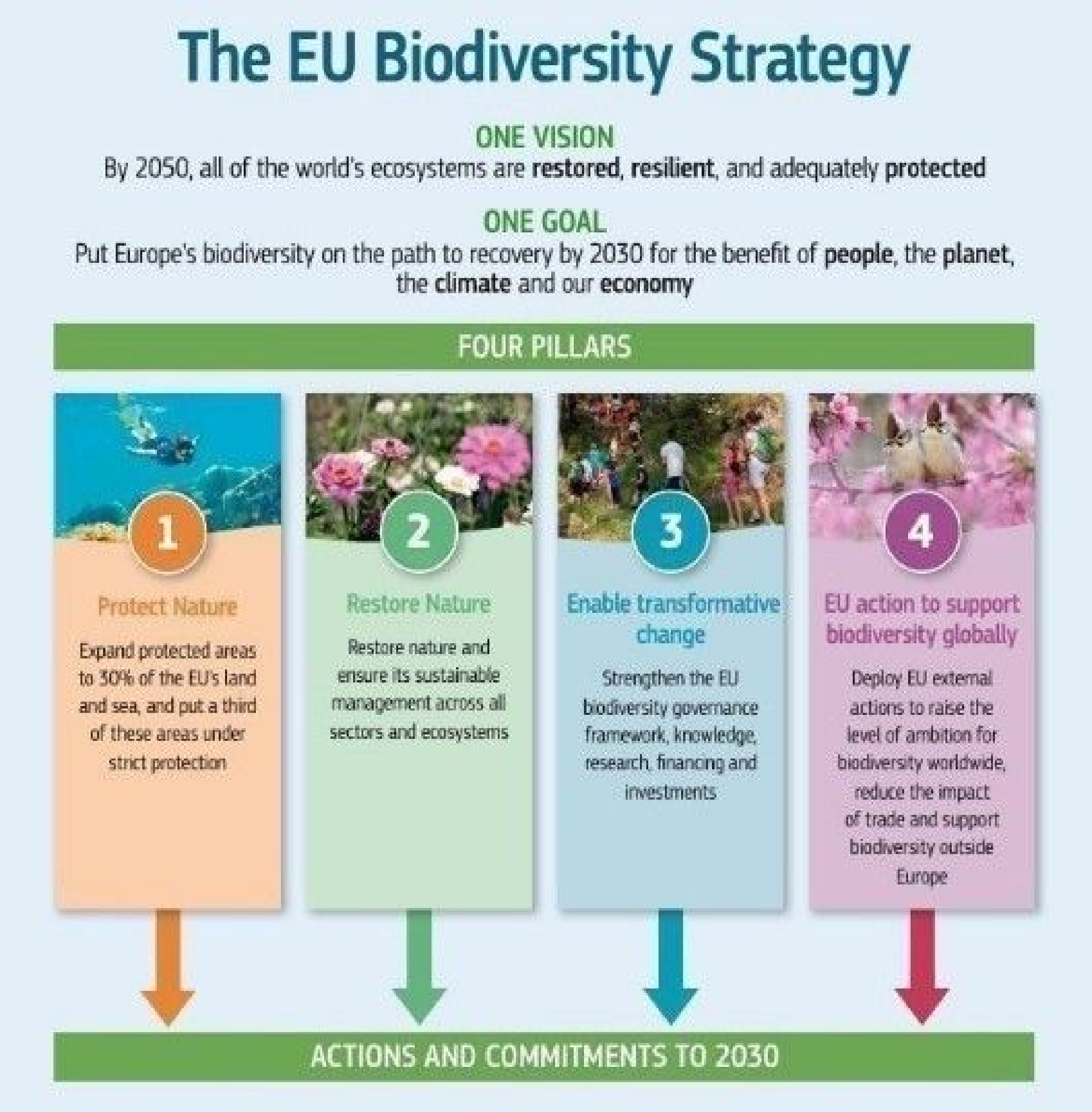
Climate change, the unprecedented loss of biodiversity, and the spread of devastating pandemics are sending a clear message: it is time to fix our broken relationship with nature.	The Biodiversity Strategy will put Europe's biodiversity on the path to recovery by 2030, for the benefit of people, climate and the planet.

Why do we need to protect biodiversity?

Biodiversity is **essential** for life. Our planet and the economy depend on it. When nature is healthy, it protects and provides.

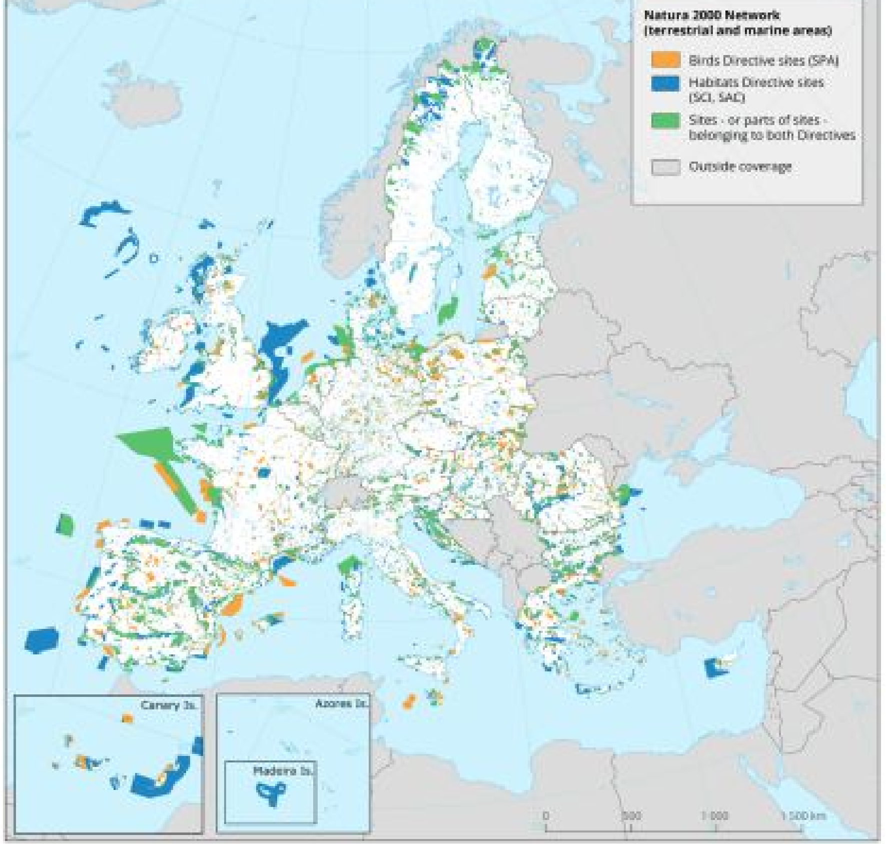
Strictly protect 10% of our land and sea for nature

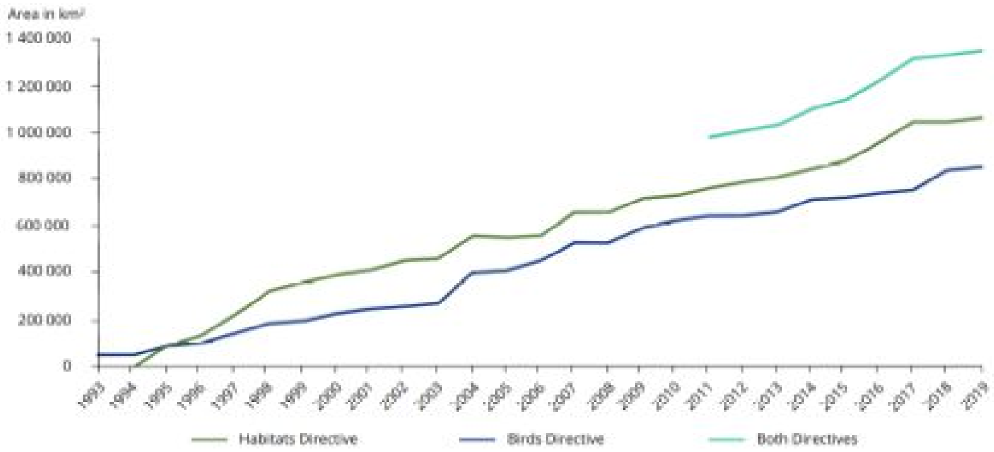
The new Strategy also calls for at least one third of these protected areas – representing 10% of EU land and 10% of EU seas – to be strictly protected by 2030. Today, only 3% of land and less than 1% of marine areas are strictly protected.



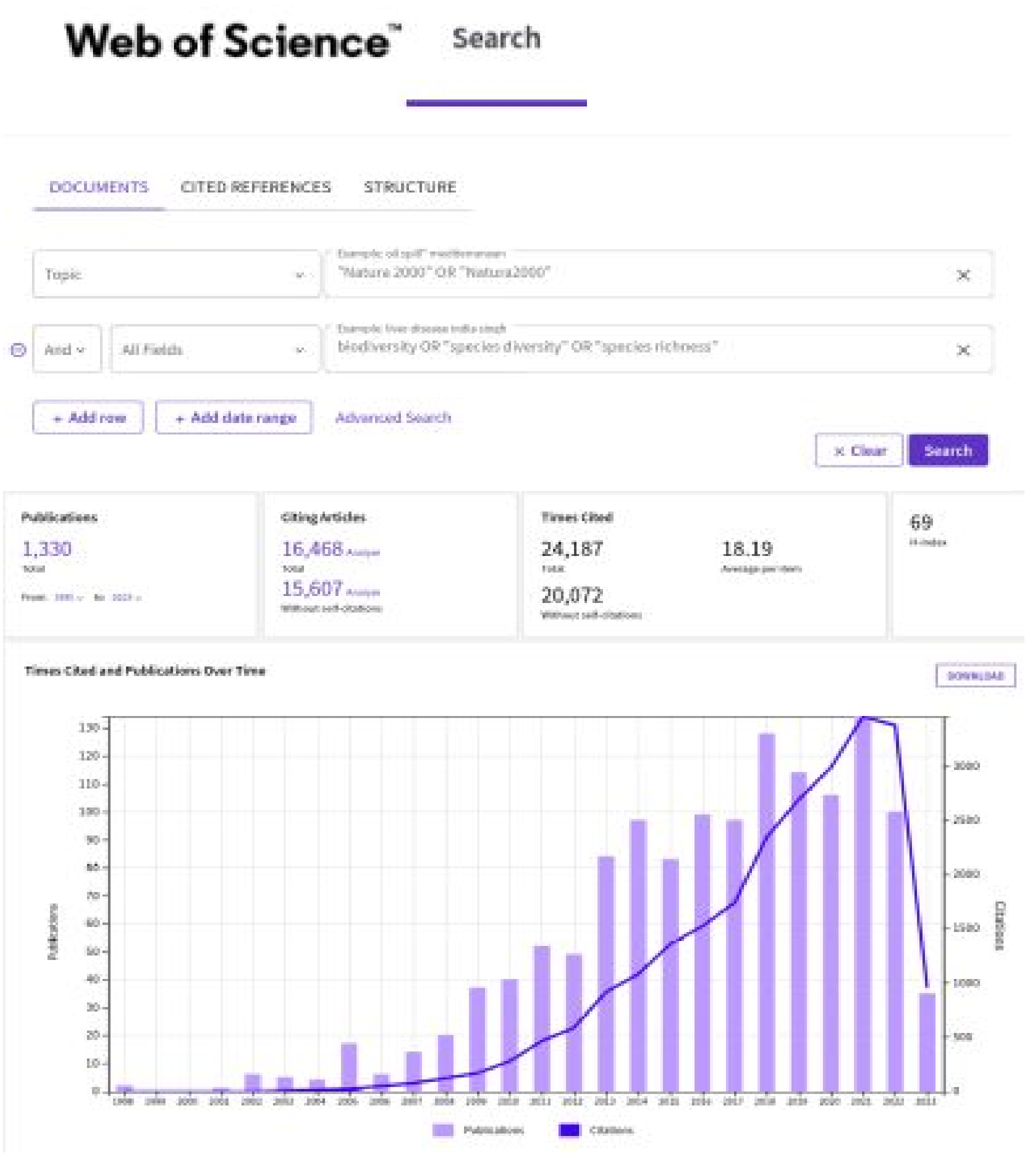
30 YEARS

NATURA 2000



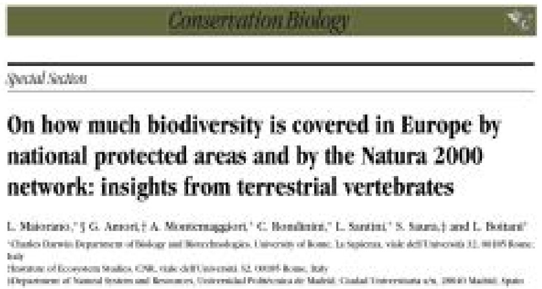


Biodiversity Research on Natura 2000 Network



Entire Natura 2000 Network in EU Member States

Breeding birds
495 species ✓

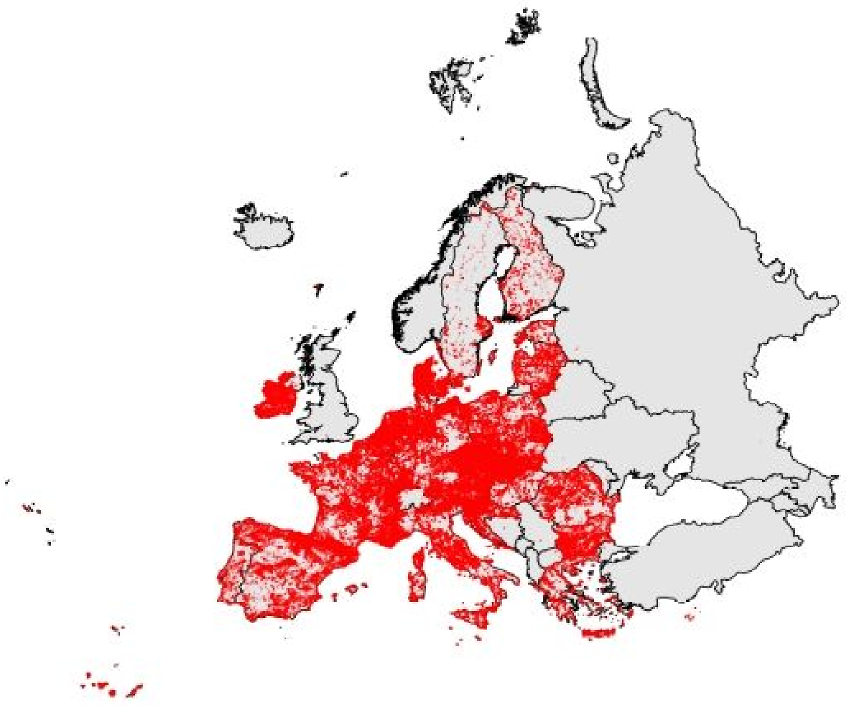


Terrestrial vertebrates
842 species ✓

Vascular plants
12-15K species ✗ ?

Plant occurrenCe data in Natura 2000 Network

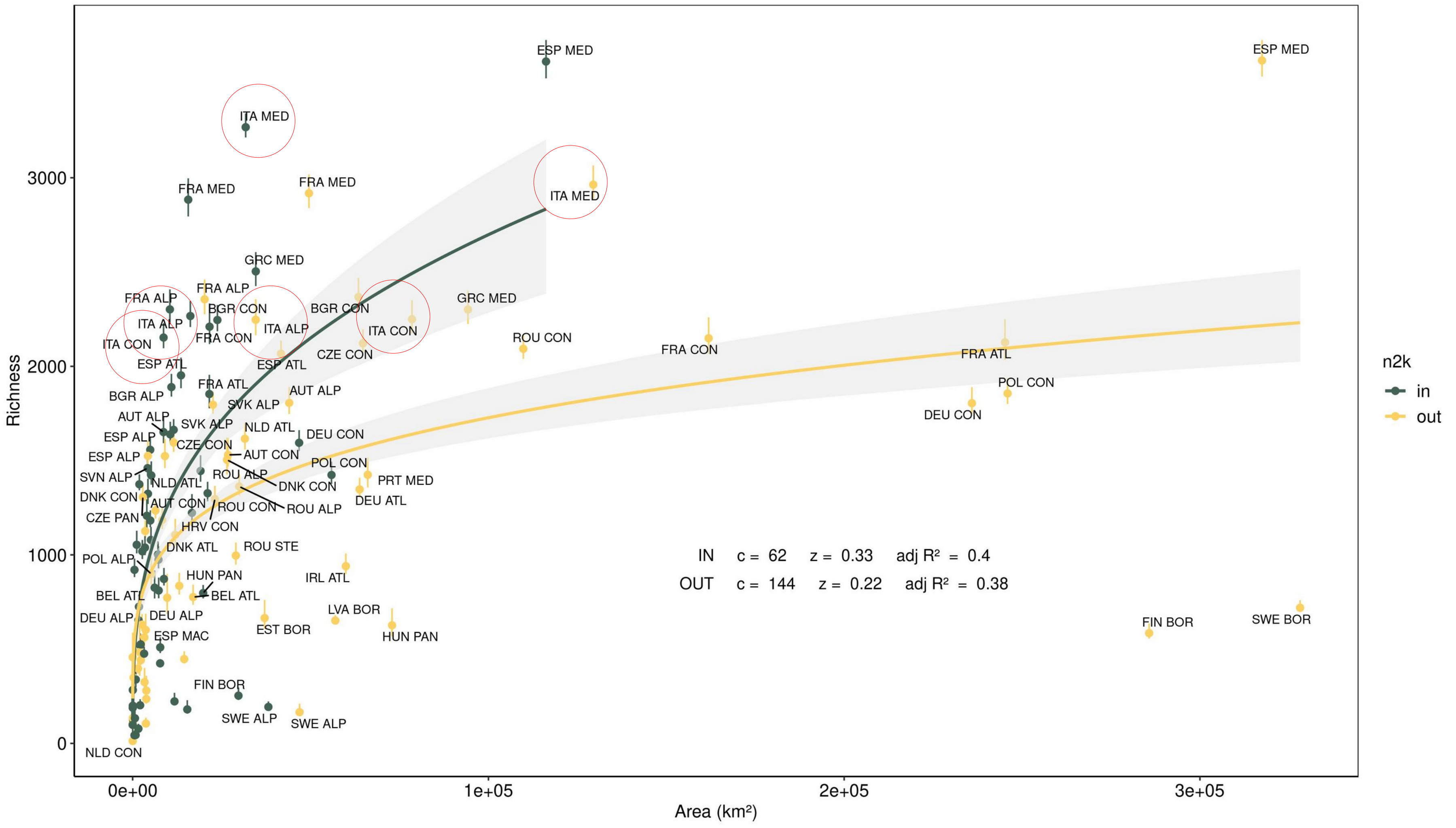
	EU Member States	*Inside Natura 2000 Network*	*Outside Natura 2000 Network*
Number of plots	769,157	340,445	428,712
Occurrences of native species	14.2 Millions	6.1 Millions	8.1 Millions
Number of native species	9,642	8,488 (88.0%)	8,837 (86.5%)
Number of Habitats Directive species	267	197 (73.8%)	190 (71.2%)



1,223,017 Vegetation plots from European Vegetation Archive

http://euroveg.org/

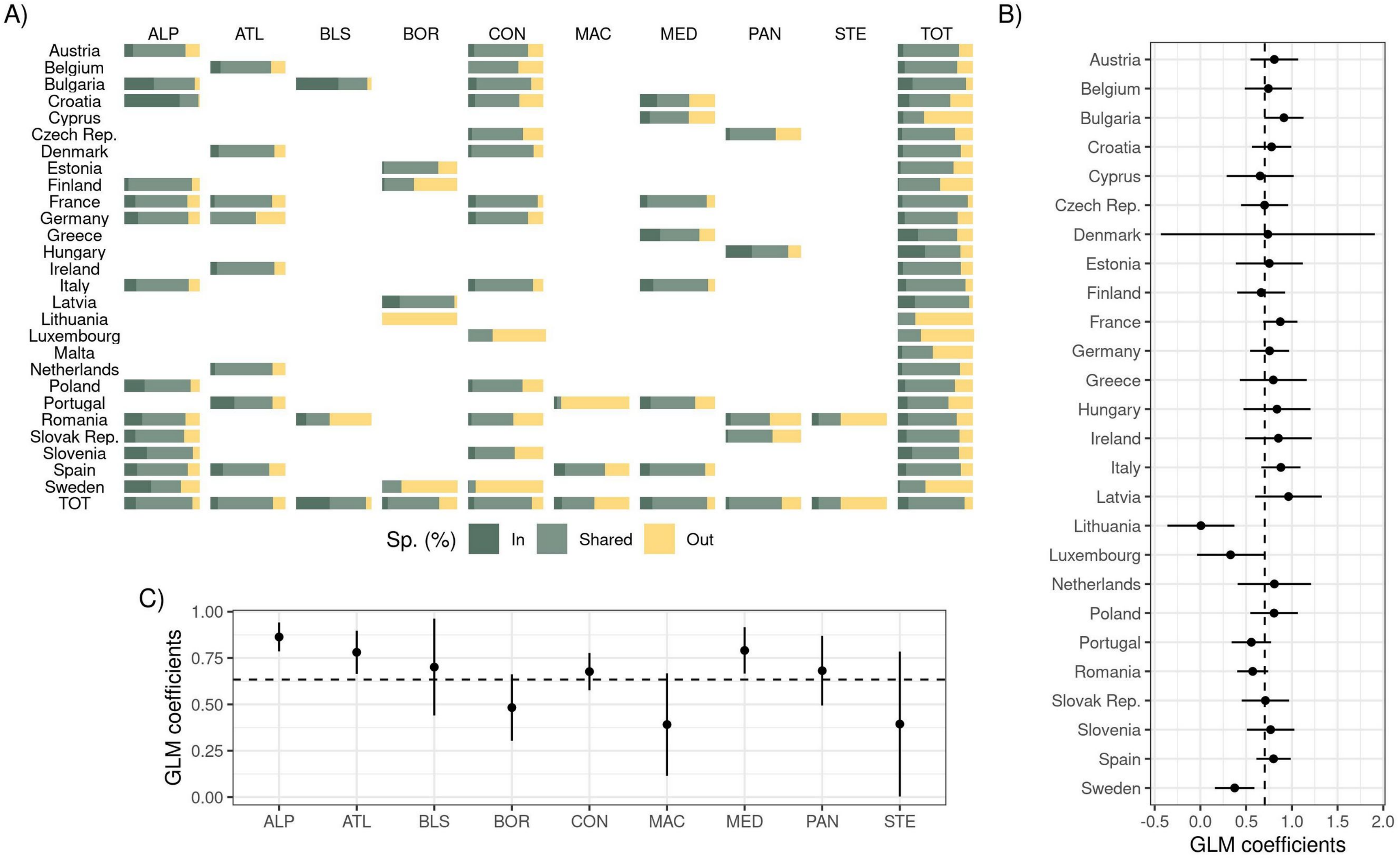
Plant species richness in Natura 2000 Network



Species-area relationship for the total number of native species recorded within (in) and outside (out) the Natura 2000 Network per each combination of country and biogeographical region.

Di Musciano, M …. Chiarucci, A. Submitted. *Importance of Natura 2000 Network in maintaining European Union's plant biodiversity*

Plant species richness in/out Natura 2000 Network



Proportion of plat species for each combination of country and biogeographical region of the EU.

Green: % of species found exclusively inside N2K:

Grey: % of species found both inside and outside N2K;

Yellow: % of species foud exclusively outside N2K.

Di Musciano et al. Submitted.
Importance of Natura 2000 Network in maintaining European Union's plant biodiversity

Strictly protect 10% of our land and sea for nature

The new Strategy also calls for at least one third of these protected areas – representing 10% of EU land and 10% of EU seas – to be strictly protected by 2030. Today, only 3% of land and less than 1% of marine areas are strictly protected.

EUROPEAN COMMISSION

Brussels, 28.1.2022
SWD(2022) 23 final

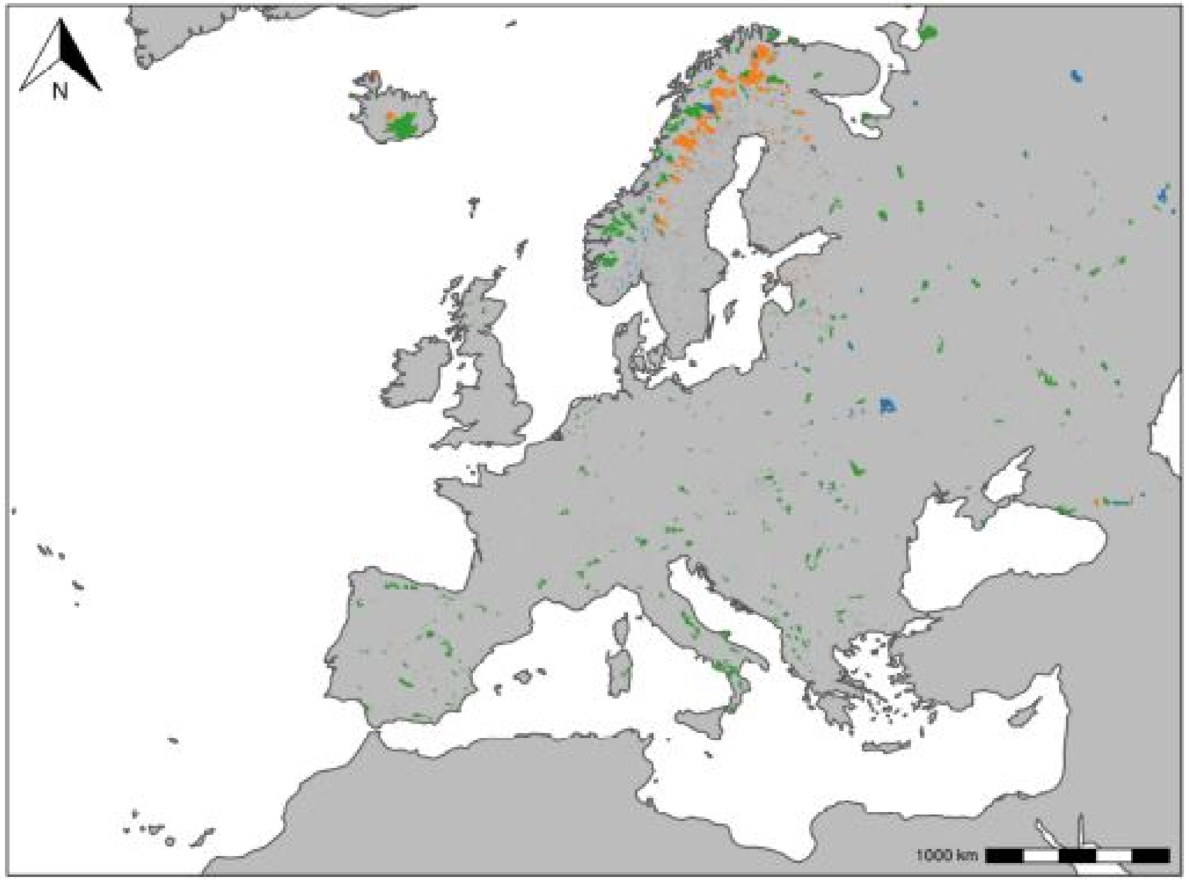
COMMISSION STAFF WORKING DOCUMENT

Criteria and guidance for protected areas designations

In the context of the 10% target in the Biodiversity Strategy, strictly protected areas are defined as follows:

“*Strictly protected areas are fully and legally protected areas designated to conserve and/or restore the integrity of biodiversity-rich natural areas with their underlying ecological structure and supporting natural environmental processes.* ***Natural processes are therefore left essentially undisturbed from human pressures and threats to the area’s overall ecological structure and functioning****, independently of whether those pressures and threats are located inside or outside the strictly protected area*”

Strictly protected areas



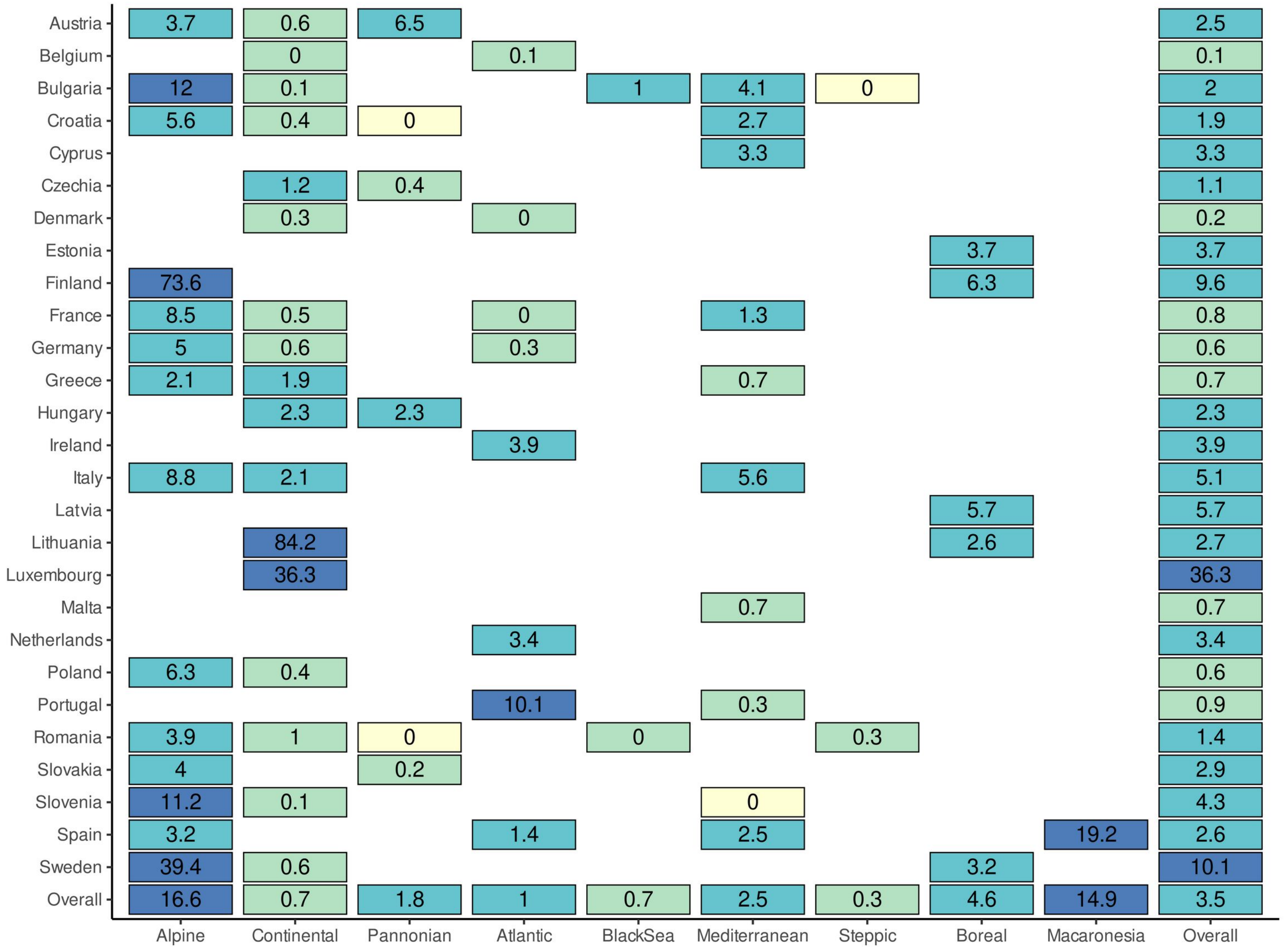
Categoria IUCN		Features
Ia	Strict nature reserve	Protected areas that are strictly set aside to protect biodiversity and also possibly geological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values.
Ib	Wilderness area	Protected areas that are usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.
II	National Park	Large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.

“Strictly” Protected Areas in EU

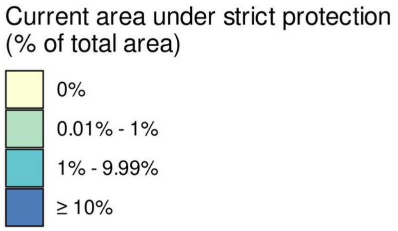
IUCN Type	*Number*	*Area*	
		km²	*%*
Ia	7812	11729.62	0.28
Ib	1101	60476.88	1,46
II	469	66946.88	1.62
Total	9382	139153.38	3.37

Cazzolla Gatti, R., …... Chiarucci, A. (2023). *Biodiversity and Conservation*, 32, 3157–3174.

Strictly protected areas



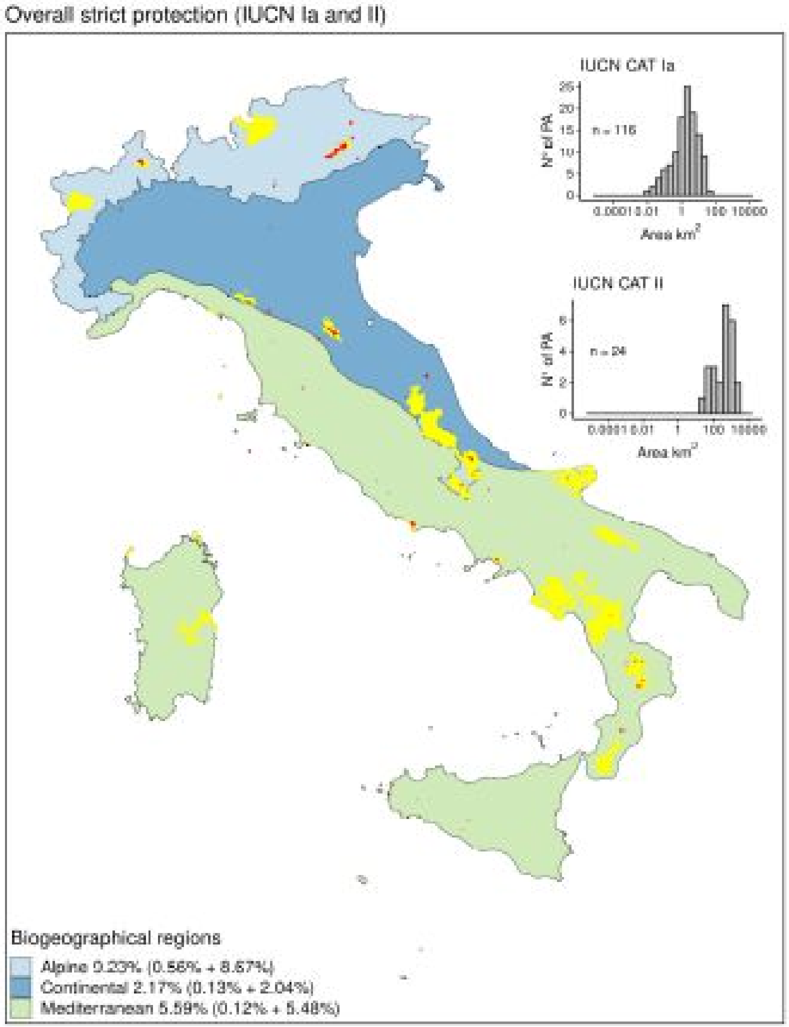
Coverage of “**strictly protected areas** (IUCN category Ia, Ib and II) across EU countries and biogeographical regions.

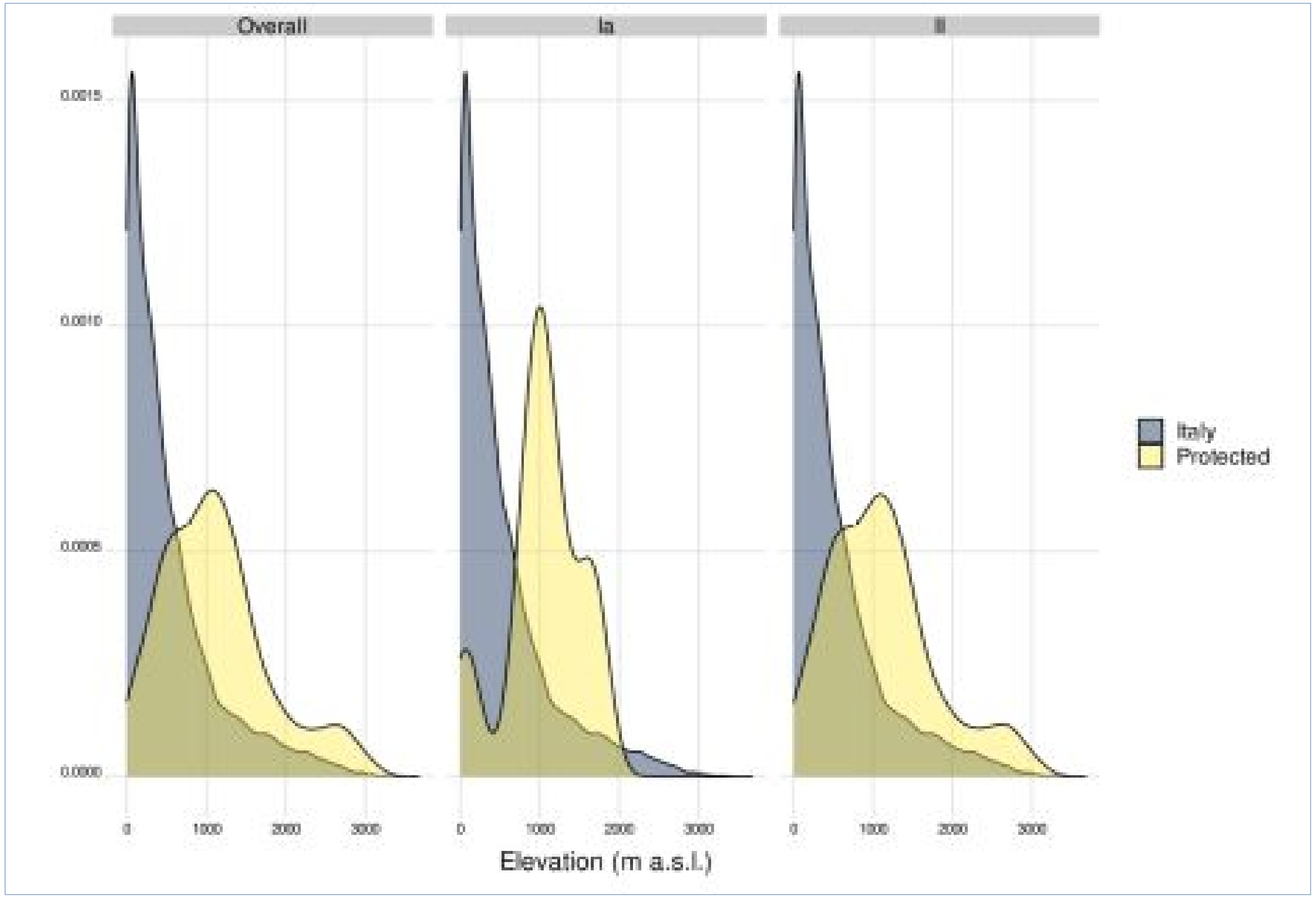


Almost all countries are far from the 10% target for most of the biogeographic regions they occupy

Cazzolla Gatti, R., …... Chiarucci, A. (2023).
Biodiversity and Conservation, 32, 3157–3174.

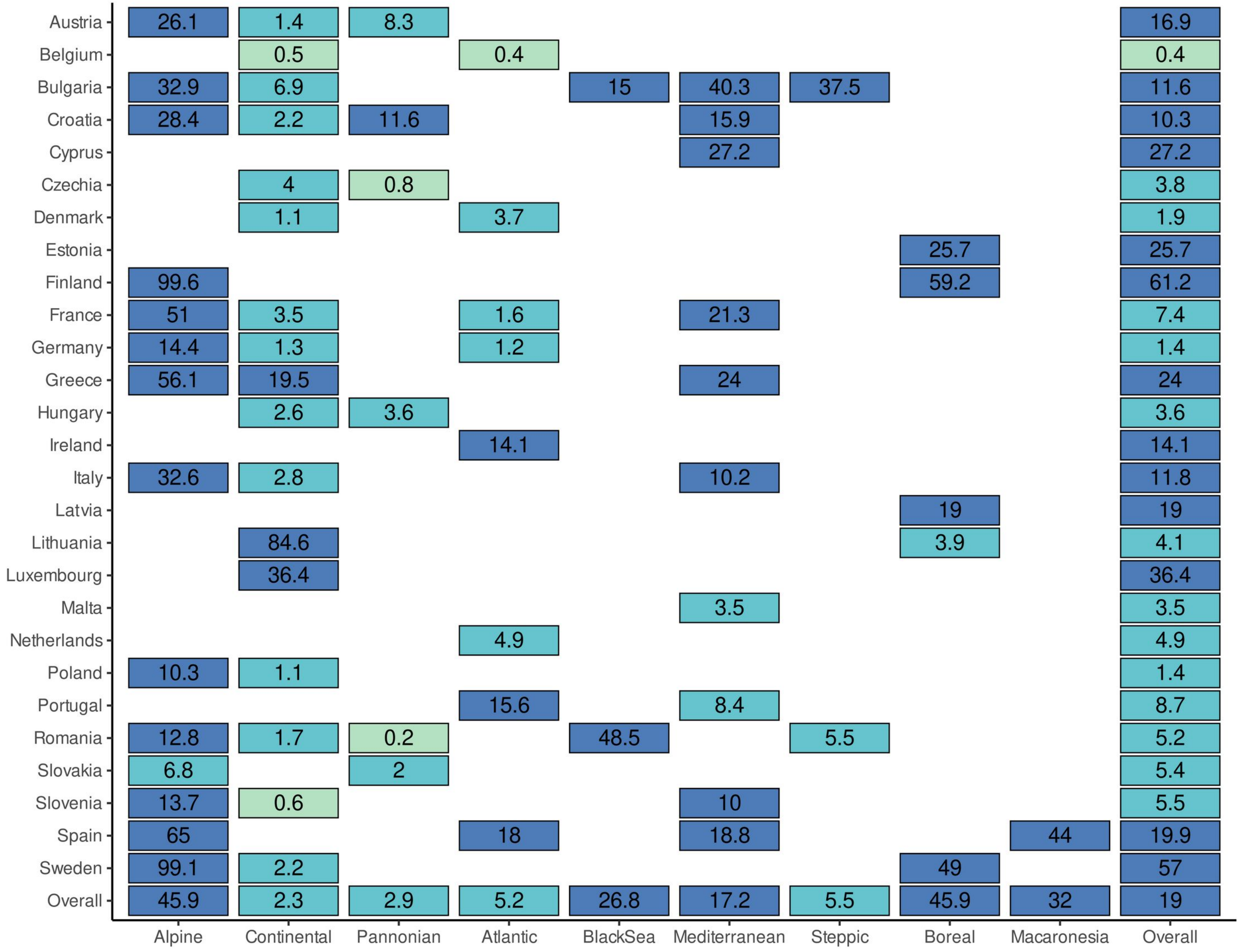
Strictly protected areas



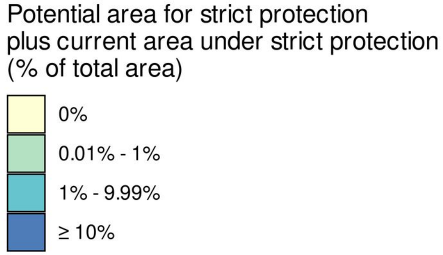


Cazzolla Gatti, R., …... Chiarucci, A. (2023).
Biodiversity and Conservation, 32, 3157–3174.

Potential new area for strictly protected areas



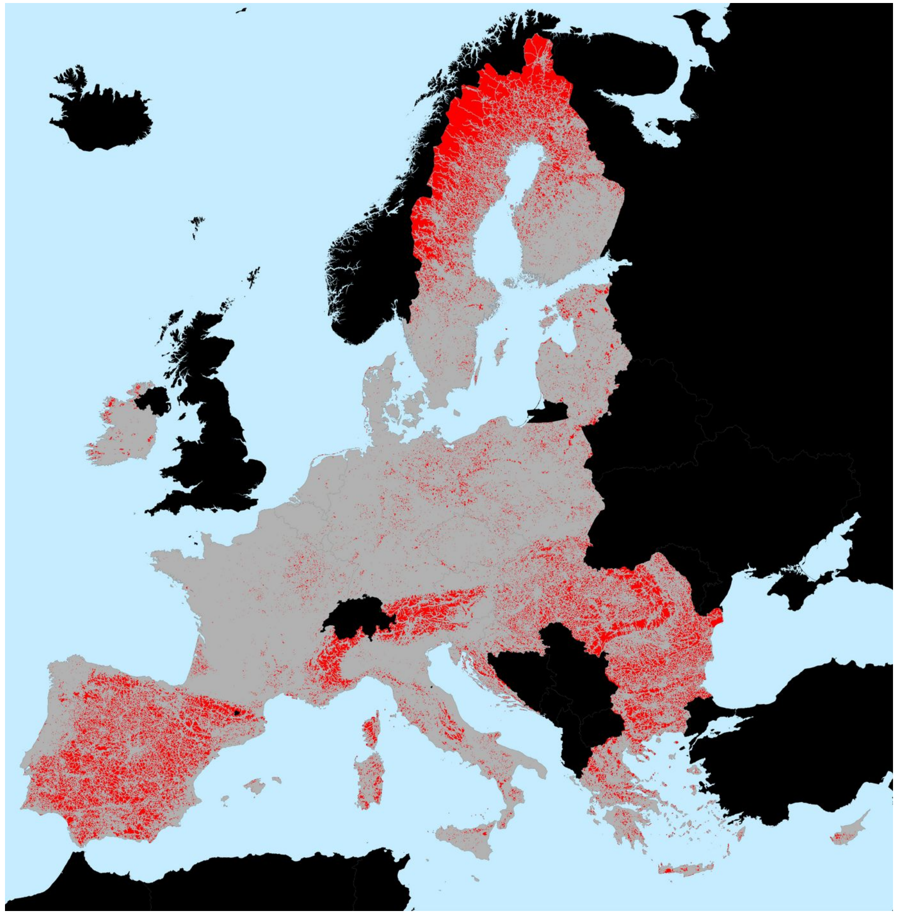
Potential area available for establishing new “**strictly protected areas** (IUCN category Ia, Ib and II) across EU countries and biogeographical regions.



In many combinations of country by biogeographical region there is no land left for the 10% target of strict protection

Cazzolla Gatti, R., …... Chiarucci, A. (2023).
Biodiversity and Conservation, 32, 3157–3174.

Roadless Areas

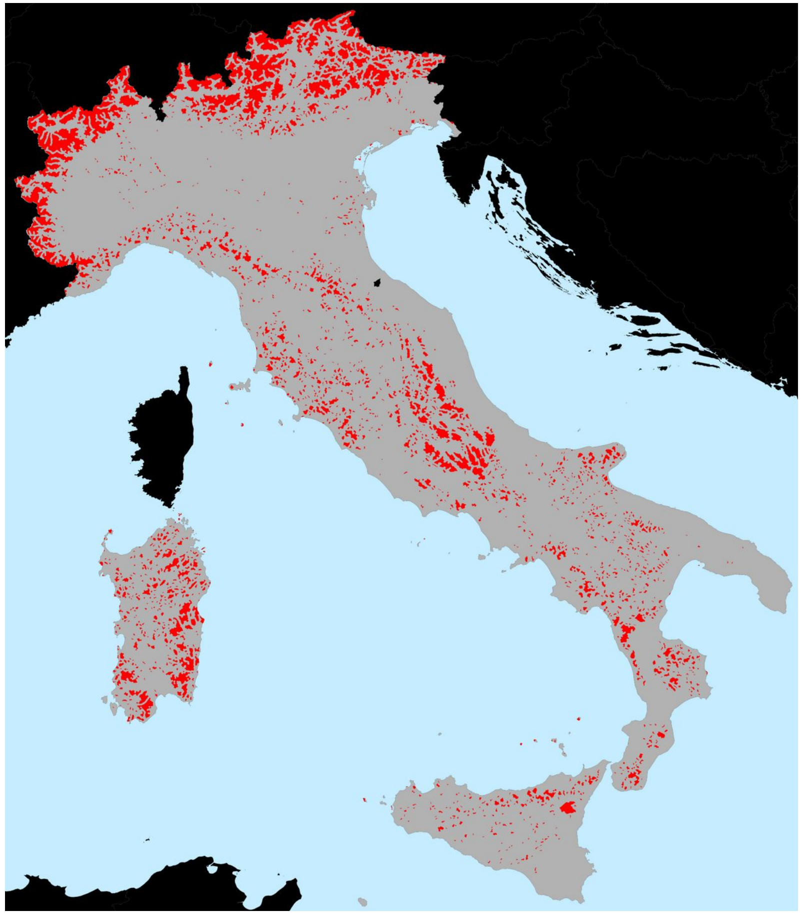


Roadless areas in the EU 27

- 42,000 areas (polygons)
- 736,000 km^2 (17% of the EU)
  - 74% < 10 km^2
  - 23% 10-100 km^2
  - 2% 100-1,000 km^2
  - 39 areas 1,000-10,000 km^2
  - 2 areas > 10,000 km^2

Roadless area in Italy

- 2,250 areas (polygons)
- 34,700 km^2 (11% of Italy)
  - 78% < 10 km^2
  - 19% 10-100 km^2
  - 3% 100-1,000 km^2
  - 2 areas 1,000-10,000 km^2
  - 0 areas > 10,000 km^2



Protecting biodiversity treasures

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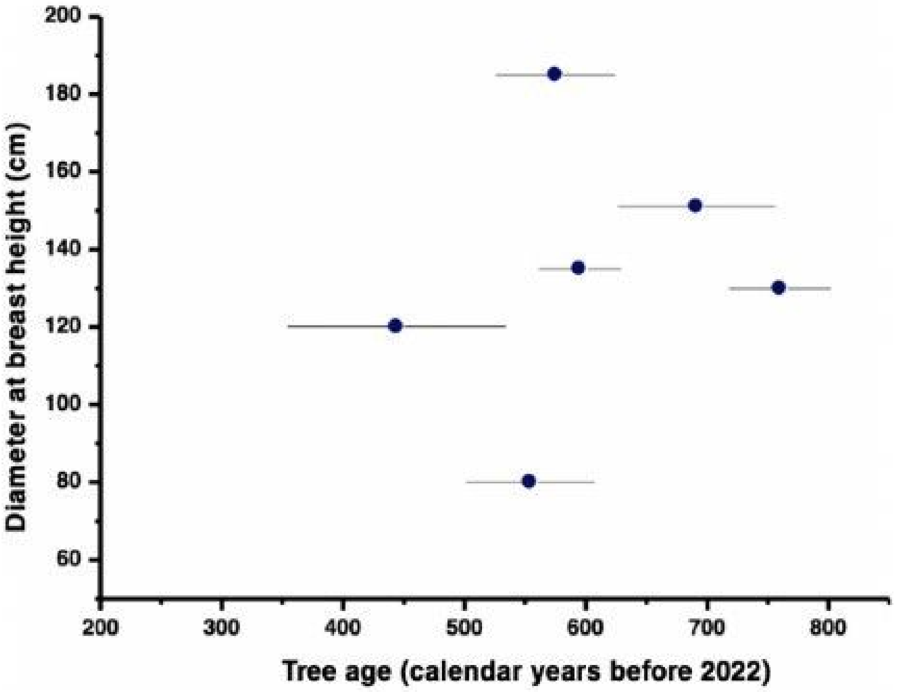
DOI: 10.1002/ecy.4064

THE SCIENTIFIC NATURALIST

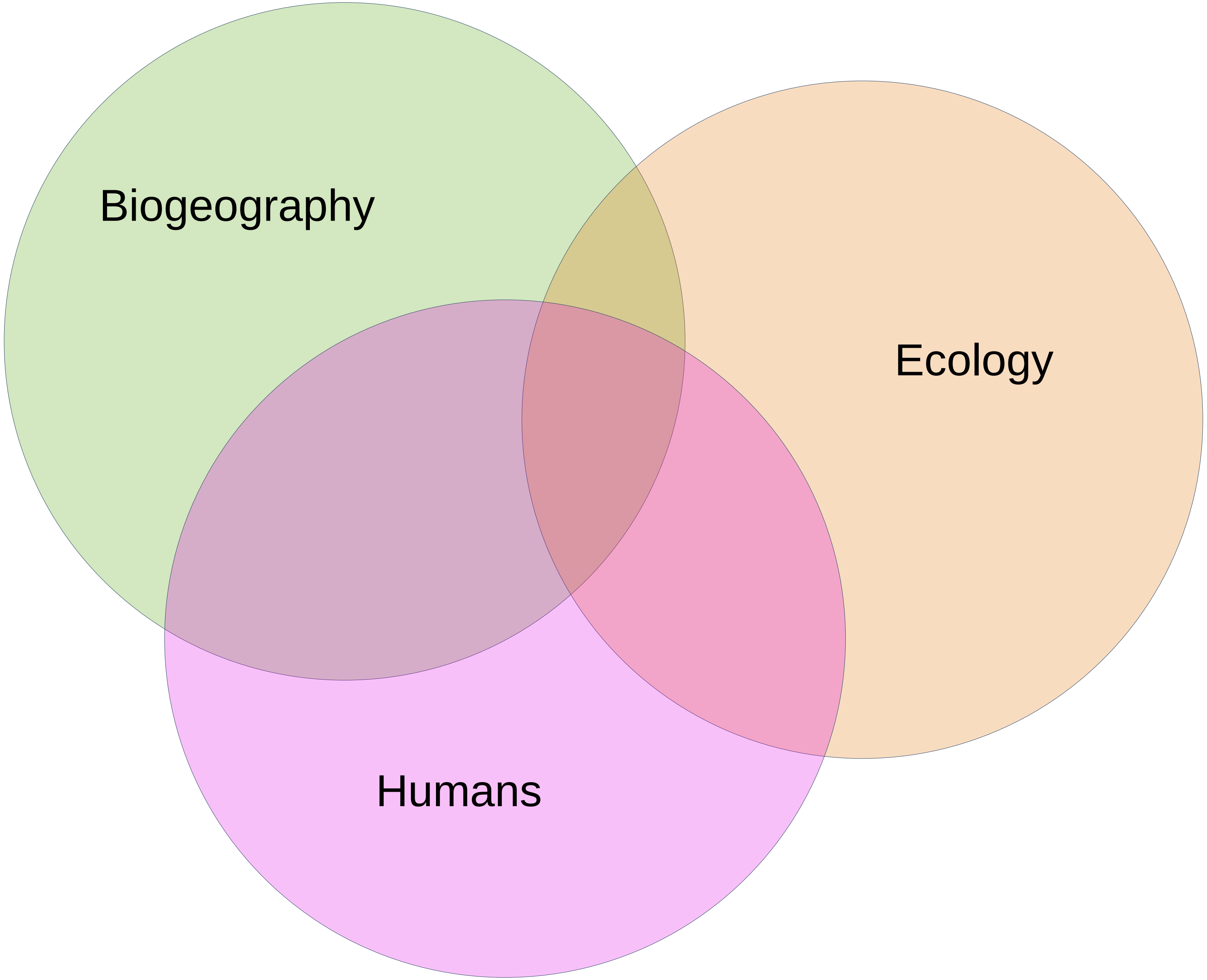
ECOLOGY

Rediscovering Montecristo's treasure: The island's holm oaks reveal exceptional longevity

Goffredo Filibeck[1] | Michele Baliva[2] | Lucio Calcagnile[3] | Alessandro Chiarucci[4] | Marisa D'Elia[3] | Gianluca Quarta[3] | Giovanni Quilghini[5] | Gianluca Piovesan[2]



Outlook



LifeWatch ITALY

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