Consiglio Nazionale delle Ricerche









Monitoring functional characterization and traceability of resilient basic propagation material for ecosystem restoration and nature-based solutions;

"from seed source to seedlings"

Negar Rezaie*_ On behalf of the working group 4.5.2 CNR IRET, Firenze





The EU Nature Restoration Law

Restoring ecosystems for people, nature and the climate

Europear Union

The key element of the <u>EU Biodiversity Strategy</u>, which sets binding targets to restore degraded ecosystems, in particular those with the most potential to capture and store carbon (*carbon rich habitat*) and to prevent and reduce the impact of natural disasters.

2024/1991

NATIONAL BIODIVERSITY

FUTURE CENTER

REGULATION (EU) 2024/1991 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 24 June 2024

European Commission

on nature restoration and amending Regulation (EU) 2022/869

Article 12

Restoration of forest ecosystems

1. Member States shall put in place the restoration measures necessary to enhance biodiversity of forest ecosystems, in addition to the areas that are subject to restoration measures pursuant to Article 4(1), (4) and (7), while taking into account the risks of forest fires.

2. Member States shall achieve an increasing trend at national level of the common forest bird index, as further specified in Annex VI, measured in the period from 18 August 2024 until 31 December 2030, and every six years thereafter, until the satisfactory levels as set in accordance with Article 14(5) are reached.

3. Member States shall achieve an increasing trend at national level of at least six out of seven of the following indicators for forest ecosystems, as further specified in Annex VI, chosen on the basis of their ability to demonstrate the enhancement of biodiversity of forest ecosystems within the Member State concerned. The trend shall be measured in the period from 18 August 2024 until 31 December 2030, and every six years thereafter, until the satisfactory levels as set in accordance with Article 14(5) are reached:

- (a) standing deadwood;
- (b) lying deadwood;
- (c) share of forests with uneven-aged structure;
- (d) forest connectivity;
- (e) stock of organic carbon;
- (f) share of forests dominated by native tree species;
- (g) tree species diversity.
- 4. The non-fulfilment of the obligations set out in paragraphs 2 and 3 is justified if caused by:
- (a) large-scale force majeure, including natural disasters, in particular unplanned and uncontrolled wildfire; or
- (b) unavoidable habitat transformations which are directly caused by climate change.

Article 13

Planting three billion additional trees

1. When identifying and implementing the restoration measures to fulfil the objectives and obligations set out in Articles 4 and 8 to 12, Member States shall aim to contribute to the commitment of planting at least three billion additional trees by 2030 at Union level.

2. Member States shall ensure that their contribution to fulfilling the commitment set out in paragraph 1 is achieved in full respect of ecological principles, including by ensuring species diversity and age-structure diversity, prioritising native tree species except for, in very specific cases and conditions, non-native species adapted to the local soil, climatic and ecological context and habitat conditions that play a role in fostering increased resilience to climate change. The measures to achieve that commitment shall aim to increase ecological connectivity and be based on sustainable afforestation, reforestation and tree planting and the increase of urban green space.

2024/1991

REGULATION (EU) 2024/1991 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 24 June 2024

on nature restoration and amending Regulation (EU) 2022/869



Article 8

Restoration of urban ecosystems

1. By 31 December 2030, Member States shall ensure that there is no net loss in the total national area of urban green space and of urban tree canopy cover in urban ecosystem areas, determined in accordance with Article 14(4), compared to 2024. For the purposes of this paragraph, Member States may exclude from those total national areas the urban ecosystem areas in which the share of urban green space in the urban centres and urban clusters exceeds 45 % and the share of urban tree canopy cover exceeds 10 %.

2. From 1 January 2031, Member States shall achieve an increasing trend in the total national area of urban green space, including through the integration of urban green space into buildings and infrastructure, in urban ecosystem areas, determined in accordance with Article 14(4), measured every six years from 1 January 2031, until a satisfactory level as set in accordance with Article 14(5) is reached.

3. Member States shall achieve, in each urban ecosystem area, determined in accordance with Article 14(4), an increasing trend of urban tree canopy cover, measured every six years from 1 January 2031, until the satisfactory level identified as set in accordance with Article 14(5) is reached.

Which genotypes, species and habitats?

Task 4.5.2 – Monitoring, functional characterization and traceability of resilient forest reproductive material aimed at the reforestation of forest sites subject to extreme events;

CNR-IRET, Firenze, Porano, Montelibretti; CNR-IBBR, Firenze; Università Pavia; Università Firenze-DAGRI; Carabinieri Forestali- CNCB; Veneto Agricoltura; Università della Tuscia, DIBAF

- i. Identification of populations resistant to biotic stresses: *Norway spruce*
- ii. Identification of drought-resistant and resilient populations for natural (*Silver fir*) and urban (*Sycamore* and *Quercus robur*) ecosystem restorations
- iii. Seed priming and seed quality



Local is the best?

Natural distribution of European spruce and bark beetle diffusion

Regeneration of Norway spruce, Lago Verde

- National Park of Parco Appennino Tosco Emiliano

EUFORGEN: European Foret Genetic Resources Programme

Negar Rezaie¹, Ettore D'Andrea², Andrea Piotti³, Camilla Avanzi, Gabriele Cencetti³, Marco Michelozzi⁴, Maurizio Sarti², Emanuele Pallozzi⁴, Alessio Giovannelli¹

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European spruce bark beetle

Study sites





Remote Sensing analysis

• Maps of temporal bark beetle outbreaks

Validation



Field monitoring

- Forest structure assessment
- Terrestrial survey of bark beetles; epidemic/endemic



BVOCs analysis

- Field samples collectionPhloem and xylem sample
- Volatile organic compound GC/MS analysis



Autochthonous

Alpine plantations



Lago Verde _29.09.2023



Campolino _03.10.2023

<u>Aim of study</u>: Verify whether southern spruce provenances could be used for *genetic improvement* for creating less susceptible genotypes to bark beetles.

Genetic control of BVOCs composition













Seedlings Productivity

• Biometric measurements of seedlings length, apical shoot increment and total biomass dry matter





linkages of physiological traits associated with genetic parameters

Correlations between Ne and Biomass Components



genetic parameters

							1 million 1	1 C 3 C 4
Popula tion	N. Samples	Nc	Ne	Ne/Nc	H _E	Ar96	F _{IS}	
OS	48	80	15	0.1875	0.314	2.857	0.068	1
LV	50	500	402	0.8040	0.377	3.277	0.025	
VN	61	61	12	0.1967	0.381	2.537	0.117	2
LN	50	900	922	1.0244	0.407	3.485	-0.030)
						1		

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Ne= Effective Population Size , represents the conservation parameter par excellence for monitoring the relationship between demography and genetic diversity of populations.

Ne/Nc= Percentage of the reproductively active population





Ventasso

La Nuda

Adaptation or recovery?

Seedling physiological response to drought stress





Urban forests, provenance matters: Investigating its influence on growth and physiological responses to drought in *Quercus robur* and *Acer pseudoplatanus*

Università Firenze-DAGRI, CnrIret-Firenze, CnrIret-Pisa



- Assess the growth, physiology and phenology, during the entire growing season, of northern, central and southern Italian provenances of two species widely used in urban contexts across Europe, Q. robur (five provenances) and A. pseudoplatanus (four provenances]);
- test if the provenance influences the physiological response to water stress and subsequent rewatering.

Improving seed processing protocols for forest species



UNIVERSITÀ Improved germination: seed priming NATIONAL BIODIVERSITY FUTURE CENTER **DI PAVIA** Phase 111 Phase 1 Phose 11 SEED MOLECULAR PHYSIOLOGY LAB Imbibitio 11 111 Controlled Water Updat Drying Im bibiti **Populus alba spp** In the Factory In the Field 30 (H An optimized seed treatment able to improve germination of long-20 80 term stored P. alba var. 'Villafranca' seeds has been developed. 50 10 \bigstar 100 μ M spermidine applied as seed soaking for 4 h: G % was 501M 1001M 500 doubled, germination speed improved 60 ৰ্জ G (%) Hydropriming (HP) treatments were due to rapid water loss during the dry-back step 40 > The positive effect of the Spd treatment can be attributed to lower ROS production > Dry seeds show consistent transcript levels for genes involved in 20 DT acquisition, PA biosynthesis, and antioxidant defense in dry 0

UT

50µM-Spd

w

100µM-Spd

seeds

Strategies For Improving Seed Quality

¹Prof. Alma Balestrazzi, ²Alessio Giovannelli

Germination test

AA-0d





- UT (untreated control seeds).
- HP (hydroprimed seeds): 12 h imbibition in dH_2O , followed by overnight (24 h) air drying.
- AA (artificially aged seeds): 24 h at 58 °C.

• Positron Emission Tomography (PET)



NEUR

ΠED

NEUROLOGICO

Comparison among the three treatments. CT (top series) and PET (bottom series)



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Prospective of Task 4.5.2

Herbaceous Table

- The tractability of local herbaceous species (seeds and pot plants) in Italy and their fundamental role in ecosystem restoration and NbS with tree species.
- Lack of a certified nursery supply chain.

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ECOphys LAB Gianluca D'Onofrio

Thank you



SEED MOLECULAR PHYSIOLOGY LAB





May 2026

National Research Council Rome CNR Isafom, CNR IBE, CNR IBBR, (CNR IRET???)

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CNR IBBR





Le piante più rare delle riserve naturali gestite dai Carabinieri forestali vengono studiate e riprodotte nei laboratori del Centro, dove rarità nascoste negli ecosistemi più fragili sono custodite come preziosi tesori della biodiversità.

Institute of Biosciences and Bioresources

Nel grande vivaio forestale si trovano piantine autoctone di provenienza certificata, per opere di rimboschimento ed ingegneria naturalistica.



