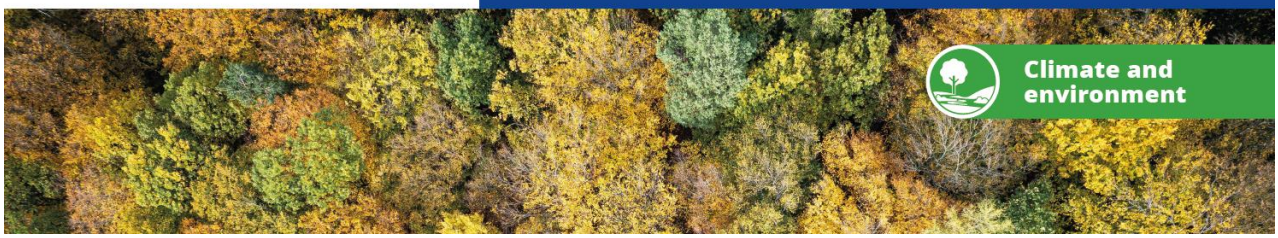
Interreg North-West Europe
Co-funded by the European Union
MigFoRest

Implementing assisted migration to increase forest resilience in North-West Europe.



MigFoRest

Work package 3

A.3.1 Sharing of experience and knowledge between forest owners/managers and nurserymen from the N and S of Europe

D.3.1.2 Report from study visit to Tuscany, Italy

October 7-8, 2026

Version	Date	Created or modified by
V1	19/10/2026	OFS
V2	20/10/2026	MLT
V3	18/11/2026	DiD

1. Program of the 2-days study visit

The study visit to Tuscany, Italy, was organised by the MigFoRest project, which aims to support forest adaptation to climate change through assisted migration and improved knowledge exchange across Europe.

The MigFoRest partners invited key stakeholders of the forest sector, namely forest policy makers, forest managers (public and private), nurserymen and researchers in forest genetics, to learn from the experience of their peers from the South-East.

Italy offers a particularly relevant case study for MigFoRest due to its exceptional diversity of forest ecosystems and environmental conditions. Stretching from the Alpine region to the Mediterranean basin, the country encompasses a wide range of climatic gradients, elevations and ecological zones. These conditions make Italy a valuable reference area for understanding how tree species and forest reproductive material may perform under the warmer and, in some regions, drier climates that are increasingly expected in north-western Europe. Italy is also of special interest for MigFoRest because it serves as a source region for several of the species and provenances included in the project, making it an important partner in discussions on seed sourcing, assisted migration and climate-adapted reforestation.

Date	**Time**	**Activity**
6 October	Evening	Arrival of participants
7 October	09:00 - 12:00	Meeting at the **CREA Forestry and Wood Research Centre**, Arezzo, Italy. Introduction to the mission and objectives of CREA, followed by presentations on forest genetics (genotyping applied to chestnut and Douglas fir) and poplar breeding.
	13:00	Lunch
	14:00	Bus transfer to the Vallombrosa Forest Presentation and update on the MigFoRest project during the bus ride.
	15:00 –18:00	Guided visit of the **Vallombrosa Experimental Forest**. Discovery of historic stands of conifers in the arboretum. Presentation of the history and experimental management of the forest, by the *Carabineri forestali*.
	19:30	Group dinner in Poppi
8 October	09:00 - 12:00	Departure from Poppi to visit the **Casentino Forest National Park**, on the Apennine slopes. Presentation of the Abies Project and ongoing genetic research on several *Quercus* species.
	12:30	Lunch
	14:00 - 17:00	Presentation on the forest management of the National Park. Concluding discussion and exchange with National Park manager.

2. Participants

The group included 21 participants from Belgium, France and Germany.

Name	Function
Silvija Bilela-Eckert	FVA project member
Aurélien Blond	Neosylva project member
Annelore de Ro	INBO project member
Diane Doucet	SRFB project member
Olivier Fabes	SRFB project member
Nicola Fischer	FVA project member
Maxime Lambinet	SRFB project member
Maxime Lantin	CRA-W project member
Guy Ledant	Forest owner in Wallonia
Samuel Lemonnier	Nurseryman (Pépinières Lemonnier)
David Mathy	CRA-W project member
Caroline Mouton	INBO project member
Charalambos Neophytou	FVA project member
May Prate	Forest owner in France, member of CETEF
Bénédicte Reyntiens	Forest owner in Wallonia
Ramon Reyntiens	Forest owner in Wallonia
Dominique Servatius	Forest owner in Wallonia
An Vanden Broeck	INBO project member
Willy Verbeke	Public forest manager (Koninklijke Schenking & Arboretum Tervuren)
Hanne Vermeiren	Policy Implementation Advisor, Dpt of Agriculture and Fisheries for Flanders
Johan Verswijvel	CRA-W project member

Special thanks to Willy Verbeke, for contributing to this report.

One interpreter, translating from English to French, was present to ensure a full translation of the explanations for the visitors who were not speaking English.

3. Our hosts

The program was coordinated in collaboration with two Italian forest researchers, who were also respectively our guides for the visits on Day 1 and Day 2:

- **Day 1, at CREA Arezzo office and in Vallombrosa Forest**

Giovanbattista De Dato is senior research scientist, working at the Forest Genetic Resources Laboratory of the CREA (Council for Agricultural Research and Agricultural Economics Analysis), Forestry and Wood Research Centre. He introduced us to the mission and activities of the CREA and was our guide for the whole day.

https://www.crea.gov.it/en/web/foreste-e-legno/-/giovanbattista-de-dato

In the CREA Arezzo offices, we also met **Angela Teani** and **Chiara Biselli**, who respectively shared presentations on KASP-based SNP genotyping and poplar breeding.

In the afternoon, the visit of the Vallombrosa arboretum et parts of the historical forest was led by **Jessica Ferrarini**, from the *Carabinieri Forestale*.

- **Day 2, in the Casentinesi Forests National Park**

Andrea Piotti is senior researcher at the Institute of Biosciences and Bioresources (IBBR), which is part of the National Research Council (CNR), Florence.

He was our guide for Day 2.

https://sites.google.com/site/andreapiotti/home

In the Casentinesi Forests National Park, Andrea Piotti was accompanied by colleague researcher **Maria Beatrice Castellani**, also from the Institute of Biosciences and Bioresources (IBBR) of the Italian National Research Council (CNR) in Sesto Fiorentino, Italy. They presented the results of a study on the genetics of *Abies alba* in Italy.

More generally, their research focuses on forest genetics, conservation genomics, gene flow and dispersal in forest trees, and the evolutionary dynamics of marginal and fragmented populations, with particular emphasis on Mediterranean forest ecosystems. Their most recent studies have addressed topics including genomic signatures of adaptation and maladaptation, conservation of endangered and marginal populations, evolutionary legacies of plantations, climate-adaptive forest restoration, the impact of nursery practices on the genetic diversity of forest reproductive material, and the development of advanced genomic tools for forest genetic conservation, with the aim of establishing evidence-based strategies for conserving forest genetic resources.

In the afternoon, the Forest Management in the Casentinesi Forests National Park was presented to us by **Alessandro Fani**, in charge of the planning and management of the national park.



Figure 1 – The group of participants to the Italian study trip

Presentation on MigFoRest's project and progress

During the bus drive to Vallombrosa forest, we introduced the MigFoRest project and its objectives to the few participants who had hardly heard of it yet. We also gave an update on our realisations.

- Objectives
- Pilot territories
- Risks and opportunities
- Species and provenances
- Planting methods

We also gave an update on our done and planned plantings, zooming on each of the 7 pilot territories in

- Flanders
- Northern France
- Baden-Württemberg
- Wallonia

The slides of the presentation are available here.

Introduction : Climate, Forest Cover and Forest Soils of Tuscany

The good vitality of the trees in the higher parts of Tuscany was striking, which can be explained by the precipitation, which is not lower than in Belgium. It can even be said that a very large part of the Tuscan forests receives more precipitation than the forests in Flanders.

The arboretum of Vallombrosa is located at an altitude of 800m with a precipitation of 800 to 1200mm. The situation is therefore more similar to that in the High Ardennes. The highest peak is Monte Amiata (1738m).

Few areas in the world have been so strongly influenced by dense human habitation as Tuscany. For example, before classical Roman times there was already the highly developed Etruscan culture, so we can safely say that the forests of Tuscany have been managed by humans in one way or another for many thousands of years. Sweet chestnut-*Castanea sativa* has been a staple food in some regions throughout history and the production of the edible seeds of umbrella pine-*Pinus pinea* was also important in the past (now replaced by imports from China).

Climate

Tuscany, located in central Italy between the Tyrrhenian Sea and the Apennine Mountains, experiences a predominantly Mediterranean climate, with significant local variations driven by elevation, topography and distance from the coast.

Coastal areas, including the Maremma and the Tyrrhenian shoreline, have mild and relatively wet winters, while summers are hot, dry and sunny. Inland valleys and plains, such as those around Florence, Siena and Arezzo, are more continental, with colder winters, occasional frost events and hotter summer temperatures. In the Apennines, temperatures decrease with altitude, precipitation increases substantially and snowfall is common during winter at higher elevations.

Annual rainfall ranges from less than 500 mm in the southern coastal areas to over 1,200 mm in the north-western foothills of the Apennines. Autumn is generally the wettest season, while summer droughts are frequent and have become increasingly severe in recent decades due to climate change.

Forest Cover and Main Forest Types

Forests cover approximately half of Tuscany's land surface, making it one of the most heavily forested regions of Italy. The present forest landscape is the result of centuries of human management combined with natural forest expansion following agricultural abandonment during the twentieth century.

1-Mediterranean Coastal Forests

Along the coast and in the low-elevation Mediterranean zone, forests are dominated by holm oak (*Quercus ilex*) woodlands and evergreen Mediterranean scrub (maquis). These forests typically develop on shallow, rocky calcareous soils, sandy coastal deposits or drought-prone substrates.

Associated species include:

- Strawberry tree (*Arbutus unedo*)
- Tree heath (*Erica arborea*)
- Lentisk (*Pistacia lentiscus*)
- Myrtle (*Myrtus communis*)
- Aleppo pine (*Pinus halepensis*)
- Stone pine (*Pinus pinea*)

These ecosystems are highly adapted to summer drought and recurrent wildfires. Their primary functions are biodiversity conservation, landscape protection, erosion control and recreation, while timber production remains limited.

2-Hill Forests of Central Tuscany

The hilly landscapes of central Tuscany, including the Chianti, Val d'Orcia and surrounding areas between 200 and 800 m elevation, are mainly occupied by deciduous oak forests.

The dominant species are:

- Downy oak (*Quercus pubescens*)
- Turkey oak (*Quercus cerris*)
- Sessile oak (*Quercus petraea*) in cooler sites
- Chestnut (*Castanea sativa*) on acidic soils

These forests generally occur on limestone, marl and schist-derived soils, notably the well-known Alberese (calcareous marl) and Galestro (schistous clay) formations.

Historically, many of these stands were managed as coppice forests to supply:

- Firewood and charcoal
- Small-diameter timber
- Vineyard stakes
- Rural construction materials

Today, firewood and biomass production remain important, although conversion toward high forests is increasingly promoted for biodiversity and carbon sequestration purposes.

3-Chestnut Forests

Extensive chestnut forests occur on acidic and relatively deep soils in the foothills of the Apennines, typically between 500 and 1,000 m elevation.

For centuries, chestnut groves played a crucial socio-economic role and were often referred to as the "bread tree" because chestnut flour was a staple food for mountain populations.

Current uses include:

- Production of chestnuts and chestnut flour
- High-value durable timber
- Firewood
- Recreation and tourism

4-Mountain Beech Forests

At elevations generally above 800-1,000 m in the Apennines, beech (*Fagus sylvatica*) becomes the dominant species.

These forests develop under cooler and wetter climatic conditions on deep, well-developed mountain soils with high organic matter content.

Beech forests represent some of the most natural forest ecosystems in Tuscany and provide:

- High biodiversity value
- Watershed protection
- Carbon storage
- Quality hardwood timber production

Many of these forests are included in protected areas and Natura 2000 sites.

5-Conifer Plantations

Throughout the twentieth century, large-scale afforestation programs established conifer stands, particularly on degraded lands and erosion-prone slopes.

Common species include:

- Black pine (*Pinus nigra*)
- Maritime pine (*Pinus pinaster*)
- Douglas fir (*Pseudotsuga menziesii*)
- Cypress (*Cupressus sempervirens*) locally

These plantations were primarily established for:

- Soil stabilization
- Watershed restoration
- Slope protection
- Timber production

Some of them are now progressively converted into mixed broadleaved forests to enhance resilience to drought, storms and pests.

Forest Soils

Tuscany exhibits remarkable soil diversity linked to its complex geological history.

- Calcareous soils, widespread across central Tuscany, are generally well-drained and moderately fertile. They support thermophilous oak forests and Mediterranean woodland communities.
- Marl and schist soils, derived from Alberese and Galestro formations, are common in the Tuscan hills. These soils provide good mineral availability and drainage, favouring mixed oak and chestnut stands.
- Clay soils, particularly in the Crete Senesi, possess high water-holding capacity but can become extremely dry and cracked during summer. Forest cover is generally less extensive on these landscapes.
- Volcanic soils, notably around Monte Amiata, are deep and nutrient-rich, supporting highly productive broadleaved forests, including chestnut and beech stands.
- Alluvial soils in river valleys such as the Arno and Ombrone are fertile and productive, supporting poplar plantations, riparian forests and agricultural land.

Main Forest Products

Tuscan forests provide a broad range of ecosystem services and forest products:

- Firewood remains the largest forest product by volume.
- Chestnut timber is valued for its natural durability in outdoor applications.
- Oak timber is used for furniture, flooring and construction.
- Douglas-fir plantations provide structural timber.
- Cork, mushrooms, truffles and chestnuts contribute to local economies.
- Forests play a key role in water regulation, soil conservation, carbon sequestration and tourism.

Day 1

Site 1: presentations at CREA

1-Presentation of the CREA activities by Giovanbattisata de Dato

The Research Centre for Forestry and Wood (CREA Forestry and Wood) is one of the 12 research centres of CREA, Italy's leading public research organization dedicated to agriculture, food systems, forestry and rural development. Operating under the supervision of the Italian Ministry of Agriculture, Food Sovereignty and Forests, CREA combines scientific autonomy with a strong commitment to innovation and sustainability. With more than 1,500 researchers and technicians, nearly 300 active projects and 86 experimental farms, it is a key player in Italian agri-food and forestry research. The CREA has been in contact with Belgian researchers for a long time, including on poplar.

CREA Forestry and Wood focuses on forests, trees and wood resources. Its mission is to support sustainable forest management, conserve biodiversity, improve forest tree genetics and enhance the value of wood and non-wood forest products. Through its activities, the centre addresses major challenges such as climate change, biodiversity loss and the development of resilient forest-based value chains. The centre operates through a network of research facilities located across Italy, including Arezzo, Trento, Casale Monferrato, Rome, Rende and San Pietro Avellana. These sites provide expertise in areas such as forest genetics, silviculture, geomatics, forest planning, biometrics, biodiversity conservation and wood quality, enabling research across a wide range of forest ecosystems.

Research activities are organized around six main themes: forest genetics and biodiversity conservation, ecosystem monitoring, sustainable forest management, wood arboriculture, poplar cultivation and precision forestry. Projects range from breeding climate-resilient tree species and restoring ecosystems to applying advanced technologies such as remote sensing, LiDAR and GIS for forest monitoring and management.

A major strength of the centre lies in its extensive research infrastructure. CREA manages 645 permanent research plots and 223 experimental protocols covering 38 research themes. These long-term networks provide valuable information on forest growth, ecosystem functioning, carbon dynamics, genetic diversity and responses to environmental change.

Particular attention is given to forest genetic resources through germplasm conservation, genetic characterization, phenological monitoring and breeding programmes. Research focuses on species such as sweet chestnut, stone pine and Douglas fir, as well as valuable hardwoods including walnut, cherry and oak. Modern molecular techniques support the identification and selection of high-quality genetic material.

An important example is the conservation programme for *Abies nebrodensis*, a critically endangered Sicilian fir. Through assisted migration and ex situ conservation measures implemented since the 1990s, CREA has helped preserve the species' genetic diversity and improve its long-term survival prospects.



20 years old specimen of *Abies nebrodensis*, the main characteristic to distinguish it from *A. alba* lies in the shape of the needle inferior surface

Beyond research, CREA Forestry and Wood contributes to international initiatives such as FAO, EUFORGEN and ICP Forests, while providing scientific support, training and knowledge transfer to public institutions and forestry stakeholders. Overall, the centre plays a major role in advancing sustainable forestry, biodiversity conservation and climate adaptation in Italy and beyond.

The presentation is available in Annex I.

2- KASP-based SNP genotyping as a tool for forest genetic resources: two applications compared by Angelas Teani

The presentation demonstrates how *Kompetitive Allele-Specific PCR* (KASP) technology can serve as a versatile and cost-effective tool for the management, conservation, and improvement of forest genetic resources.

KASP genotyping relies on the analysis of *Single Nucleotide Polymorphisms* (SNPs), which are stable and highly transferable genetic markers. The workflow involves DNA collection from plant material, DNA extraction, KASP genotyping assays, and automated genotype calling. This standardized pipeline enables the generation of reliable molecular data that can be used for a wide variety of forestry applications.

The presentation compares two distinct case studies illustrating the flexibility of the approach. The first focuses on sweet chestnut (*Castanea sativa*), where KASP genotyping is used for varietal identification, conservation, and traceability purposes. Working on a large clonal collection containing cultivars, provenances, and unidentified accessions, researchers developed a two-stage strategy combining a reduced 15-SNP panel and a more detailed 38-SNP panel. This approach allows the identification of unique genetic profiles, the detection of synonymies and homonymies among varieties, and the characterization of previously unknown material. The resulting genetic database supports the conservation and valorization of traditional chestnut resources (less disease susceptible) while facilitating certification and traceability systems.

The second case study concerns Douglas fir (*Pseudotsuga menziesii*) and demonstrates the use of KASP markers for marker-assisted selection in breeding programs. Building on previous genomic resources, researchers identified candidate genes associated with growth traits and screened a set of SNPs across multiple provenances. By combining genotypic information with phenotypic measurements such as tree height and diameter, they identified informative markers significantly associated with growth performance. These markers provide the basis for developing selection indices that can accelerate the identification of superior reproductive material and improve the efficiency of reforestation programs. A seed orchard was established using *Pseudotsuga menziesii* var. menziesii from the southern coastal range. This provenance was selected following observations that *P. menziesii* var. glauca, although generally better adapted across much of Italy, performed poorly at the Vallombrosa site.

Future work includes large-scale validation of the selected markers, functional genomic analyses, and the expansion of SNP panels to better explain phenotypic variation.

Overall, a single KASP platform can address both conservation and breeding objectives. In sweet chestnut, the technology enhances agrobiodiversity conservation, varietal authentication, and germplasm management. In Douglas fir, it supports genetic improvement through early selection of high-performing material. The comparison demonstrates the adaptability of SNP-based approaches across species and objectives, while emphasizing future opportunities for integrating standardized marker systems into international databases and forest genetic resource management frameworks.

The presentation is available in Annex II.

3-Genetics, Genomics and Biotechnology of Poplar by Chiara Biselli

Poplar breeding at CREA is based on long-established breeding programmes involving several *Populus* species, including *P. deltoides*, *P. nigra* and their hybrids. These activities have resulted in the registration and commercialization of nine *P. × canadensis* clones currently available in Italy and across Europe. The breeding programme focuses on key traits such as growth performance, rooting ability, disease resistance and adaptation to environmental constraints.

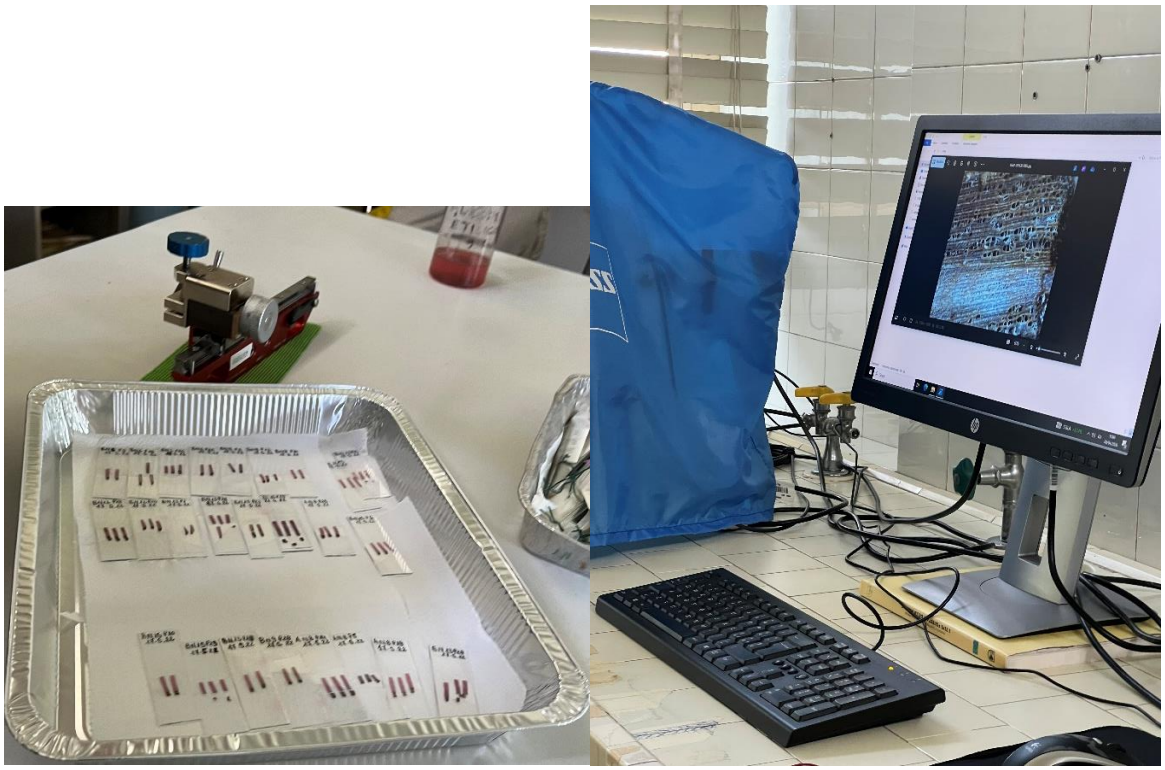
A major focus of the research is resistance to the woolly poplar aphid (*Phloeomyzus passerinii*), a highly damaging pest capable of reducing wood production by up to 12%. The insect affects bark tissues, disrupts water and nutrient transport and can severely compromise plantation productivity. To address this challenge, CREA has developed molecular approaches combining quantitative trait loci (QTL) mapping, genome-wide association studies (GWAS) and genomic prediction. Research was conducted on two segregating populations and large collections of *P. nigra* and *P. deltoides*, genotyped using the high-density 4TREE array containing more than 13,000 poplar-specific markers. These studies successfully identified genomic regions associated with resistance and demonstrated the potential of genomic prediction models for selecting resistant genotypes at an early stage.

The research includes also ongoing work on rooting ability in *P. deltoides*, an important trait for vegetative propagation and plantation establishment. Root architecture and development traits were measured on hundreds of clones, while genomic analyses and sequencing are being used to support genomic prediction and accelerate selection.

Another important research area concerns the identification of alleles associated with drought tolerance and aphid resistance. Whole-genome sequencing of approximately 200 clones, combined with RNA sequencing and physiological measurements such as stomatal density and leaf wax content,

is being used to identify candidate genes and targets for future breeding and genome-editing applications.

The biotechnology component of the programme includes both genome editing and cisgenesis. Researchers are modifying genes involved in lignin biosynthesis to improve biomass quality and targeting genes related to cellulose production and plant architecture. Several edited and cisgenic lines have already been obtained and are currently undergoing molecular and phenotypic characterization.



On the left : prepared wood microscopic sections (after specific tissues dying) using a microtome (above the aluminium tray). On the right: the picture under microscope that can be taken to analyse the tissues.

Finally, a large common garden experiment comprising 400 *P. nigra* clones from CREA and INRAE germplasm collections has been presented. The experiment aims to evaluate phenotypic plasticity and genotype-by-environment interactions, with plans to extend testing to additional countries. Overall, the research program demonstrates how the integration of phenotyping, genetic mapping and genomic prediction is contributing to the development of a high-resolution poplar genetic system capable of supporting future breeding efforts, forest productivity and climate resilience. Cooperation with Belgium on poplar is done through Lieven De Veylder (UGent).

The presentation is available in Annex III.



Presentation of the microbiology laboratory by Chiara Biselli

Visit of the Arezzo greenhouses





On the left: discussion of Turkey oak-*Quercus cerris* between Giovanbattista de Dato (CREA) and participants from Germany. On the right, selection of stone pine -*Pinus pinea* clones from Tuscany for pest resistance selection. This pine is very important in Italy. This pine is grafted using a cleft grafting.

Site 2: Vallombrosa historical forest

In the afternoon, the group visited the Vallombrosa Experimental Forest and Arboreta, a site that occupies a unique place in the history of European forestry. Nestled in the Tuscan Apennines, Vallombrosa combines nearly a thousand years of forest stewardship with more than 150 years of scientific experimentation.



The story of Vallombrosa begins with the foundation of the Abbey of Vallombrosa in 1036. For centuries, the monks managed the surrounding forests, particularly the native silver fir (*Abies alba*).

One of Europe's oldest assisted migration experiments

A major turning point occurred after Italian unification. In 1870, the first Italian forestry school was established at Vallombrosa and, under the leadership of Adolfo de Bérenger, the site became the cradle of modern Italian silviculture. Often regarded as one of the founding fathers of forestry in Italy, de

Bérenger promoted a scientific approach to forest management based on experimentation, observation and long-term monitoring.

That same year, he founded the first section of what would become the Vallombrosa Arboreta, creating a living laboratory where students and researchers could compare tree species and provenances from different regions of the world.

Over the following decades, the arboretum expanded through a succession of new collections established by de Bérenger's successors. Today, the site comprises seven arboreta developed between 1870 and 1976, containing over 5,000 specimens representing more than 700 species of trees and shrubs. It remains Italy's most important scientific tree collection.

For the MigFoRest participants, the guided visit offered a fascinating perspective on what could be considered one of Europe's oldest assisted migration experiments. Long before climate change entered public debate, foresters at Vallombrosa were already testing species from North America, Asia and other parts of Europe under Tuscan conditions. Many of the questions they investigated remain at the heart of MigFoRest today: Which species can adapt to new environments? How important is provenance? Which genetic resources may prove valuable under future climatic conditions?



View on spectacular Douglas-firs in the Vallombrosa arboreti

Among the most impressive specimens observed during the visit were giant North American conifers, including coast redwoods (*Sequoia sempervirens*), Douglas-firs (*Pseudotsuga menziesii*), and the remarkable sugar pine (*Pinus lambertiana*). More than a century after their introduction, these trees continue to demonstrate the value of long-term experimentation and provide unique insights into species adaptation.



The remarkable sugar pine (Pinus lambertiana), said to be the biggest pine in Italy, with 5,93m of circumference and 51,5m of height (measured in 2023).

© https://www.gianttrees.org/it/alberi-giganti/nazareno

The paradox of Italian forestry

Our guide in the Vallombrosa arboreta, **Jessica Ferrarini**, from the *Carabinieri Forestale*, mentioned a broader challenge facing Italian forestry. While Italy possesses extensive forest resources and could produce high-quality timber locally, yet the country's wood-processing industry relies heavily on imported raw material, particularly from Central and Eastern Europe. This creates a striking paradox. While forests continue to expand and mature, a significant share of the timber transformed by Italy's world-renowned furniture and woodworking industries originates abroad. This paradox raises important questions about forest management, harvesting policies, rural development and the future role of forests in the national economy.



Restoration strategy in silver fir stands affected by windstorms

The visit to Vallombrosa was not limited to the historic arboreta. Nearby, participants also observed an example of how climate-related disturbances are reshaping forest management.

For centuries, Vallombrosa has been closely associated with **silver fir (*Abies alba*)**, a species actively promoted by the Vallombrosan monks and later by generations of foresters. Large, even-aged silver fir stands became one of the defining features of the landscape. However, severe windstorms, particularly those of 2013 and 2015, caused extensive damage to several stands, with around 50 hectares of forest heavily affected.

During the field visit, participants explored one of these former silver fir stands, where windthrow had completely altered the forest structure. The restoration strategy combines **natural regeneration** with the **planting of a wider range of tree species** to increase structural and biological diversity, including silver fir, Douglas fir (*Pseudotsuga menziesii*), Calabrian pine (*Pinus brutia* var. *calabrica*), beech (*Fagus sylvatica*), chestnut (*Castanea sativa*) and Turkey oak (*Quercus cerris*).

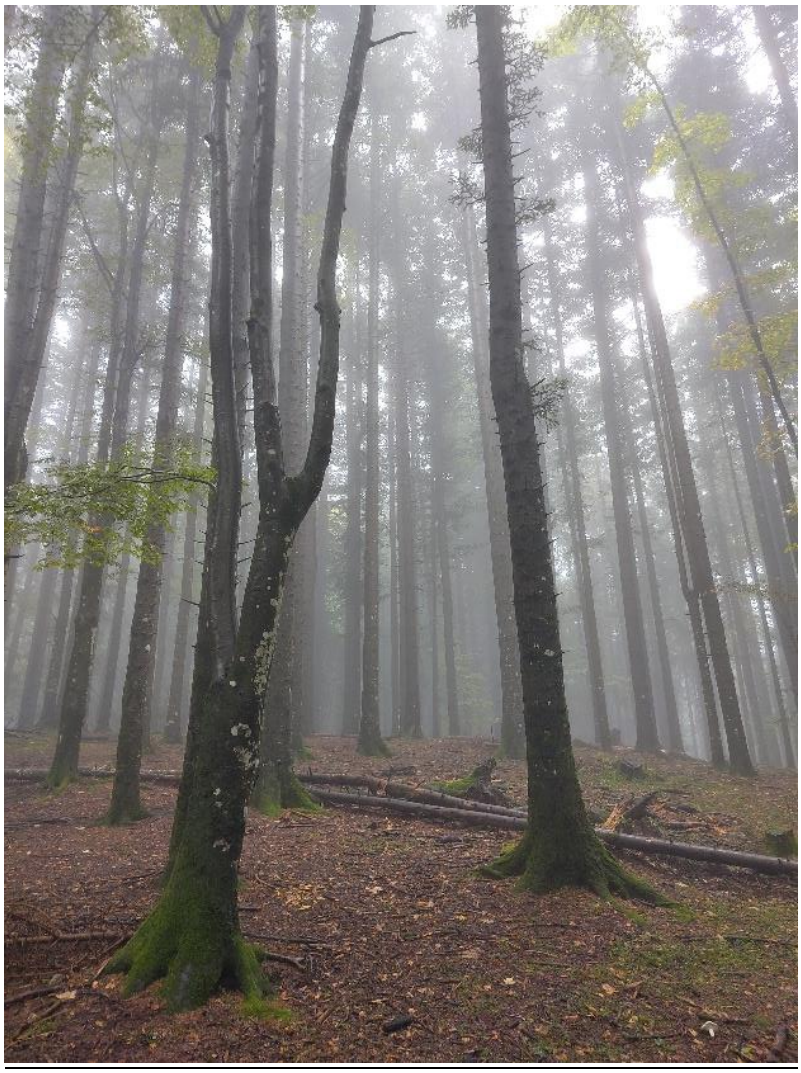


View on the restoration area, after damage due to windstorms

From a MigFoRest perspective, this restoration area is particularly instructive. It illustrates a key principle of climate adaptation: restoring a forest is not necessarily about recreating the past, but about preparing for the future. By combining local genetic resources with carefully selected species and provenances, managers are seeking to create forests that are more resilient under uncertain climatic conditions.

Site 3: Casentinesi Forests National Park

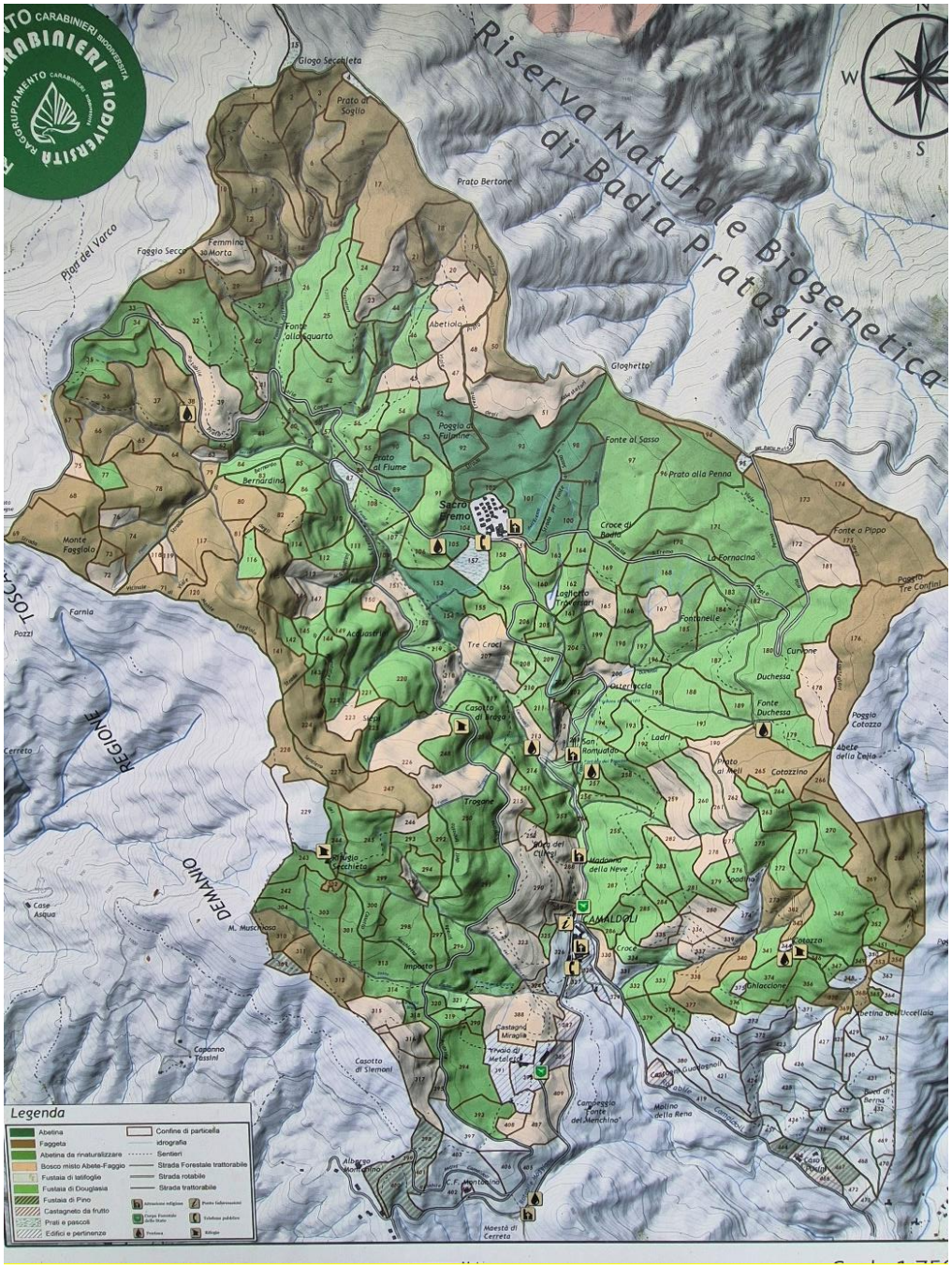
Already in the Middle Ages, the monks of the famous monastery of Camaldoli practiced forestry with fir *Abies alba*. The historic buildings of Florence are largely built with wood from *Abies alba* from this region. Now, however, almost no active forest management is carried out in the Casentino Forests National Park. The stocks of *Abies alba* are extremely dense with trees of 200 years old locally. The soil is clearly calcareous.



Very dense stock of *Abies alba* with few *Fagus sylvatica* and *Acer pseudoplatanus* in Camaldoli

The stock of *Abies alba* in Camaldoli is considered the best seed stock for forestry in the Apennines. However, genetic research revealed that the tradition was correct that seeds had also been brought in from Bohemia (Central Europe). Other forests with *Abies alba* in the Apennines are completely autochthonous.

The Casentinesi Forests National Park, covering 36.838 hectares and is composed by 88 % of forests, mainly broadleaved (65 % - beech, turkey oak, hornbeam, chestnut and pubescent oak). Coniferous species, covering about 15 % of the forest, are mainly silver fir and Austrian pine.

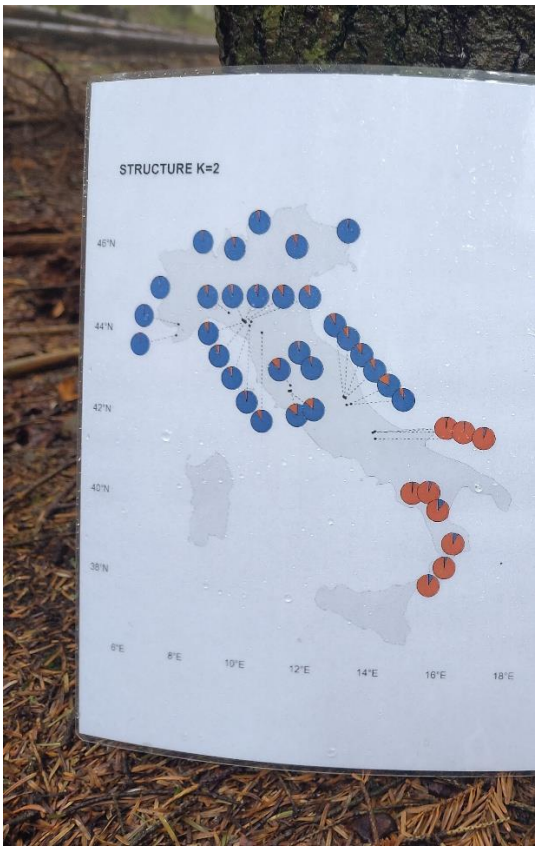


The park is characterized by a predominantly humid temperate climate, with significant rainfall. With 2/3 public ownership, the key management objectives are biodiversity conservation, research and tourism. Sylvicultural interventions are limited (ecosystem-based management with minimal intervention), wood production consists mainly of coppicing on privately owned land (local firewood market).

Recent research conducted by Maria Beatrice Catellani and Andrea on the genetics of Italian silver fir (the publication is available in Annex IV)

By characterizing a series of natural populations and plantation throughout Italy, they showed:

- The presence of two very distinct genetic groups (North and South), the first of which can be divide into three genetic clusters (Western Alps, Northern Appenines and Eastern Alps)



The Italian material of *Abies alba* can be distinguished into two distinct groups.

- Old plantations and not necessarily composed of local material. For instance, in the Tuscan-Emilian and Tuscan Romagnol Appenines, the genetic cluster identified as representative of the local material was dominant in most sampled plantations, indicating more localized seed sourcing and stronger continuity with natural populations. However, the recurrent detection and sometimes the prevalence of other genetic clusters in many plantations provide robust evidence that local seed sources were often integrated with multiple and geographically distant ones.
- Some plantations – which are sometimes designed as Genetic Conservation Units – are therefore not representative of the local genetics, which as an impact in terms of seed-sourcing (for genetic conservation of assisted migration purpose)
- These plantations can be viewed as early, unintentional events of assisted migration, allowing for the conservation of certain specific genetic features of natural populations. However, only a portion of the rare genetic variants detected in natural stands was also detected in plantations. This highlights the irreplaceable role of natural populations as long-term reservoirs of evolutionary potential, essential for adaptation of forests to climate change.

Another study on the same stands revealed differences in terms of resilience between different provenances, showing that local is not necessarily the most performant.



Maria Beatrice Catellani and Andrea Piotti presenting, under a continuous rain, the results of their final research on the historical translocations of silver fir in peninsular Italy: Implications for managing the genetic diversity of plantations (Castellani *et al*, 2027).

More information is available in Annex IV.

Forest Management in the Casentinesi Forests National Park by Alessandro Fani

At the headquarters of the Casentino Forests National Park in Pratovecchio, Alessandro Fani presented the key aspects of the park's management. Covering 36,843 ha, of which 88% is forested (65% broadleaved forests, 15% coniferous forests, and 8% mixed forests), the park encompasses some of the oldest forests in Europe (Parco Nazionale Foreste Casentinesi).

The ancient beech forests of the National Park, together with the Sasso Fratino Integral Nature Reserve, have been listed as a UNESCO World Heritage Site since 7 July 2017.

Part of the park is designated as an integral reserve, where natural processes are allowed to proceed without human intervention. The remaining areas are managed with the objective of maintaining and enhancing naturalness through protection measures, carefully targeted interventions, and the continuation of traditional educational, recreational, and agro-sylvo-pastoral activities that are compatible with the conservation of the park's highly natural character.

The primary objectives of park management are nature conservation, biodiversity enhancement, and the protection of old-growth stands. Forests are managed mainly for ecotourism, research, and ecological monitoring, rather than for timber production. Management practices focus on increasing

forest resilience, converting coppice stands into uneven-aged high forests, avoiding or minimizing clear-cutting, and promoting natural regeneration.

Climate change impacts are primarily observed through altered precipitation regimes and longer drought periods. *Quercus pubescens* and *Quercus cerris* exhibit good drought resistance, while *Q. cerris* is gradually expanding to higher elevations. *Quercus ilex* demonstrates a very high tolerance to drought stress.

The most widespread tree species are European beech (*Fagus sylvatica*) (>11,000 ha), Turkey oak (*Quercus cerris*) (>6,000 ha), European hornbeam (*Carpinus betulus*) (>4,000 ha), silver fir (*Abies alba*) (>2,000 ha), and black pine (*Pinus nigra*) (approximately 2,000 ha). Downy oak (*Quercus pubescens*) occupies only 564 ha.

Maple species, such as Italian maple (*Acer opalus*), are marginal within the park. These species remain poorly studied and are mainly conserved in isolated locations, for example where they have traditionally been retained as shade trees for livestock.

A population of more than 100 wolves is present within the park. While wolves generally regulate their population naturally within forested areas, challenges may arise along the park boundaries, where park authorities work closely with local shepherds to mitigate conflicts with livestock.

ANNEXES

Presentations made at and by CREA Arezzo, as well as research paper on historical translocations of silver fir in Italy, are available here.