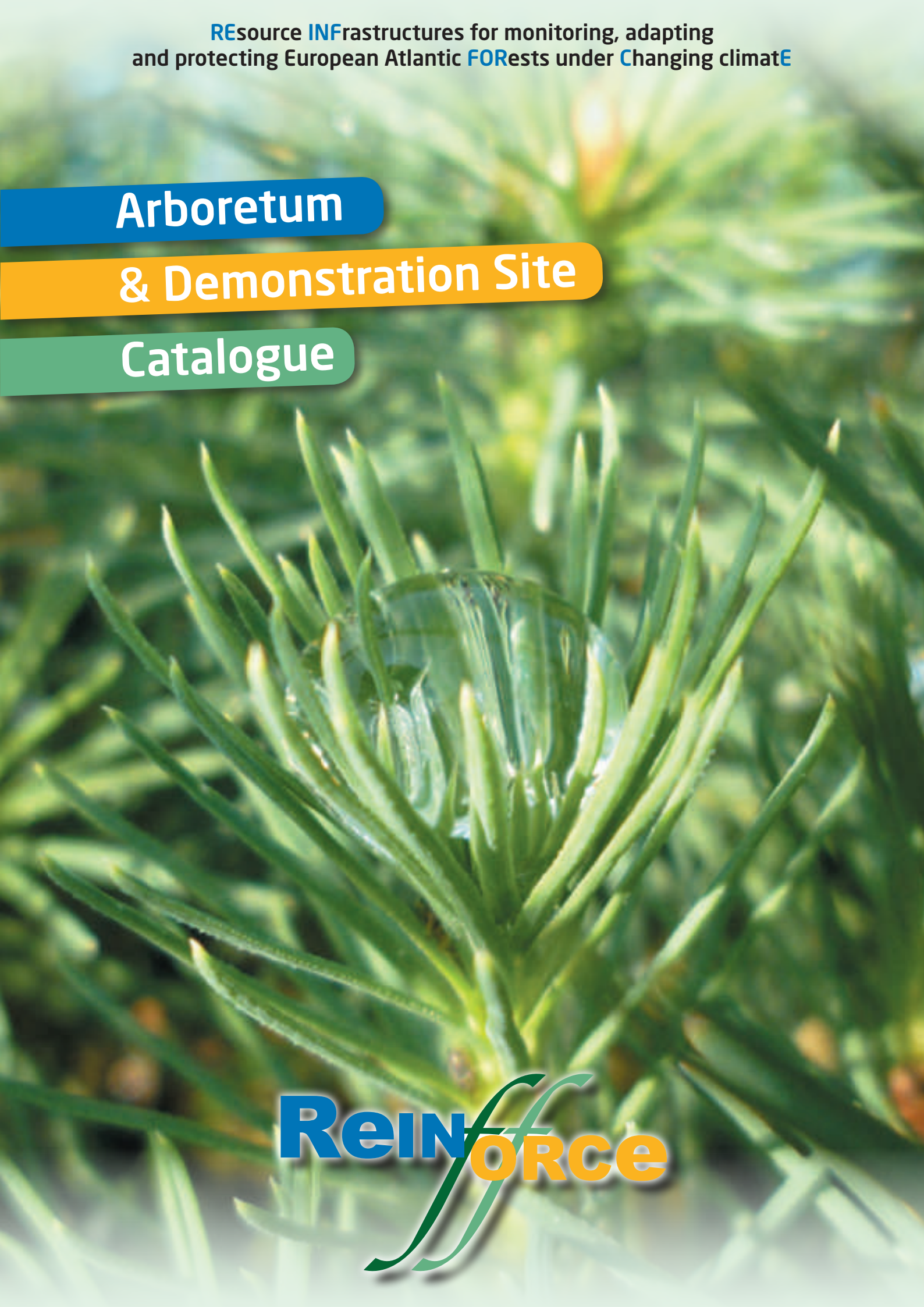
REsource INFrastructures for monitoring, adapting
and protecting European Atlantic FORests under Changing climatE

Arboretum & Demonstration Site Catalogue



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FOREWORD

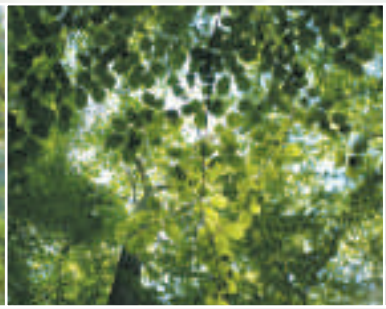
This document summarises the work that has been achieved after 5 years of efforts to set up the REINFFORCE infrastructure. It has been a huge challenge to move from the simple idea of designing a research tool for climate change adaptation to the actual implementation of this tool: to agree on protocols, find seeds, produce 150 000 seedlings, design demonstration sites and set up databases.
I would like to thank all those who contributed to making this idea become a reality, which not only requested the necessary funding, but also a lot of patience and passion.

This document does not describe the end of a story but rather the beginning of one. Thanks to INTERREG IVB EA funds, a unique research tool has been designed to work on forest adaptation to climate change. In this catalogue, you will find all useful information concerning the design and content of the 79 trials that are part of this infrastructure; information to understand the data collected, the species planted, the effects observed.

You are welcome to contact the coordinator or trial managers directly for questions on some results or to propose collaboration on a specific species or a specific issue that has been addressed thanks to this infrastructure.

Christophe Orazio





AVANT-PROPOS

Ce document résume les travaux qui ont été réalisés après 5 ans d'efforts pour mettre en place l'infrastructure REINFFORCE. A partir d'une simple idée de concevoir un outil de recherche pour l'adaptation au changement climatique jusqu'à la mise en œuvre effective de cet outil a été un énorme défi : se mettre d'accord sur les protocoles, trouver des graines, produire 150 000 plants, la conception des sites de démonstration et la mise en place des bases de données.
Je tiens à remercier tous ceux qui ont contribué à faire de cette idée une réalité, qui n'a pas seulement demandé le financement nécessaire, mais aussi beaucoup de patience et de passion.

Ce document ne décrit pas la fin d'une histoire mais plutôt le début. Grâce aux fonds INTERREG IVB EA, un outil de recherche unique a été conçu pour travailler sur l'adaptation des forêts au changement climatique. Dans ce catalogue, vous trouverez toutes les informations utiles concernant la conception et le contenu des 79 essais qui font partie de cette infrastructure; l'information pour comprendre les données recueillies, les espèces plantées, les effets observés.

Vous êtes invités à contacter le coordinateur ou les responsables d'essais directement pour les questions sur certains résultats ou pour proposer une collaboration sur une espèce spécifique ou un problème spécifique qui a été abordé grâce à cette infrastructure.

Christophe Orazio

PREFACIO

Este documento resume el trabajo realizado, tras 5 años de esfuerzo, para establecer la infraestructura REINFFORCE.
El reto ha sido grande: a partir de una idea sencilla sobre cómo diseñar una herramienta que permita investigar la adaptación al cambio climático hasta la implementación efectiva de la misma ha sido necesario alcanzar un acuerdo sobre los protocolos, encontrar las semillas, producir 150.000 árboles, definir el diseño de los sitios de demostración y establecer las bases de datos.
Quiero expresar mi agradecimiento a todos los que contribuyeron a hacer de esta idea una realidad, la cual exigió no solamente la financiación necesaria, sino también mucha paciencia y pasión.

Este documento no describe el final de la historia, sino más bien el principio. Gracias a la financiación de INTERREG IVB EA, se ha diseñado esta herramienta de investigación única que ha sido concebida para trabajar en la adaptación de los bosques al cambio climático. En este catálogo se puede encontrar toda la información práctica correspondiente al diseño y al contenido de los 79 ensayos que forman parte de esta infraestructura así como la información que permite comprender los datos obtenidos, las especies plantadas y los efectos observados.

Le invitamos a ponerse en contacto directamente con el coordinador del proyecto o con los responsables de los ensayos para obtener información sobre algún resultado concreto o para proponer una colaboración referente a una especie determinada o a un tema específico que haya sido abordado gracias a esta infraestructura.

Christophe Orazio





PREFACIO

Este documento resume o trabalho realisado após cinco anos de esforços para implementar a infrastrutura REINFFORCE.
Desde a simples ideia de conceber uma ferramenta de investigação sobre a adaptação às mudanças climáticas até à sua implementação, o desafio tem sido enorme: concordar sobre os protócolos, encontrar as sementes, produzir 150 000 mudas, conceber os sítios de demonstração e estabelecer as bases de dados.
Desejo agradecer a todos os que contribuiram a fazer desta ideia uma realidade, que não necessitou apenas do financiamento necessário, mas também de muita paciência e paixão.

Este documento não descreve o fim de uma história, mas sim o início. Graça aos fundos INTERREG IVB EA, foi concebida uma ferramenta única de investigação sobre a adaptação das florestas às mudanças climáticas.
Neste catálogo pode encontrar todas as informações úteis sobre a concepção e o conteúdo dos 79 ensaios que fazem parte da infrastrutura, a informação para compreender os dados recolhidos, as espécies plantadas e os efeitos observados.

Convidamos-o a entrar directamente em contacto com o coordenador ou os responsáveis dos ensaios para todas as questões sobre os resultados ou se desejar propôr uma colaboração sobre uma espécie em particular que tenha sido estudada graças a esta infrastutura.

Christophe Orazio

INTRODUCTION

Consequences of climate change on forests

The Earth's temperature is mainly driven by the greenhouse effect. Indeed natural gases keep the energy originating from the sun and the centre of the earth close to the surface. Therefore the mean temperature at the Earth's surface is the current approximate 15 °C, and not -19 °C as it would be if it was not for the greenhouse effect.

Over the last 10 000 years, the concentration of greenhouse gases (GHGs) (between 200 and 250ppm) remained quite stable, and emissions from animal respiration were compensated by plant photosynthesis. But since the industrial period started a lot of fossil carbon has been released, increasing the GHG concentration in the atmosphere of up to over 350ppm. The quantity of fossil carbon released so far is predicted to lead to an increase of mean temperature by 1 or 2 °C.
As this process is human driven, the range and speed of evolution of this process is hard to predict, but there is still hope that humanity will reduce its emissions. Thus forecast of future climate in the next decades is based on fossil carbon emission scenarios, from the most optimistic predicting a +2°C increase of temperature by 2100 to the most pessimistic predicting an increase of +6°C by 2100 and +15°C by 2300.

Tropical storm clouds, Porto, Portugal (L. Di Lucchio, EFIATLANTIC)

Climate change does not only mean increase in temperature and in GHG concentration, but also change in water regimes, in wind regimes and increase of extreme events such as droughts, storms and temperature extremes.

Measurements for Pine plantation, INRA Pierroton Site (F. Lagane, INRA)

Consequences for trees can be extremely damaging, and foresters cannot only focus on what was working in the past to know what will work in the future. The forester needs to obtain an accurate knowledge of the tree's capacity to cope with future climate characteristics, and anticipate the best management for future changes related to climate change. So far, the main consequences on forests identified are:

- Maladaptation of trees to the mean climatic parameters: if the mean annual precipitation or the mean annual temperature changes significantly in one century; even if a tree was planted in a location with appropriate climate, the same tree that is supposed to be harvested 40 or 120 years later may no longer be adapted before the harvesting date anymore. Also, the natural selection process requires several generations to be able to produce adapted trees. Some of the trees will be able to adapt their physiology and phenology, but in all cases the growth regime and wood quality will be affected. During the 20th century a minor climate change with longer growing periods and with a fertilising effect of CO_2 was observed and had a beneficial impact on tree growth, but major changes are expected to have adverse effects.

- Vulnerability to extreme events: even if mean parameters remain the same, the tree may face extreme winds, drought or frost that were not encountered under previous climates. This can induce mortality, growth losses and wood quality deterioration. Pests and diseases can take advantage of the new climate by extending their areas and making the most of the weakened stressed trees. They can also change their life cycle due to more favourable weather conditions and in some cases, they can even switch from an endemic status to an epidemic one.

- Fires will be favoured by more drought and higher temperatures.

It is with these consequences in mind that we built the REINFFORCE network, in order to obtain precise and globally applicable data on different tree species to help foresters face the inevitable consequences of climate change.

Pine processionary moth nests on Radiata Pines, Aquitaine (EFIATLANTIC)

Analysis of forest adaptation to climate change: limitations of current approaches

As early as the year 2000 and onwards, a succession of droughts and extreme events alerted forest managers and climate change became more and more obvious for all foresters. As a consequence, the records related to forest phenology, growth and damages reflected the impacts of climate change, increasing awareness, but providing only a few answers on how to deal with it.

Demonstration Site DS03 with particular arid conditions, Central Portugal (C. Orazio, EFIATLANTIC)

Many different approaches are used by scientists to address climate change adaptation and impact on forests using existing trials and knowledge. The more common ones are:

- **analysis of historical series:** using national inventories, experimental plots for silviculture or genetics, and dendrochronology. It is possible to estimate and compare the growth of trees of the same age under various climates on the same site. However there are often methodological problems related to the management, health or design of the trials, making it difficult to compare and obtain accurate conclusions. This tool provides very good trends, but cannot help in providing answers locally.

- **analysis in climatic chambers:** controlling the climatic parameter in artificial conditions can be considered as the best option to conduct studies on climate change adaptation. However in reality the number of trees and types of climates possibly explored are limited by the size and capacity of the chamber. This approach is criticised mainly due to the fact that the reduced number of trees studied cannot reflect the whole species' plasticity, also the weather simulated is often not realistic enough (too homogeneous, without wind effects) and other heterogeneity present on the field related to the topography and surrounding trees is not taken into account.

Measurements using coring, done by Christophe Orazio, Pontenx Case Study (R. Cordero Debets, EFIATLANTIC)

- **climatic envelopes** and actual distribution. A common way to forecast what will happen in the future is to relate the repartition of tree species to the actual climate. In doing so we assume that the distributions of tree species match the optimal (or maximal) occupational capacity, that the knowledge of tree species distribution is correct, and that we are able to assess all climate parameters with good accuracy. However, as most of the forests in Europe are managed, they cannot be considered as natural, and there is probable bias in the actual distribution (pasture effects, forest manager preferences, major diseases like for the ulmus...). The criging tools providing mean climatic values are also very uncertain in some contexts such as mountains or heterogeneous landscapes, conducing bias on some extreme values (such as frosts).

So even if all the methods listed above are of high interest for climate change analysis, it seemed essential to design a research infrastructure dedicated to climate change and tackling these criticisms.

Reinforced analysis with the European Atlantic network

Climate change is often predicted to represent the switching over of climates as we have known them from the warmer southern areas to the colder northern areas. This rather simplistic approach however is far from reality: all climatic parameters will change and the climate 500km further north will never be exactly the same as the one found further south and 50 years ago. Also, it is important to take into account all the local aspects that are likely to affect and influence the evolution of the climate. Taking advantage of the Atlantic network of IEFC & EFIATLANTIC partners, we have the capacity to compare sites from latitudes 37° to 57°, and at the same longitude.

So it means that we can compare sites with mean annual precipitations varying from 2500mm to 500mm and mean temperatures between 6°C and 18°C, with a large range of topographic and soil characteristics. This large variety of options put together in a common infrastructure makes the statistical analysis more robust rather than just comparing 2 or 3 sites.

Two complementary networks of forest trial sites:

to better define adaptive management practices

Mature Maritime Pine plantations, INRA Pierroton site (B. Carnus, EFIATLANTIC)

Being now aware of the potential impacts of climate change on forests, the forest managers are expecting help from science to better manage their forests.
The 'what to do?' question has to be addressed differently depending on if you are dealing with a forest that will be mature in only a few decades, or if the stand has just been harvested and you are wondering what to plant next.

In the first case, it is important to identify the main characteristics of the forest stands that could affect its resistance to the future climate to know if a change of management is needed, and what type of risk is taken in normal terms. Thus we needed to review the scientific literature to identify the main threats that can affect the forest under changing climates and propose the best alternative management on **Demonstration Sites** and test them in trials especially designed, with weather control to link the observed differences to the climate suffered by the stands.

In the second case, the question can be summarized by which species/provenances should be planted that will cope with the actual weather conditions and also future climates after harvest. It is therefore necessary to find the same species/provenances managed in the same way, on similar soils, under various climatic conditions. Such a study can be achieved in two ways:

- by asking experts and checking literature related to adaptation of species, but in many cases, tolerance to some specific extreme weather conditions, or on certain sites are missing.

- setting up a **network of Arboreta**, installing the same tree species and provenances under various climatic conditions.

Harmonised data collection & sharing

Once these networks are designed, the data collection needs to be homogeneous on the various sites in order to be valid, otherwise if there are doubts in the values provided, the data will not be comparable and no conclusions will be drawn. So the partners agreed on a common protocol, defining a minimum set of data they will monitor in the next 15 years. The common protocol also includes additional data that can be collected making the most of project opportunities or local capacity. The data collected on site in the various sites can be consulted in the common protocol online.

Seedlings growing, R. Cordero Debets in Guémené Nursery (M. Bouvier, CRPF)

All the type of data collected can be summarised as follows:

- Site characteristics: all data related to soil, topography, mean climate, aspect and shadowing that can describe the growing conditions of the trees, are required to be able to differentiate the effects of the site parameters on the trees from the climatic effects.

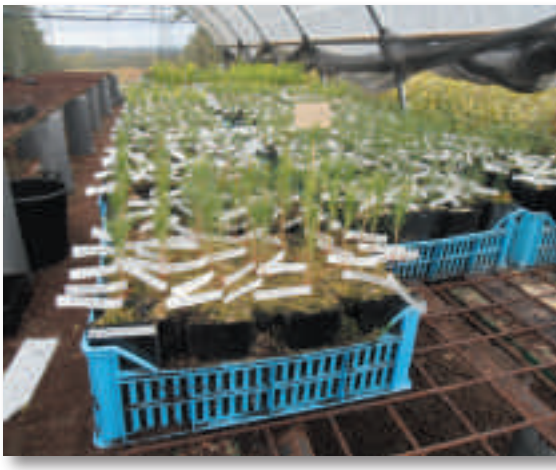
- Tree characteristics over time: the planted trees will grow and thus various parameters will be regularly measured such as height, diameter, shape, wood quality. These data are useful to identify the growing rate of the species and the quality of the wood produced

- Tree health: climatic stress, or maladaptation may not only result in a lower growing rate, but also in a higher sensitivity to diseases. So a protocol to capture the sanitary status and process to identify which kinds of diseases are affecting the various tree species and provenances has been designed.

- Phenology: phenology is the monitoring of the tree life rhythms (i.e. date of bud burst, flowering, loss of leaves, etc.). This information is important to see how the tree life cycles are affected by climate. These data can help to understand how trees adapt, and estimate their tolerance to climate change.

• Weather: as the main aim of this network is to understand the effect of climate on trees, it is important to have relevant weather data collected close enough from the site to avoid bias due to relief of meso-climatic effects, which may lead to the use of data without considering some local frosts, or local rains. The data collected are mainly daily data, which in some cases can include soil moisture.

As the protocol is harmonised, it is easy to design a database where all partners upload and consult the data collected from the network online. These data are exchanged for free between the partners but remain their own property. Having all these data on the same server makes the validation process on the consistency of the data easier, and also secures a permanent easy access.



Seedlings in Guémené Nursery for REINFFORCE (R. Cordero Debets, EFIATLANTIC)

Expected outputs

Support for scientific and technical cooperation

As this infrastructure is a research infrastructure, the main expectations are related to science. The design of the network should provide answers to scientific questions such as:

• what is the site induced or the climate induced reaction of the tree species/provenance tested?

• what is the climate impact on pest and diseases according to the tree species?

• what kind of adaptive measures make a difference under severe climatic conditions?

• what is the critical climatic parameter according to species/provenance and site inducing mortality?...

Neiker partners checking on planted small trees, AR14, Castillonville (S. Hayes, EFIATLANTIC)

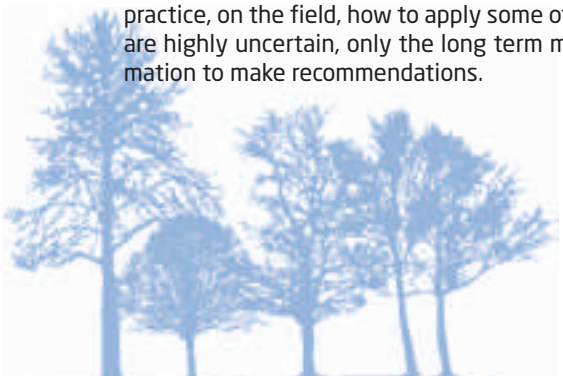
After 3 or 4 years, once the trees have been planted and have survived the crucial first years of growth in a new environment, the trees can be considered as stable and therefore the first set of data can be collected and compared. The data collected will be focusing on a specific climatic parameter, on a specific species or gender, or on a specific adaptive measure. As all the material and management actions are recorded, it will be easy also to compare some data from the REINFFORCE network with other networks, and to cooperate with other projects and teams working on climate change under a different perspective. For 15 years, only non destructive measurements will be considered.

This network can also be used as a standard screening tool, offering the opportunity to make bigger trials and more focused on provenances or silviculture when a specific species seems promising.

For end users

For the forest manager waiting for answers from science, it can be frustrating to know that 15 years or more are needed to get the answer from such an infrastructure. But even when the data are not already published, obvious results on tree growth and mortality can be observed by visiting some trials. Many of the trials can be visited under local manager supervision to avoid damages induced by the visitors and potential bias.

Some of the demonstration trials, as their name indicates, are decision support oriented. They offer opportunities to see in practice, on the field, how to apply some of the theories on adaptive management. As the effect of some of these measures are highly uncertain, only the long term monitoring or the data collection after extreme events will provide relevant information to make recommendations.



ARBORETUM

Retjons Arboretum, Christophe Orazio & Risto Päivinen (S. Hayes, EFIATLANTIC)

OBJECTIVES

The main objective of the network of arboreta is to improve our understanding of species' capacity to cope with future climate by planting the same genetic material under 38 different climates. Since not all provenances and clones have the same ecological characteristics within the same species of trees, it was mandatory to use various sources of material from the same species to assess the intra-specific variability of that species to react to various climates. The other benefit of in-situ trials is that we can capture the effects of a combination of hazards and extreme climatic events on trees that can occur in nature, but might not be considered in climatic chambers.

From all these observations we should be able to produce recommendations for a selection of species according to future climate and site characteristics with more accurate parameters than mean precipitation and mean temperature, but also considering tolerance to some extreme values.

THE NETWORK DESIGN

Tree species selection

The tree species and provenances selection process for the arboreta has been described in a technical report available online. The focus was on species with an economical interest that can cope with actual and future oceanic climate in Europe.

A first list of species was drafted using expert knowledge, consulting all the scientists from all project members. From this list of 174 species a first screening was done by experts, where a subset of 101 species considered of interest was extracted. Based on the scientific literature, 70 cards describing ecology and interest of some of the tree species were drafted (can be consulted online). The data collected during this reviewing was coded into a decision support tool, resulting in the selection of 35 species of interest for climate change studies. Some additional consideration on seed availability, seed germination and local interest resulted in the following species list.

Cunninghamia lanceolata, Guémené Nursery (R. Cordero Debets, EFIATLANTIC)

Acer pseudoplatanus L.
Betula pendula Roth
Calocedrus decurrens (Torr.) Florin
Castanea sativa Mill.
Cedrus atlantica (Endl.) Manetti ex Carrière
Cedrus libani A.Rich.
Ceratonia siliqua L.
Cunninghamia lanceolata (Lamb.) Hook.
Cupressus sempervirens L.
Eucalyptus nitens (H.Deane & Maiden) Maiden
Eucalyptus globulus Labill.
Eucalyptus gundal (gunnii x darlympleana)
Fagus orientalis Lipsky
Fagus sylvatica L.
Larix decidua Mill.
Liquidambar styraciflua L.
Pinus brutia Ten.
Pinus caribaea var. hondurensis (Sénécl.) W.H.G.
Pinus elliottii Engelm.
Pinus nigra subsp. laricio Maire
Pinus nigra subsp. salzmannii (Dunal) Franco
Pinus peuce Griseb.
Pinus pinaster Aiton
Pinus pinea L.
Pinus ponderosa Douglas ex C.Lawson
Pinus sylvestris L.
Pinus taeda L.
Pseudotsuga menziesii (Mirb.) Franco
Quercus ilex L.
Quercus ilex subsp. rotundifolia (Lam.) O. Shwarz ex Tab. Morais
Quercus petraea (Matt.) Liebl.
Quercus robur L.
Quercus rubra L.
Quercus shumardii Buckley
Quercus suber L.
Robinia pseudoacacia L.
Sequoia sempervirens (D.Don) Endl.
Thuja plicata Don ex D.Don

William Oliva, INRA, planting small trees for the AR13, Sarlande (S. Hayes, EFIATLANTIC)

Arboretum of Sao Miguel, Açores (C.Orazio, EFIATLANTIC)

Number of trees per species

At the beginning of the project the plan was to have a minimun of 100 trees per species to be able to keep significant statistical analysis comparing tree data. As the size of arboreta and funds reserved for the project were limited, the compromise found was that all the species listed before must be represented by a set of 3 mandatory provenances present in all the sites. So from north to south, we are supposed to find in all arboreta a minimum of 36 trees of the same species and 3 provenances per species on all sites. However, due to problems in seedling production and seed availability, this is not always the case.

Benefit of replicate species for site heterogeneity

In most of the sites, the 12 trees of the same provenance are planted together to simplify monitoring; only on very heterogeneous sites, blocks of 12 trees are split in two. As a consequence, it is necessary to assess the site heterogeneity to know if the differences observed between provenances on the same site are really due to genetic factors and not to site heterogeneity. The site heterogeneity assessment is done using four species: *Pinus pinaster, Betula pendula, Cedrus atlantica* and *Quercus robur*. These 4 species are planted together in three parts of the site to confirm that the growth and health is homogeneous inside the site.

Site selection criteria

To install the arboreta, partners looked for 2 hectares of field that were as flat and as homogenous as possible. Some of the trials are installed in private properties where forest owners offer to use the land for free. Other trials are planted in properties owned by communities or foundations. The capability of the local manager to maintain the trial clean and over a long period of time was also part of the selection criteria.

Oak and Pine, INRA Pierroton Site (B. Carnus, EFIATLANTIC)

Tree plantation and arboreta patterns

To simplify monitoring and visits of the trials, and to avoid competition between fast growing species and slow growing species, all the seedlings have been installed following nested schemes:

- broadleaves on one side and conifers on the other side
- within broadleaves: oaks and non-oaks
- within conifers: pines and non-pines

Maritime Pine, INRA Pierroton Site (B. Carnus, EFIATLANTIC)

In addition to this standard design, on the extremities and in the middle of the arboreta, we find the replicated species. Please refer to the following description sheets to find details for each individual arboretum setup.

ARBORETUM DESCRIPTION SHEETS

In the following pages, you will find the details relevant for each Arboretum, with a short description of the site. Concerning the legends for the maps, globally they are similar with on the one hand broadleaves, conifers, oaks & pines, and on the other the replicates. For further details or questions regarding these Arboreta, please refer to the REINFFORCE website or the contact detail at the top of the page.

AR01 - Mull

Local name: Mull
Municipality: Lochgilphead
Region: Argyll and Butte / **Country:** Scotland, UK
Altitude (m): 50

Department in charge: Center for Sustainable Forestry and Climate Change
Contact e-mail: richard.jinks(at)forestry.gsi.gov

Topography: low slope
Orientation: S
Slope (%): 12
Hydrology: free draining

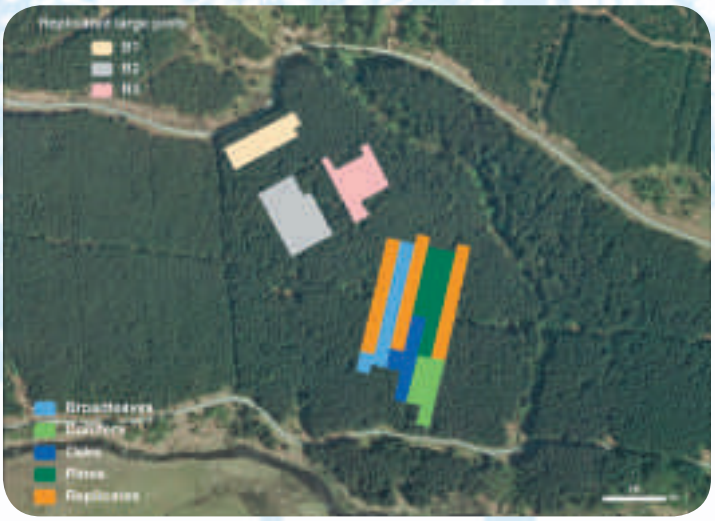
pH (soil layer 0 - 30cm): 4.5
Type of Soil: HISTOSOLS
Subtype of Soil: dystric-eutric
Bedrock: basalt

Mean T (°C): 8.8
Mean T (°C) Coldest Month: 1.2
Mean Precipitation (mm): 1821
N Frost Days: 99

This is a Forestry Commission (FC) site adjacent to the FC office at Salen on the Isle of Mull.

The area has been clear felled about 2 years previously and lies immediately to the west of another experiment looking at the performance of different species grown for short rotation forestry. The site is fenced against deer and rabbits, and the REINFFORCE mandatory species are planted in the southern part of the site, and a replicated trial testing both REINFFORCE and other species is planted out in the upper part of the site.

We chose the site because of a history of previous experimental use plus it was the most oceanic of the UK experimental sites.



AR02 - Crychan Forest

Local name: Crychan Forest
Municipality: Carmathen
Region: Carmathenshire / **Country:** Wales, UK
Altitude (m): 185

Department in charge: Center for Sustainable Forestry and Climate Change
Contact e-mail: richard.jinks(at)forestry.gsi.gov

Topography: plateau
Orientation: S
Slope (%): 5
Hydrology: free draining with some wetter areas

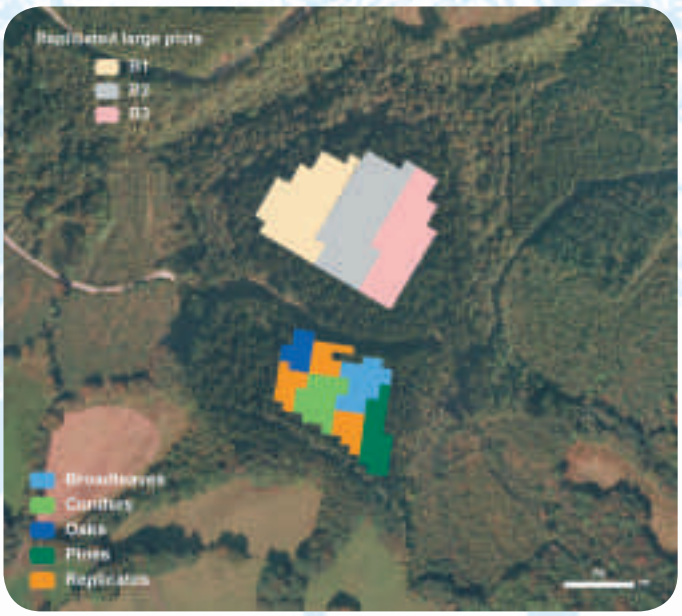
pH (soil layer 0 - 30cm):
Type of Soil: CAMBISOLS
Subtype of Soil: stagnic
Bedrock: claystone-mudstone

Mean T (°C): 9
Mean T (°C) Coldest Month: 0.7
Mean Precipitation (mm): 115
N Frost Days: 9

This is a Natural Resources Wales (formerly the Forestry Commission in Wales) site that is about 15 km from the forest district office in Llandovery. The previous crop of Sitka spruce was clear felled about 3 years before planting, and much of the brash and log debris was removed. The site is bisected by a forest road into two roughly equal sized parts.

The REINFFORCE mandatory species are planted in the upper half to the east of the forest road, and a replicated trial testing both REINFFORCE and other species is planted out in the lower part of the site. Although the area is considered to be free of deer, the site has been fenced to protect from deer and rabbits.

We chose this site because of its proximity to the Forest Research`s office in Wales, and because it was the flattest of the available sites.



AR03 - Westonbirt

Local name: Westonbirt
Municipality: Cotswold
Region: Gloucestershire / **Country:** England, UK
Altitude (m): 140

Department in charge: Center for Sustainable Forestry and Climate Change
Contact e-mail: richard.jinks(at)forestry.gsi.gov

Topography: plain
Orientation: S
Slope (%): 0
Hydrology: free draining with some wetter areas

pH (soil layer 0 - 30cm): 4.7
Type of Soil: CAMBISOLS
Subtype of Soil: chromic
Bedrock: limestone

Mean T (°C): 9.2
Mean T (°C) Coldest Month: 0.5
Mean Precipitation (mm): 768
N Frost Days: 98

This site is situated in the Forestry Commission`s National Arboretum at Westonbirt. It is located on two former experimental sites: a larch progeny trial, and a trial of elms established to test for resistance to Dutch elm disease. Both areas were clear felled the year before planting. Because of constraints imposed by the position of existing paths, the new planting is in four fenced areas.

A replicated trial testing both REINFFORCE and other species is planted out in a single enclosure on the old elm site, and the REINFFORCE mandatory species are planted on three fenced enclosures on the former larch site.

We chose this site because Westonbirt Arboretum attracts 300000 visitors a year, and the new REINFFORCE site is an important opportunity for interpreting messages to both professionals and the general public about the impacts of climate change.

AR04 - Domaine d'Harcourt

Local name: Domaine d'Harcourt
Municipality: Harcourt
Region: Haute-Normandie / **Country:** France
Altitude (m): 130

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

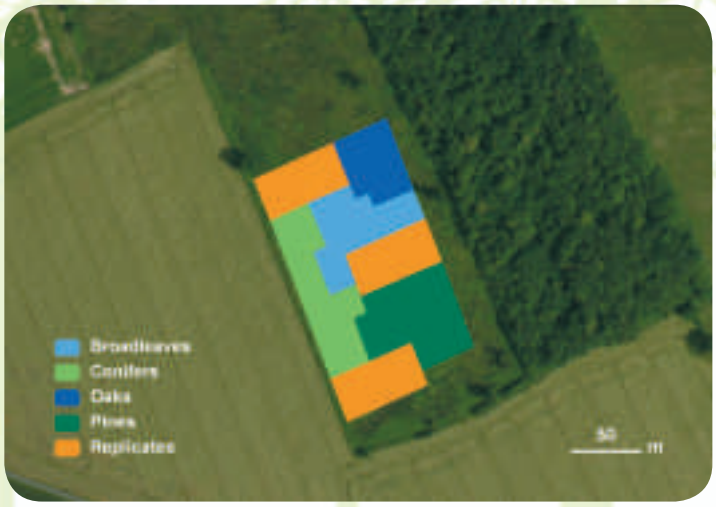
Topography: plateau
Orientation: flat
Slope (%): 2
Hydrology: none

pH (soil layer 0 - 30cm): 4.5
Type of Soil: LUVISOLS
Subtype of Soil: stagnic
Bedrock: loess

Mean T (°C): 10.8
Mean T (°C) Coldest Month: 0.9
Mean Precipitation (mm): 757
N Frost Days: 59

This arboretum is planted on an old grassland, located on a private property.
There is a structure of the General Council of the Eure, the "domaine d'Harcourt" which organizes educational activities on forests with an old and famous arboretum and many other infrastructures.
This structure is in charge of the site management and is also able to use it for educational purposes.

Cet arboretum est implanté sur une ancienne prairie, située sur une propriété privée.
Localement, nous avons une structure du Conseil Générale de l'Eure, le "domaine d'Harcourt", qui a un ancien et célèbre arboretum, et de nombreuses infrastructures pour organiser des activités pédagogiques autour de la forêt.
Cette structure sera chargée de la gestion du site et sera également en mesure de l'utiliser pour leurs activités pédagogiques.



AR05 - La Chaumouflère

Local name: La Chaumouflère
Municipality: Monceaux au Perche
Region: Basse-Normandie / **Country:** France
Altitude (m): 157

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

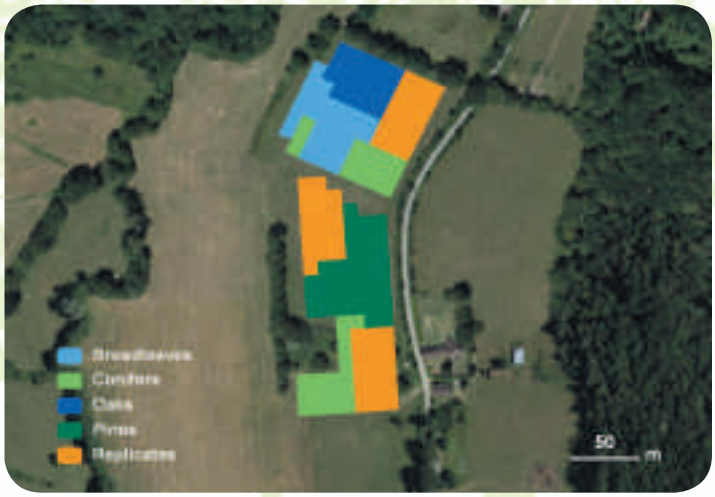
Topography: low slope
Orientation: W
Slope (%): 20
Hydrology: river at 400m

pH (soil layer 0 - 30cm): 5.2
Type of Soil: LUVISOLS
Subtype of Soil: stagnic
Bedrock: marine and estuarine sands

Mean T (°C): 10.6
Mean T (°C) Coldest Month: 0.8
Mean Precipitation (mm): 795
N Frost Days: 67

This arboretum is planted on an old grassland, located on a private property.
The owner is very interested by the topic of climatic change and on evaluating solutions like using more adapted forest species.

Cet arboretum est implanté sur une ancienne prairie, située sur une propriété privée.
Le propriétaire est très intéressé par la problématique du changement climatique et par l'évaluation de solutions telle que l'utilisation d'essences mieux adaptées.



AR06 - Vaumadeuc

Local name: Vaumadeuc
Municipality: Pléven
Region: Bretagne / **Country:** France
Altitude (m): 94

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

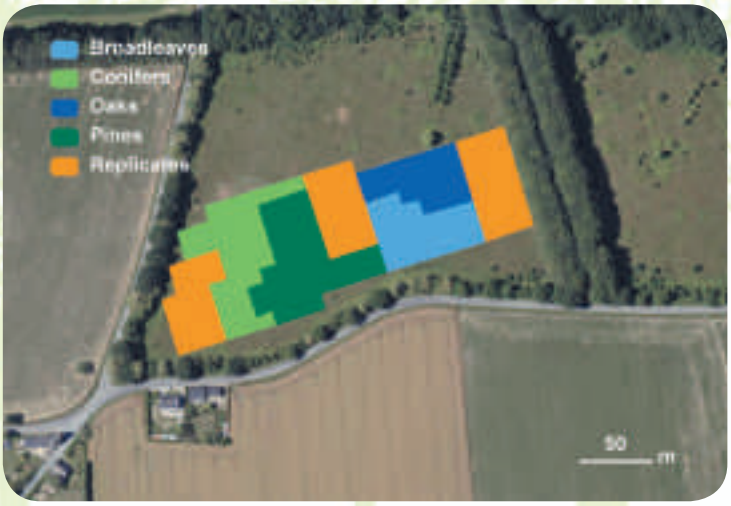
Topography: plateau
Orientation: flat
Slope (%): 2
Hydrology: none

pH (soil layer 0 - 30cm): 5.2
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: micaschist

Mean T (°C): 11.2
Mean T (°C) Coldest Month: 3
Mean Precipitation (mm): 794
N Frost Days: 32

This arboretum is planted on an old grassland, located on a private property. The owner is interested by the topic of climatic change and on evaluating solutions like using more adapted forest species.
The site is on a classified site, which includes a prestigious Hotel. The owner of the site, who is also a forest owner, is able to have an educational purpose by presenting the arboretum to visitors but also our action on the problematic of forest adaptation with the changing climate.

Cet arboretum est implanté sur une ancienne prairie, située sur une propriété privée. Le propriétaire est intéressé par le thème du changement climatique et sur l'évaluation des solutions telles que l'utilisation d'espèces forestières les plus adaptées.
Le site se trouve sur un site classé, avec un hôtel de prestige. Le propriétaire du site, qui est également propriétaire de la forêt, sera en mesure d'avoir une action pédagogique en présentant aux visiteurs, l'arboretum, mais aussi notre action sur la problématique des forêts avec le changement climatique.



AR07 - Priziac

Local name: Priziac
Municipality: Priziac
Region: Bretagne / **Country:** France
Altitude (m): 204

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

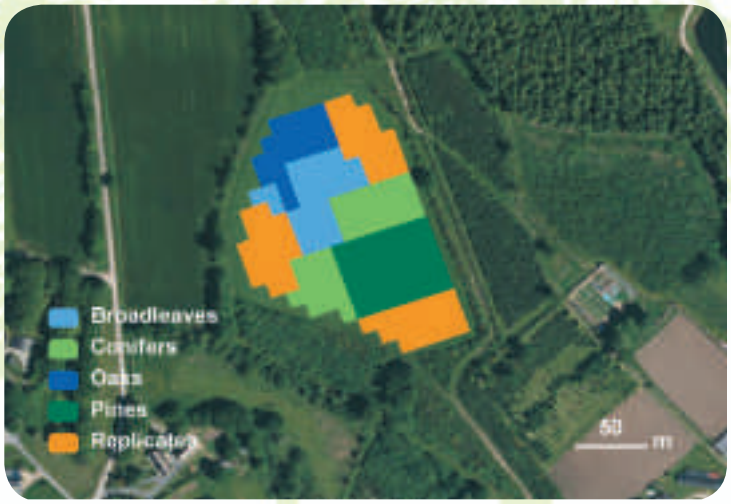
Topography: low slope
Orientation: SW
Slope (%): 4
Hydrology: none

pH (soil layer 0 - 30cm): 5.2
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: granite

Mean T (°C): 10.9
Mean T (°C) Coldest Month: 2.5
Mean Precipitation (mm): 1210
N Frost Days: 30

This arboretum is planted on an old grassland, located on a private property.
The owner is very interested by the topic of climatic change and on evaluating solutions like using more adapted forest species.

Cet arboretum est implanté sur une ancienne prairie, située sur une propriété privée.
Le propriétaire est très intéressé par la problématique du changement climatique et par l'évaluation de solutions telle que l'utilisation d'essences mieux adaptées.



AR08 - Pêcheseul

Local name: Pêcheseul
Municipality: Avoise
Region: Pays de la Loire / **Country:** France
Altitude (m): 42

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

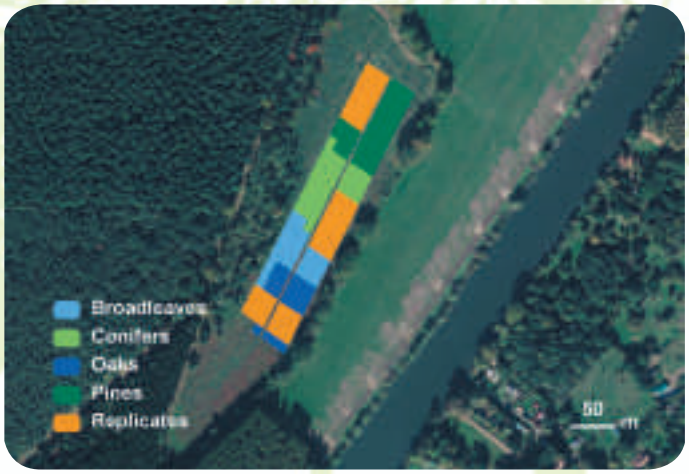
Topography: terrace
Orientation: flat
Slope (%): 2
Hydrology: river at 500m

pH (soil layer 0 - 30cm): 4.8
Type of Soil: CAMBISOLS
Subtype of Soil: skeletic
Bedrock: river terrace sand

Mean T (°C): 11.6
Mean T (°C) Coldest Month: 1.7
Mean Precipitation (mm): 688
N Frost Days: 48

This arboretum is planted on an old plot of Norway spruce, located on a private property.
The owner is interested by the topic of climatic change and on evaluating solutions like using more adapted forest species.

Cet arboretum est implanté sur une ancienne parcelle d'épicéa, située sur une propriété privée.
Le propriétaire est intéressé par la problématique du changement climatique et par l'évaluation de solutions telle que l'utilisation d'essences mieux adaptées.



AR09 - Bécon les Granits

Local name: Bécon les Granits
Municipality: Bécon-les-Granits
Region: Pays de la Loire / **Country:** France
Altitude (m): 59

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

Topography: plateau
Orientation: flat
Slope (%): 4
Hydrology: none

pH (soil layer 0 - 30cm): 5.2
Type of Soil: LUVISOLS
Subtype of Soil: stagnic
Bedrock: granite

Mean T (°C): 12.1
Mean T (°C) Coldest Month: 2.5
Mean Precipitation (mm): 682
N Frost Days: 35

This arboretum is planted on an old agricultural land, located on a private property.
The owner is interested by the topic of climatic change and on evaluating solutions like using more adapted forest species.

Cet arboretum est implanté sur une ancienne terre agricole, située sur une propriété privée.
Le propriétaire est intéressé par la problématique du changement climatique et par l'évaluation de solutions telle que l'utilisation d'essences mieux adaptées.

AR10 - Chantecorps

Local name: Chantecorps
Municipality: Chantecorps
Region: Poitou-Charentes / **Country:** France
Altitude (m): 211

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

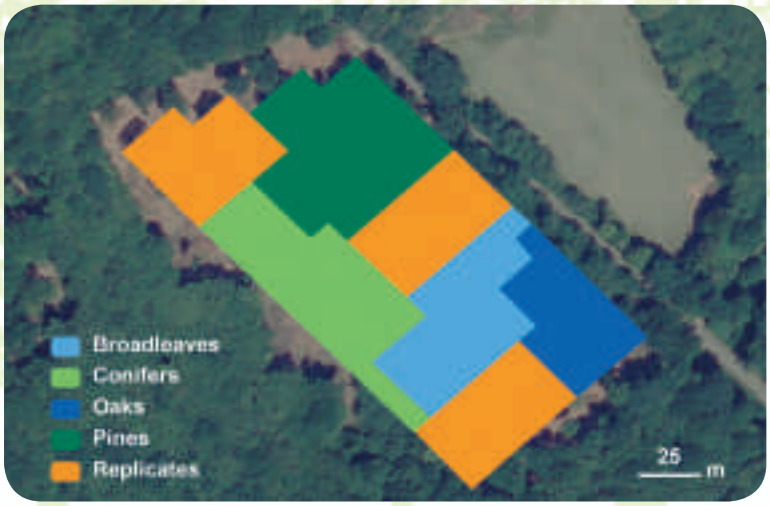
Topography: plateau
Orientation: flat
Slope (%): 3
Hydrology: none

pH (soil layer 0 - 30cm): 4.5
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: granite

Mean T (°C): 11.9
Mean T (°C) Coldest Month: 1.4
Mean Precipitation (mm): 996
N Frost Days: 51

This arboretum is planted on an old chestnut coppice, located on a private property.
The owner is interested by the topic of climatic change and on evaluating solutions like using more adapted forest species.

Cet arboretum est implanté sur une ancienne prairie, située sur une propriété privée.
Le propriétaire est intéressé par la problématique du changement climatique et par l'évaluation de solutions telle que l'utilisation d'essences mieux adaptées.



AR11 - Chey

Local name: Chey
Municipality: Chey
Region: Poitou-Charentes / **Country:** France
Altitude (m): 164

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

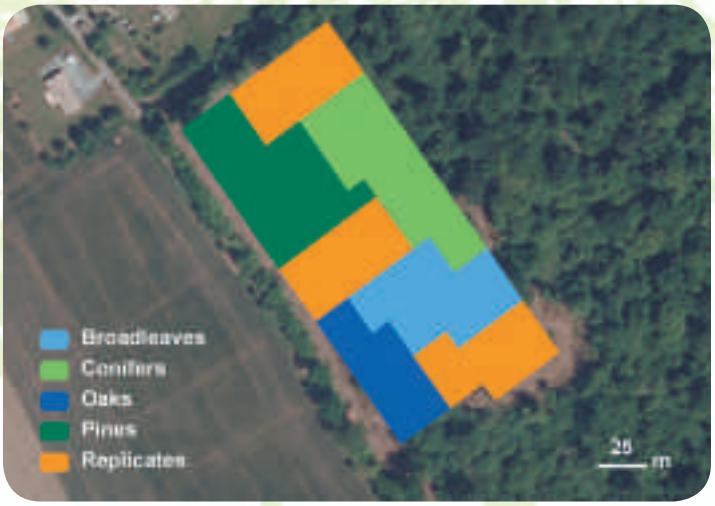
Topography: plateau
Orientation: flat
Slope (%): 4
Hydrology: none

pH (soil layer 0 - 30cm): 5.2
Type of Soil: LUVISOLS
Subtype of Soil: stagnic
Bedrock: calcareous rocks

Mean T (°C): 12.1
Mean T (°C) Coldest Month: 1.7
Mean Precipitation (mm): 943
N Frost Days: 51

This arboretum is planted on an old oak stand, on a private property.

Cet arboretum est implanté sur un ancien peuplement de chênes, situé sur une propriété privée.



AR12 - La Chétardie

Local name: La Chétardie
Municipality: Exideuil
Region: Poitou-Charentes / **Country:** France
Altitude (m): 178

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

Topography: low slope
Orientation: flat
Slope (%): 5
Hydrology:

pH (soil layer 0 - 30cm): 5.5
Type of Soil: STAGNOSOLS
Subtype of Soil: dystric-eutric
Bedrock: basic plutonic rocks

Mean T (°C): 12
Mean T (°C) Coldest Month: 1.4
Mean Precipitation (mm): 898
N Frost Days: 55

This arboretum is planted on an old grassland, located on a private property.
The owner is very interested by the topic of climatic change and on evaluating solutions like using more adapted forest species.

Cet arboretum est implanté sur une ancienne prairie, située sur une propriété privée.
Le propriétaire est très intéressé par la problématique du changement climatique et par l'évaluation de solutions telles que l'utilisation d'essences mieux adaptées.

AR13 - La Bonne Foussie

Local name: La Bonne Foussie
Municipality: Sarlande
Region: Aquitaine / **Country:** France
Altitude (m): 365

Department in charge: INRA
Contact e-mail: contact.ue(at)pierroton.inra.fr

Topography: plateau
Orientation: south
Slope (%): 0
Hydrology: none

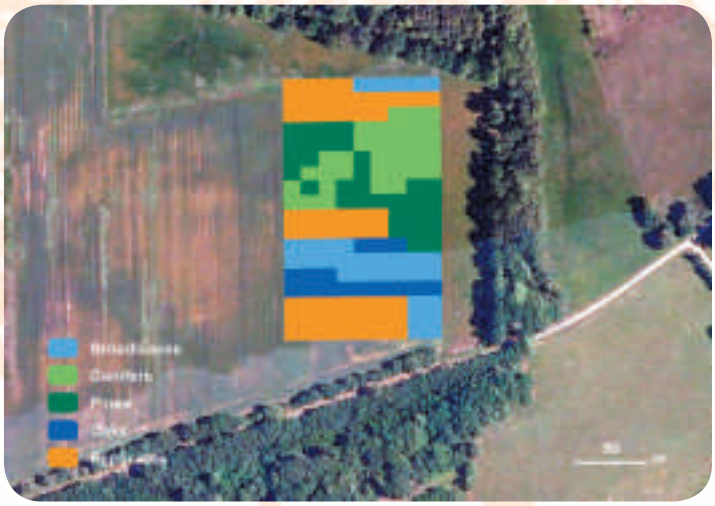
pH (soil layer 0 - 30cm): 4.70
Type of Soil: CAMBISOLS
Subtype of Soil: eutric
Bedrock:

Mean T (°C): 11.1
Mean T (°C) Coldest Month: -1
Mean Precipitation (mm): 914
N Frost Days: 40

The arboretum is located on private land which was formerly dedicated to sunflower cultivation. This site was chosen because it met all the criteria: little slope, easy access... The plot was fenced off to avoid damages caused by wild animals.
The owner is a forest enthusiast and organises every year a forest event on his property. He is promoting the project in local press and is actively managing about 200ha of forest, making also his own experiments.

L'arboretum est installé sur un terrain privé anciennement dédié à la culture du tournesol. Ce terrain a été choisi car il correspondait à tous les critères : peu de pente, accès facile... La parcelle a été clôturée à cause du gibier.

Le propriétaire est un passionné de la forêt et organise une fois par an des colloques. Il gère 2000 ha de forêt et il réalise aussi ses propres expérimentations.



AR14 - Castillonville

Local name: Castillonville
Municipality: Cestas
Region: Aquitaine / **Country:** France
Altitude (m): 60

Department in charge: INRA
Contact e-mail: contact.ue(at)pierroton.inra.fr

Topography: plane
Orientation: flat
Slope (%): 0
Hydrology: none

pH (soil layer 0 - 30cm): 3.91
Type of Soil: PODZOLS
Subtype of Soil: albic-entic
Bedrock: eolian sands

Mean T (°C): 12.64
Mean T (°C) Coldest Month: -1
Mean Precipitation (mm): 846
N Frost Days: 28

Old stand of maritime pine in a wet/heath land covered with molinia at 80%. The land belongs to the General Council of Gironde. This site was chosen because of its only slight slope and easy access.

The arboretum is located right next to the INRA Experimental Unit which is in charge of this programme, and is therefore very convenient for all cultural purposes, measurements and fine observation. It also enables regular organization and frequent visits from professional groups, students and forest owners. The plot was fenced off to avoid damages caused by wild animals.

C'est une ancienne parcelle de pin maritime. Le terrain appartient au Conseil Général de Gironde. C'est un terrain de lande humide puisque recouvert à 80% de molinie. Ce site a été retenu car il y a peu de pente et l'accès est facile.

La parcelle a été clôturée à cause du gibier. Cet arboretum est juste à coté de L'Unité Expérimentale de l'INRA, ce qui permet de réaliser des mesures et des observations plus fines. Cette situation permet aussi d'organiser des visites fréquentes pour les groupes de professionnels, des étudiants et des propriétaires forestiers.

AR15 - Domaine des Agreaux

Local name: Domaine des Agreaux
Municipality: Retjons
Region: Aquitaine / **Country:** France
Altitude (m): 110

Department in charge: INRA
Contact e-mail: contact.ue(at)pierroton.inra.fr

Topography: plane
Orientation: flat
Slope (%): 0
Hydrology: none

pH (soil layer 0 - 30cm): 3.74
Type of Soil: PODZOLS
Subtype of Soil: albic-entic
Bedrock: eolian sands

Mean T (°C): 12.3
Mean T (°C) Coldest Month: 6
Mean Precipitation (mm): 680
N Frost Days: 53

This is an old private maritime pine stand recently harvested, and where the stumps were not removed.

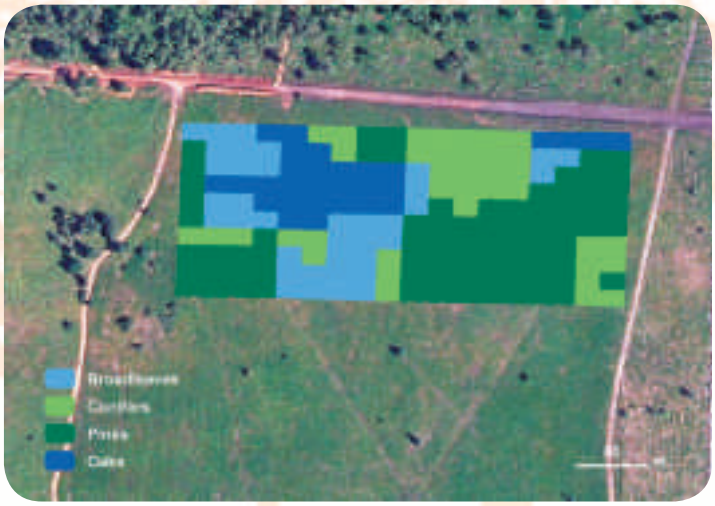
The arboretum is installed on a humid/heath land covered with 80% fern . Hardpan (alios) was observed at 55cm depth. It is also located within an experimental forest which is under an agreement between the owner, INRA forest research and the agricultural school of Bordeaux (Bordeaux Sciences Agro) to promote actions for research and education.

This site was chosen because it has little slope and easy access. The plot has been fenced off to avoid damages caused by wild animals.

C'est une ancienne parcelle de pin maritime. A notre arrivée, la parcelle avait été rasée et il restait des souches. L'arboretum est installé sur un type de lande mésophile puisque recouverte à 80% de fougère.

Lors des prélèvements de sol, nous sommes tombés sur une tâche d'alios à 55 cm.

Ce dispositif est installé chez un propriétaire privé dont une partie du domaine fait l'objet d'une convention associant l'INRA et Bordeaux Sciences Agro, dont l'objet est de promouvoir les actions de recherche et d'enseignement. Ce site a été retenu car il y a peu de pente et l'accès est facile. La parcelle a été clôturée à cause du gibier.



AR16 - Domaine d'Ognoas

Local name: Domaine d'Ognoas
Municipality: Le Frêche
Region: Aquitaine / **Country:** France
Altitude (m): 64

Department in charge: INRA
Contact e-mail: contact.ue(at)pierroton.inra.fr

Topography: plane
Orientation: SW
Slope (%): 2
Hydrology: free draining with ditch inside arboretum

pH (soil layer 0 - 30cm): 4.66
Type of Soil: CAMBISOLS
Subtype of Soil: dystric
Bedrock: river terrace sand or gravel

Mean T (°C): 12.6
Mean T (°C) Coldest Month: 8
Mean Precipitation (mm): 918
N Frost Days: 53

The site is installed on an old grassland which is bisected by a ditch and where individual protections have been installed to avoid damages caused by wild animals.

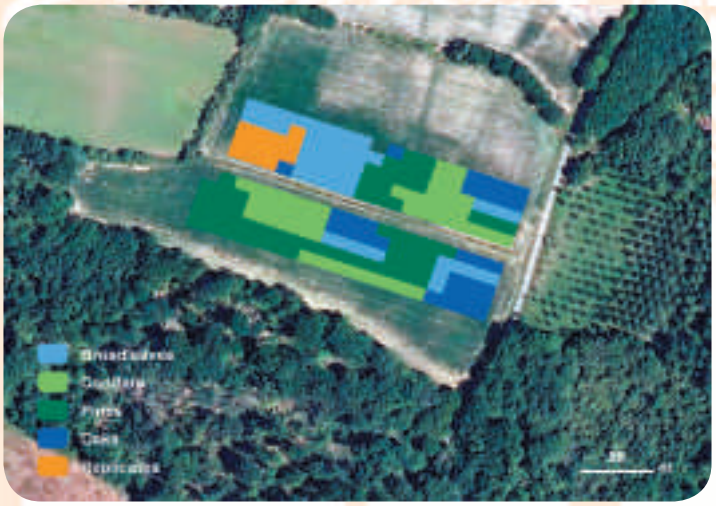
The arboretum is situated on the "domain of Ognoas", which is owned by the General Council of the Landes. This forest and agriculture area mainly produces Armagnac (wine grape) and it also hosts other forestry devices for research and development.

This site was chosen because it has little slope and easy access.

Le site a été installé sur une ancienne prairie qui est divisée en deux par un fossé. Des protections individuelles ont été installées contre le gibier.

L'arboretum est situé sur le domaine d'Ognoas, propriété du Conseil Général des Landes. La principale production de ce domaine forestier et agricole est l'Armagnac. Il accueille également d'autres dispositifs forestiers de recherche et développement.

Ce site a été retenu car il y a peu de pente et l'accès est facile.



AR17 - Moulin de Habas

Local name: Moulin de Habas
Municipality: Bayonne
Region: Aquitaine / **Country:** France
Altitude (m): 30

Department in charge: INRA
Contact e-mail: contact.ue(at)pierroton.inra.fr

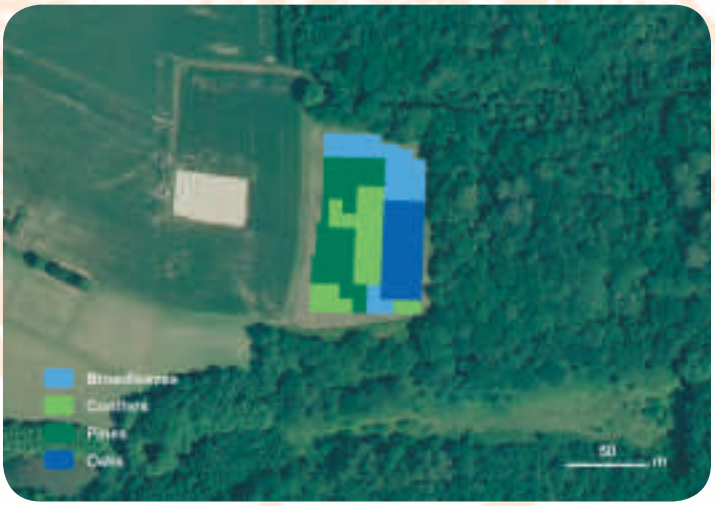
Topography: low slope
Orientation: flat (top)
Slope (%): 0
Hydrology: nearest water line 500m

pH (soil layer 0 - 30cm): 5.81
Type of Soil: CAMBISOLS
Subtype of Soil: eutric
Bedrock: terrace clay and silt

Mean T (°C): 13.2
Mean T (°C) Coldest Month: 4
Mean Precipitation (mm): 1149
N Frost Days: 17

This property belongs to the municipality of Bayonne, formerly grassland and facing the south.
This site was chosen because it is representative of the humid Atlantic climate on the Basque coastal country.
The plot has been fenced off to avoid damages caused by wild animals.

Anciennement la parcelle était en prairie, c'est un terrain communal exposé au sud.
Ce site a été choisi pour représenter le climat atlantique humide de la Côte Basque.
La parcelle a été clôturée à cause du gibier.



AR18 - Unbemendi1

Local name: Unbemendi1
Municipality: Laukiz
Region: Basque Country / **Country:** Spain
Altitude (m): 90

Department in charge: Forestry Unit
Contact e-mail: basozaintza(at)neiker.net

Topography: low slope
Orientation: E
Slope (%): 10
Hydrology: free draining with some wetter areas

pH (soil layer 0 - 30cm): 5.9
Type of Soil: CAMBISOLS
Subtype of Soil: dystric
Bedrock: marly limestone

Mean T (°C): 14
Mean T (°C) Coldest Month: 6.2
Mean Precipitation (mm): 1233
N Frost Days: 33

The Unbemendi arboreta are established in a land that belongs to the Provincial Council of Bizkaia (BFA). Unbemendi1 (AR18), Unbemendi2 (AR19) and Unbemendi3 (AR20) are 3 complete replicates of each arboretum to improve the robustness of the trial to test the responses to climate that these provenances show and to allow us to make powerful comparisons of their performance.

The climate data comes from WORLDCLIM- Global Climate data for the reference period of 1950-2000, except for the "frost days" figure, that has been recorded from the closest point in the CRU_CL_2.0 gridded datasets. It has to be pointed out that WORLDCLIM underestimates precipitation for the region and that CRU overestimates the number of frost days.

The Provincial Government ceded the land to the company Oihanberri in 1991: This Company was promoted by the Basque Government and the three provincial councils (Bizkaia, Gipuzkoa and Araba) to produce saplings of radiata pine (*Pinus radiata* D. Don) from genetically improved seeds. It was granted with 20 years of exploitation which could not be taken through to the end because, in 2004, the Basque Government proposed the dissolution of the company. The plot has several facilities that are not in use at the moment (a warehouse, a facility for drying pine cones, a greenhouse, etc.). All of these infrastructures could be recovered and restored if needed and taking into account the availability of funds for it. It also has an artificial pond where the water required for the irrigation needed during the plant production process could be taken. The access to the plot and various routes that connect the different arboreta are in perfect condition. One of the radiata pine clonal orchards of the Basque Autonomous Community, where the genetic material from the breeding program of this species in the Basque Country is preserved, is located in this property. Unbemendi, which extends over 22 ha, is currently kept for forest research and experimentation.

Los arboretos de Unbemendi se han establecido en un terreno propiedad de la Diputación Foral de Bizkaia (DFA/BFA). Unbemendi1 (AR18), Unbemendi2 (AR19) y Unbemendi3 (AR20) son 3 réplicas idénticas del mismo arboreto. Esto permite mejorar la robustez del ensayo a la hora de mostrar la respuesta al Cambio Climático de las diferentes procedencias de las especies ensayadas.

Los datos climáticos mostrados provienen de "WORLDCLIM- Global Change Data" para el periodo de referencia de 1950-2000, excepto los "días de helada (N Frost Days)" que se han tomado del punto más cercano en la malla de puntos de información de "CRU_CL_2.0". Cabe destacar que WORLDCLIM parece subestimar la precipitación de la región mientras que CRU sobreestima el número de días con heladas.

La Diputación Foral cedió el terreno a la empresa Oihanberri en 1991. Oihanberri fue promovida por el Gobierno Vasco y las tres Diputaciones Forales (Bizkaia, Gipuzkoa y Araba) para producir planta de pino radiata (Pinus radiata D. Don) procedente de semilla de material selecto. Aunque la cesión de explotación fue de 20 años, en 2004 el Gobierno Vasco propuso su disolución. La finca dispone de varias instalaciones en desuso (un almacén, una planta de secado de piñas, un invernadero, etc.).Todas estas infraestructuras se podrían recuperar y restaurar si fuese necesario, teniendo en cuenta la disponibilidad de fondos para ello. También cuenta con un estanque artificial de donde se podría extraer agua para el riego.

Los accesos y vías que conectan los diferentes arboretos están en perfectas condiciones. Uno de los huertos clonales de pino radiata del País Vasco donde se conserva el material genético del programa de mejora genética de esta especie también se encuentra en esta finca. Unbemendi tiene una extensión de 22 Ha y actualmente está destinado a la investigación y la experimentación forestal.

AR19 - Unbemendi2

Local name: Unbemendi2
Municipality: Laukiz
Region: Basque Country / **Country:** Spain
Altitude (m): 121

Department in charge: Forestry Unit
Contact e-mail: basozaintza(at)neiker.net

Topography: low slope
Orientation: N
Slope (%): 5
Hydrology: free draining

pH (soil layer 0 - 30cm): 4.3
Type of Soil: CAMBISOLS
Subtype of Soil: dystric
Bedrock: marly limestone

Mean T (°C): 14
Mean T (°C) Coldest Month: 6.2
Mean Precipitation (mm): 1233
N Frost Days: 33

The Unbemendi arboreta are established in a land that belongs to the Provincial Council of Bizkaia (BFA). Unbemendi1 (AR18), Unbemendi2 (AR19) and Unbemendi3 (AR20) are 3 complete replicates of each arboretum to improve the robustness of the trial to test the responses to climate that these provenances show and to allow us to make powerful comparisons of their performance.

The climate data comes from WORLDCLIM- Global Climate data for the reference period of 1950-2000, except for the "frost days" figure, that has been recorded from the closest point in the CRU_CL_2.0 gridded datasets. It has to be pointed out that WORLDCLIM underestimates precipitation for the region and that CRU overestimates the number of frost days.

The Provincial Government ceded the land to the company Oihanberri in 1991: This Company was promoted by the Basque Government and the three provincial councils (Bizkaia, Gipuzkoa and Araba) to produce saplings of radiata pine (*Pinus radiata* D. Don) from genetically improved seeds. It was granted with 20 years of exploitation which could not be taken through to the end because, in 2004, the Basque Government proposed the dissolution of the company. The plot has several facilities that are not in use at the moment (a warehouse, a facility for drying pine cones, a greenhouse, etc.). All of these infrastructures could be recovered and restored if needed and taking into account the availability of funds for it. It also has an artificial pond where the water required for the irrigation needed during the plant production process could be taken. The access to the plot and various routes that connect the different arboreta are in perfect condition. One of the radiata pine clonal orchards of the Basque Autonomous Community, where the genetic material from the breeding program of this species in the Basque Country is preserved, is located in this property. Unbemendi, which extends over 22 ha, is currently kept for forest research and experimentation.

Los arboretos de Unbemendi se han establecido en un terreno propiedad de la Diputación Foral de Bizkaia (DFA/BFA). Unbemendi1 (AR18), Unbemendi2 (AR19) y Unbemendi3 (AR20) son 3 réplicas idénticas del mismo arboreto. Esto permite mejorar la robustez del ensayo a la hora de mostrar la respuesta al Cambio Climático de las diferentes procedencias de las especies ensayadas.

Los datos climáticos mostrados provienen de "WORLDCLIM- Global Change Data" para el periodo de referencia de 1950-2000, excepto los "días de helada (N Frost Days)" que se han tomado del punto más cercano en la malla de puntos de información de "CRU_CL_2.0". Cabe destacar que WORLDCLIM parece subestimar la precipitación de la región mientras que CRU sobreestima el número de días con heladas.

La Diputación Foral cedió el terreno a la empresa Oihanberri en 1991. Oihanberri fue promovida por el Gobierno Vasco y las tres Diputaciones Forales (Bizkaia, Gipuzkoa y Araba) para producir planta de pino radiata (Pinus radiata D. Don) procedente de semilla de material selecto. Aunque la cesión de explotación fue de 20 años, en 2004 el Gobierno Vasco propuso su disolución. La finca dispone de varias instalaciones en desuso (un almacén, una planta de secado de piñas, un invernadero, etc.).Todas estas infraestructuras se podrían recuperar y restaurar si fuese necesario, teniendo en cuenta la disponibilidad de fondos para ello. También cuenta con un estanque artificial de donde se podría extraer agua para el riego.

Los accesos y vías que conectan los diferentes arboretos están en perfectas condiciones. Uno de los huertos clonales de pino radiata del País Vasco donde se conserva el material genético del programa de mejora genética de esta especie también se encuentra en esta finca. Unbemendi tiene una extensión de 22 Ha y actualmente está destinado a la investigación y la experimentación forestal.

AR20 - Unbemendi3

Local name: Unbemendi3
Municipality: Laukiz
Region: Basque Country / **Country:** Spain
Altitude (m): 114

Department in charge: Forestry Unit
Contact e-mail: basozaintza(at)neiker.net

Topography: plain
Orientation: NE
Slope (%): 10
Hydrology: free draining with some flooded areas in wet conditions

pH (soil layer 0 - 30cm): 5.0
Type of Soil: CAMBISOLS
Subtype of Soil: dystric
Bedrock: marly limestone

Mean T (°C): 14
Mean T (°C) Coldest Month: 6.2
Mean Precipitation (mm): 1233
N Frost Days: 33

The Unbemendi arboreta are established in a land that belongs to the Provincial Council of Bizkaia (BFA). Unbemendi1 (AR18), Unbemendi2 (AR19) and Unbemendi3 (AR20) are 3 complete replicates of each arboretum to improve the robustness of the trial to test the responses to climate that these provenances show and to allow us to make powerful comparisons of their performance.

The climate data comes from WORLDCLIM- Global Climate data for the reference period of 1950-2000, except for the "frost days" figure, that has been recorded from the closest point in the CRU_CL_2.0 gridded datasets. It has to be pointed out that WORLDCLIM underestimates precipitation for the region and that CRU overestimates the number of frost days.

The Provincial Government ceded the land to the company Oihanberri in 1991: This Company was promoted by the Basque Government and the three provincial councils (Bizkaia, Gipuzkoa and Araba) to produce saplings of radiata pine (*Pinus radiata* D. Don) from genetically improved seeds. It was granted with 20 years of exploitation which could not be taken through to the end because, in 2004, the Basque Government proposed the dissolution of the company. The plot has several facilities that are not in use at the moment (a warehouse, a facility for drying pine cones, a greenhouse, etc.). All of these infrastructures could be recovered and restored if needed and taking into account the availability of funds for it. It also has an artificial pond where the water required for the irrigation needed during the plant production process could be taken. The access to the plot and various routes that connect the different arboreta are in perfect condition. One of the radiata pine clonal orchards of the Basque Autonomous Community, where the genetic material from the breeding program of this species in the Basque Country is preserved, is located in this property. Unbemendi, which extends over 22 ha, is currently kept for forest research and experimentation.

Los arboretos de Unbemendi se han establecido en un terreno propiedad de la Diputación Foral de Bizkaia (DFA/BFA). Unbemendi1 (AR18), Unbemendi2 (AR19) y Unbemendi3 (AR20) son 3 réplicas idénticas del mismo arboreto. Esto permite mejorar la robustez del ensayo a la hora de mostrar la respuesta al Cambio Climático de las diferentes procedencias de las especies ensayadas.

Los datos climáticos mostrados provienen de "WORLDCLIM- Global Change Data" para el periodo de referencia de 1950-2000, excepto los "días de helada (N Frost Days)" que se han tomado del punto más cercano en la malla de puntos de información de "CRU_CL_2.0". Cabe destacar que WORLDCLIM parece subestimar la precipitación de la región mientras que CRU sobreestima el número de días con heladas.

La Diputación Foral cedió el terreno a la empresa Oihanberri en 1991. Oihanberri fue promovida por el Gobierno Vasco y las tres Diputaciones Forales (Bizkaia, Gipuzkoa y Araba) para producir planta de pino radiata (Pinus radiata D. Don) procedente de semilla de material selecto. Aunque la cesión de explotación fue de 20 años, en 2004 el Gobierno Vasco propuso su disolución. La finca dispone de varias instalaciones en desuso (un almacén, una planta de secado de piñas, un invernadero, etc.).Todas estas infraestructuras se podrían recuperar y restaurar si fuese necesario, teniendo en cuenta la disponibilidad de fondos para ello. También cuenta con un estanque artificial de donde se podría extraer agua para el riego.

Los accesos y vías que conectan los diferentes arboretos están en perfectas condiciones. Uno de los huertos clonales de pino radiata del País Vasco donde se conserva el material genético del programa de mejora genética de esta especie también se encuentra en esta finca. Unbemendi tiene una extensión de 22 Ha y actualmente está destinado a la investigación y la experimentación forestal.

AR21 - Monte Corona

Local name: Monte Corona
Municipality: Valdáliga
Region: Cantabria / **Country:** Spain
Altitude (m): 245

Department in charge: Plant Production and Forest Resources. University of Valladolid
Contact e-mail: jdcasero(at)pvs.uva.es

Topography: low slope
Orientation: E
Slope (%): 10
Hydrology: waters under river Saja basin

pH (soil layer 0 - 30cm): 4.65
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: siltstone

Mean T (°C): 13
Mean T (°C) Coldest Month: 4
Mean Precipitation (mm): 1300
N Frost Days: 5

The arboretum is owned by the Treceño Neighborhood Board. The potential vegetation consists of; series Colino-Montana Orocantabrica, mesophytic galaico asturiana cantabroeuskalduna of *Fraxinus excelsior* (Polysticho setiferi-Fraxineto excelsioris sigmetum) ashes and oaks. (Source: Rivas Martinez, 1987).

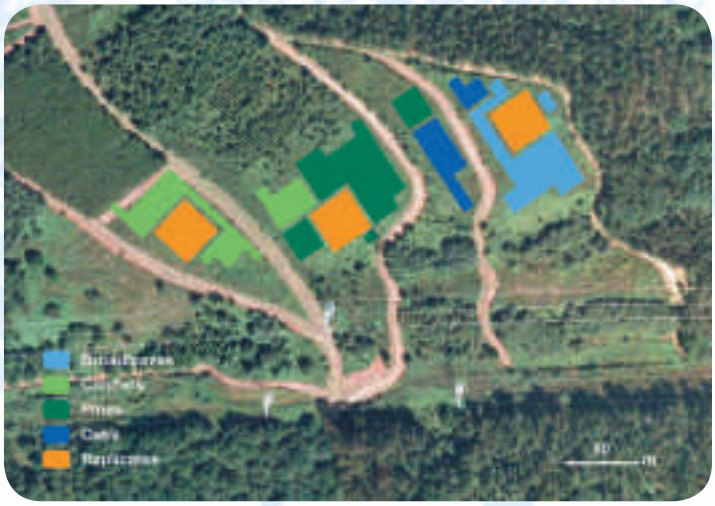
The arboretum is situated on what used to be an old forest plant nursery, and which is not currently in production. Nearby we can observe *Pinus sp.* and *Eucalyptus sp.* Status of the land before planting the arboretum: before the planting of the arboretum the land had a status of no tillage with abundant bush (*Rubus sp., and Ulex sp.*).

The species surrounding the arboretum present potential susceptibility to pests and diseases.

El arboreto pertenece a la Junta vecinal de Treceño. El tipo de vegetación potencial consiste en la serie colino-montana orocantabrica, cantabroeuskalduna y galaicoasturiana mesofítica del fresno (Fraxinus excelsior) (Polysticho setiferi-Fraxineto excelsioris sigmetum). Vegetación potencial: fresneda con robles. (Fuente: Rivas Martinez, 1987).

El arboreto se encuentra en un antiguo vivero de planta forestal, que actualmente no se encuentra en producción. En las inmediaciones se pueden observar plantaciones de Pinus sp. y Eucalyptus sp. Estado actual del terreno antes de plantar el arboreto: sin laboreo con abundante matorral (Rubus sp. y Ulex sp.)

La susceptibilidad a plagas y enfermedades proviene de las que puedan tener las especies de las inmediaciones.



AR22 - Irisasi

Local name: Irisasi
Municipality: Usurbil
Region: Basque Country / **Country:** Spain
Altitude (m): 240

Department in charge: Diputación Foral de Gipuzkoa / Gipuzkoako Foru Aldundia
Contact e-mail: forestal(at)hazi.es

Topography: hight slope
Orientation: NE
Slope (%): 7-50%
Hydrology: flat soil, without rivers

pH (soil layer 0 - 30cm): 6.5
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: marl

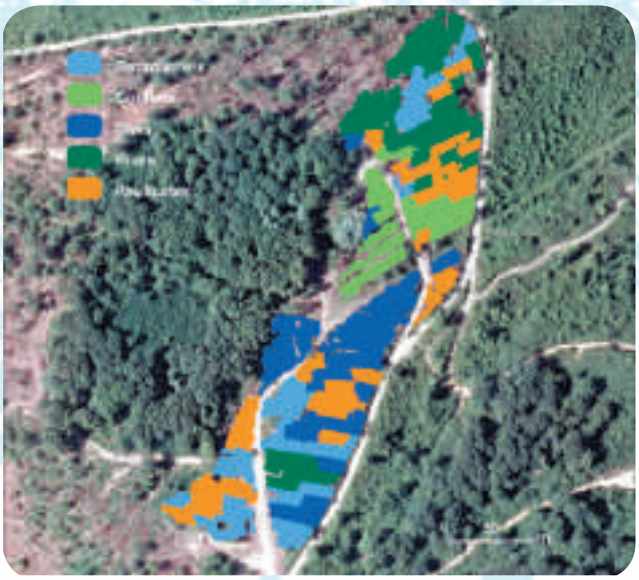
Mean T (°C): 13.5
Mean T (°C) Coldest Month: 8.6
Mean Precipitation (mm): 1500
N Frost Days: 13

The arboretum was planted in an old forest of radiata pine (40 years old) which was cut down in the summer of 2011.
All the forest labour which was needed after the cutting (clearing branches, stacking rests in rows) all had to be done by hand, because of the strong slopes. The land is property of Diputación Foral of Gipuzkoa, the provincial Government.
Its Forest Service gave permission to IKT/Hazi to establish this plantation at the end of 2011.

El arboreto fue plantado en una antigua plantación de pino radiata de 40 años, cortada en el verano de 2011.

Todas las labores posteriores a esa corta (limpieza y recogida de ramas, apilado de restos en filas) fueron realizadas de forma manual, a causa de las fuertes pendientes. El terreno es propiedad de la Diputación Foral de Gipuzkoa.

A finales de 2011, el Servicio Forestal de esta Diputación Foral dio permiso a IKT/Hazi con el fin de establecer este arboreto.



AR23 - Potes

Local name: Potes
Municipality: Potes
Region: Cantabria / **Country:** Spain
Altitude (m): 525

Department in charge: Plant Production and Forest Resources. University of Valladolid
Contact e-mail: jdcasero(at)pvs.uva.es

Topography: high slope
Orientation: NW
Slope (%): 50
Hydrology: waters under river Deva basin

pH (soil layer 0 - 30cm): 4.89
Type of Soil: CAMBISOLS
Subtype of Soil: umbric
Bedrock: sandstone

Mean T (°C): 13
Mean T (°C) Coldest Month: 0.1
Mean Precipitation (mm): 900
N Frost Days: 70

The arboretum is owned by the City Council of Potes . The potential vegetation consists of: Series Colino-Montana Orocantabrica relict of *Quercus rotundifolia* (Cephalanthero longifoliae - Querceto rotundifoliae sigmetum), *Arbutus unedo* siliceous Faciación (Source: Rivas Martinez, 1987).

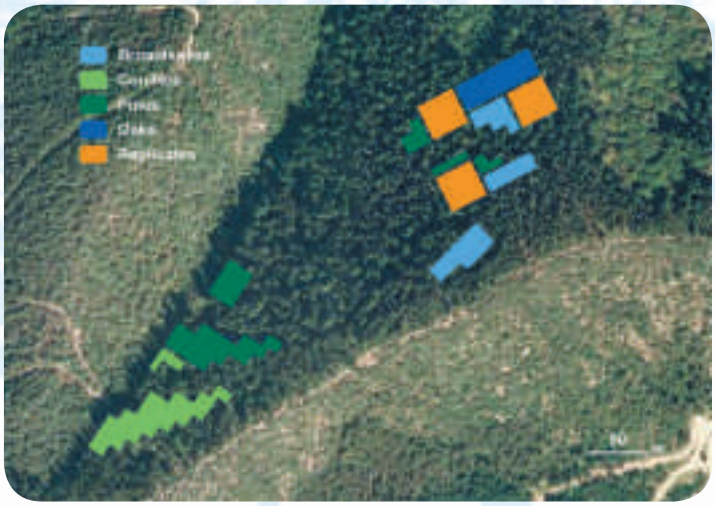
The arboretum is situated in an environment of scrubland and grassland next to Pinus plantations. A *Pinus radiata* forest of about 37 years of age was previously managed in this area.The *Pinus radiata* plantation is currently being cut and removed to give way to the arboretum.

The species surrounding the arboretum present potential susceptibility to pests and diseases.

El arboreto pertenece al Ayuntamiento de Potes. El tipo de vegetación potencial consiste en la serie colino-montana orocantabrica relicta de la encina o Quercus rotundifolia (Cephalanthero longifoliae – Querceto rotundifoliae sigmetum). Encinares. Faciación silicícola de Arbutus unedo. (Fuente: Rivas Martínez, 1987).

Descripción del entorno: zona de matorral próxima a pastizales y plantaciones del género pinus. Gestión anterior de la zona: masa forestal de pinus radiata de unos 37 años de edad. Estado actual del terreno antes de la plantación del arboreto: plantación de pinus radiata que actualmente se encuentra en proceso de corta y saca.

La susceptibilidad a plagas y enfermedades proviene de las que puedan tener las especies de las inmediaciones.



AR24 - Albinabehea

Local name: Albinabehea
Municipality: Aramaio
Region: Basque Country / **Country:** Spain
Altitude (m): 645

Department in charge: Diputación Foral de Alava / Arabako Foru Aldundia
Contact e-mail: forestal(at)hazi.es

Topography: middle slope
Orientation: S
Slope (%): 12-30
Hydrology: near a little river in the south border

pH (soil layer 0 - 30cm): 4.8
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: sandstone

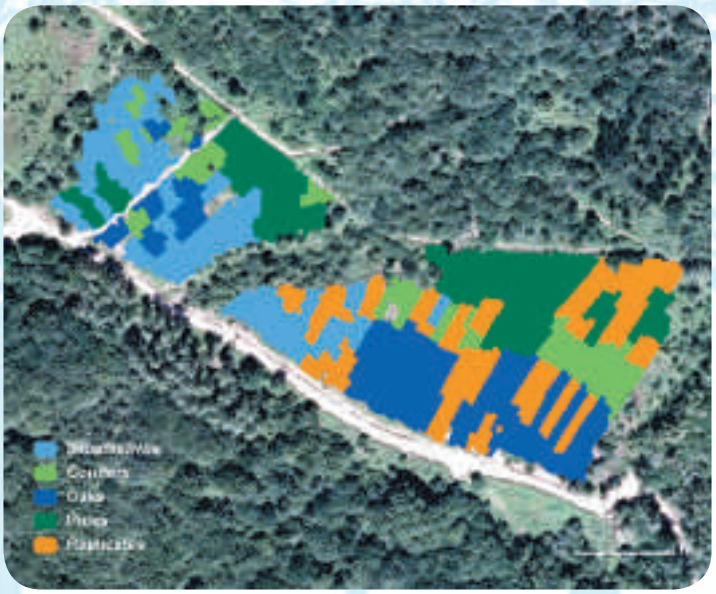
Mean T (°C): 11
Mean T (°C) Coldest Month: 5.2
Mean Precipitation (mm): 800
N Frost Days: 72

The arboretum was planted in an old forest of radiata pine (40 years old) which was cut down in the year 2007. The first labour before the new plantations (clearing, establishment of plantation holes) was done by machine in autumn 2011.

The land is property of Diputación Foral of Alava, the provincial Government. Its Forest Service gave permission to IKT/Hazi to establish this plantation at the end of 2011.

El arboreto fue plantado en una antigua plantación de pino radiata de 40 años, cortada en 2007. Las primeras labores previas a la nueva plantación (limpieza y recogida de ramas, ahoyado) fueron realizadas de forma mecánica en otoño de 2011.

El terreno es propiedad de la Diputación Foral de Álava. A finales de 2011, el Servicio Forestal de esta Diputación Foral dio permiso a IKT/Hazi con el fin de establecer este arboreto.



AR25 - Etxauri

Local name: Etxauri
Municipality: Etxauri
Region: Navarra / **Country:** Spain
Altitude (m): 430

Department in charge: European Projects
Contact e-mail: info(at)ganasa.es

Topography: plain
Orientation: flat
Slope (%): 0.5
Hydrology: arga river drainage basin, Mediterranean watershed

pH (soil layer 0 - 30cm): 7.9
Type of Soil: FLUVISOLS
Subtype of Soil: dystric-eutric
Bedrock: fluvial sands and gravels

Mean T (°C): 12.5
Mean T (°C) Coldest Month: 1.2
Mean Precipitation (mm): 770
N Frost Days: 50

The arboretum is located on a farm owned by the Government of Navarre who gave permission to Gestión Ambiental de Navarra S.A. for the installation of the arboretum. Part of the estate is occupied by a plantation of forest trees for timber production quality and also houses an experimental plot.

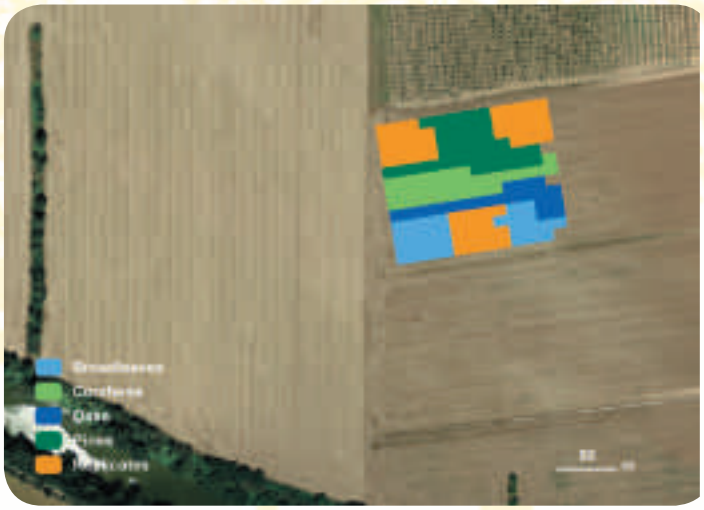
The rest of the farm is an area dedicated to grow agronomic cereal. Before installing the arboretum, in 2011, the area was used for cultivating oats. This site was chosen because it represents a localized climatic transition zone - Mediterranean transition with some Atlantic influence - which makes it different from any other arboreta nearby.

Besides, its location near Pamplona with good accessibility makes it ideal for outreach.

El arboreto se localiza en una finca propiedad del Gobierno de Navarra que dio el permiso para la instalación del arboreto a Gestion Ambiental de Navarra SA. Parte de la finca está ocupada por una plantación de árboles forestales para la producción de madera de calidad y también alberga una parcela experimental. El resto de la finca es un terreno agronómico dedicado al cultivo del cereal.

Antes de la instalación del arboreto, en 2011, la última cosecha cultivada fue avena. Este sitio fue elegido por localizarse en una zona de transición climática – mediterraneo de transición con cierta influencia atlántica – que la hace diferente de los otros arboretos próximos.

Además, su emplazamiento cerca de Pamplona y buena accesibilidad la hacen idónea para las actividades de divulgación.



AR26 - Cerráncanos

Local name: Cerráncanos
Municipality: Urraul Alto
Region: Navarra / **Country:** Spain
Altitude (m): 670

Department in charge: European Projects
Contact e-mail: info(at)ganasa.es

Topography: dale
Orientation: flat
Slope (%): 3.5
Hydrology: drainage basin: Areta river, which belongs to Aragon river drainage basin (Mediterranean watershed).

pH (soil layer 0 - 30cm): 7.9
Type of Soil: REGOSOLS
Subtype of Soil: dystric-eutric
Bedrock: marly limestone

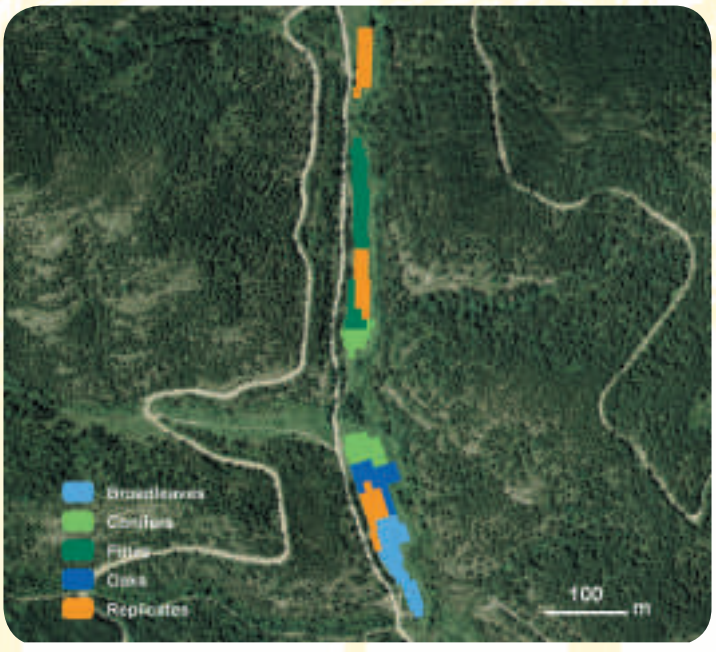
Mean T (°C): 12
Mean T (°C) Coldest Month: -1.1
Mean Precipitation (mm): 905
N Frost Days: 84

The site is part of the Forest Properties of Government of Navarra. Government of Navarra gave Gestión Ambiental de Navarra S.A. the permission to install one of the arboreta on this site. Before site preparation the shrubs covered approximately 70% of the area. The main species present are *Prunus spinosa* L., *Crataegus monogyna* Jacq. and *Ulex europeaus* L. There were also some isolated *Pinus sylvestris* L.

This site was chosen mainly due to its location and Pyrenean influence which makes it different from the other arboreta of the REINFFORCE project network.

Cerráncanos forma parte del Patrimonio Forestal del Gobierno de Navarra, el cual concedió a Gestión Ambiental de Navarra la autorización correspondiente para la instalación en este emplazamiento de uno de los arboretum. Antes de la preparación para la plantación, la cubierta arbustiva alcanzaba el 70% de la superficie. Las principales especies presentes eran Prunus spinosa, Crataegus monogyna y Ulex europeaus. También se encontraban individuos aislados de Pinus sylvestris.

Este lugar fue escogido por su localización e influencia pirenaica, que lo hace diferente del resto de arboretum que componen la red del proyecto REINFFORCE.



AR27 - Vidanes

Local name: Vidanes (León)
Municipality: Cistierna
Region: Castilla y León / **Country:** Spain
Altitude (m): 965

Department in charge: Plant Production and Forest Resources. University of Valladolid
Contact e-mail: jdcasero(at)pvs.uva.es

Topography: plane
Orientation: flat
Slope (%): 0
Hydrology: plot next to the Esla River, to the upper irrigation channel of Payuelos, and the valley of Valdehontanos stream

pH (soil layer 0 - 30cm): 5.04
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-humic
Bedrock: conglomerate

Mean T (°C): 9
Mean T (°C) Coldest Month: -1.6
Mean Precipitation (mm): 800
N Frost Days: 90

The arboretum is owned by the Vidanes Neighborhood Board . The potential vegetation consists of: (Supramediterránea carpetano-ibéricaleonesa) *Quercus pyrenaica, Quercus petraea* and *Pinus sylvestris* (Source: Rivas Martinez, 1987).

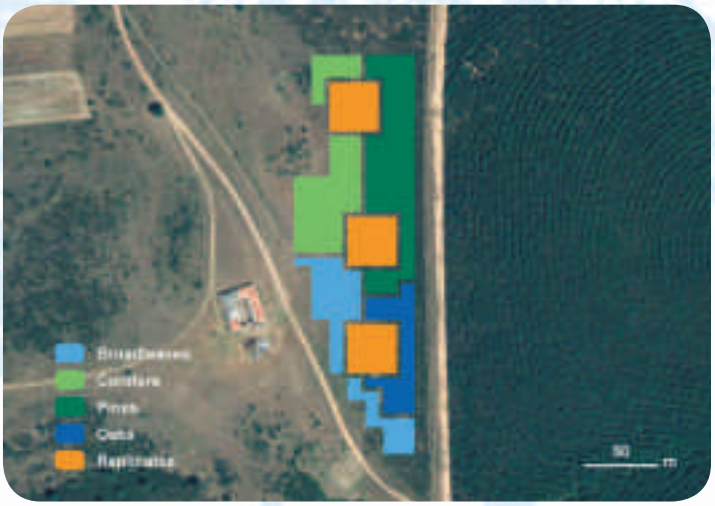
This environment now represents reforestation plantations with *Pinus nigra* and *Pinus sylvestris*. Previously the area was used as pasture for livestock, and later became a heath. The current situation of the land before planting the arboretum; the plot was covered by scrubs composed of several species of heather and *Erica australis*.

Also there were some pines (*Pinus sylvestris*) from old stocking and isolated oaks (*Quercus pyrenaica*). Concerning the susceptibility to pests and diseases, there have been sporadic episodes of processionary (*Thaumetopoea pityocampa*) and other defoliators such as *Tortrix viridana*.

El arboreto pertenece a la Junta vecinal de Vidanes. El tipo de vegetación potencial consiste en la (Supramediterránea carpetano-ibéricaleonesa) de Quercus pyrenaica, Quercus petraea y Pinus sylvestris. (Fuente: Rivas Martínez, 1987). Descripción del entorno: el entorno de la zona objeto de actuación se caracteriza por estar repoblado con Pinus nigra y Pinus sylvestris. Gestión anterior de la zona: anteriormente la zona se usaba como pasto para el ganado, convirtiéndose posteriormente en un brezal.

Estado actual del terreno antes de la plantación del arboreto: en la actualidad se encontraba cubierto por matorral compuesto de varias especies de brezo como Erica australis.

También se podían observar algunos pinos (Pinus sylvestris) procedentes de antiguas repoblaciones y robles aislados (Quercus pyrenaica). Susceptibilidad a plagas y enfermedades: no se ha detectado la existencia de ataques especialmente virulentos de plagas u otras enfermedades, si bien, han existido episodios esporádicos de procesionaria (thaumetopoea pityocampa) y de otros defoliadores como tortrix viridana.



AR28 - Escóbados de Abajo

Local name: Escóbados de Abajo (Burgos)
Municipality: Los Altos
Region: Castilla y León / **Country:** Spain
Altitude (m): 950

Department in charge: Plant Production and Forest Resources. University of Valladolid
Contact e-mail: jdcasero(at)pvs.uva.es

Topography: plane
Orientation: flat
Slope (%): 0
Hydrology: there is no permanent water-course that crosses the plot, although precipitation waters that run through the plot are tributaries of the Ebro Basin, Goose River subbasin

pH (soil layer 0 - 30cm): 5.70
Type of Soil: LEPTOSOLS
Subtype of Soil: nudilithic-lithic
Bedrock: limestone

Mean T (°C): 9
Mean T (°C) Coldest Month: -1.1
Mean Precipitation (mm): 925
N Frost Days: 80

The arboretum is owned by the City council of Los Altos . The potential vegetation consists of: Series supra-mesomediterranean carpetana western, sanabriense orensano and wet-hiper-wet leonesa siliceous of *Quercus pyrenaica* (Holco mollis-Querceto pyrenaicae sigmetum) and Series supramediterránea Castilian-Cantabrian and Estellesa-Riojana basophilic of *Quercus faginea* (Epipactidi helleborines-fagineae Querceto sigmetum), depending on the substrate. (Source: Rivas Martinez, 1987).

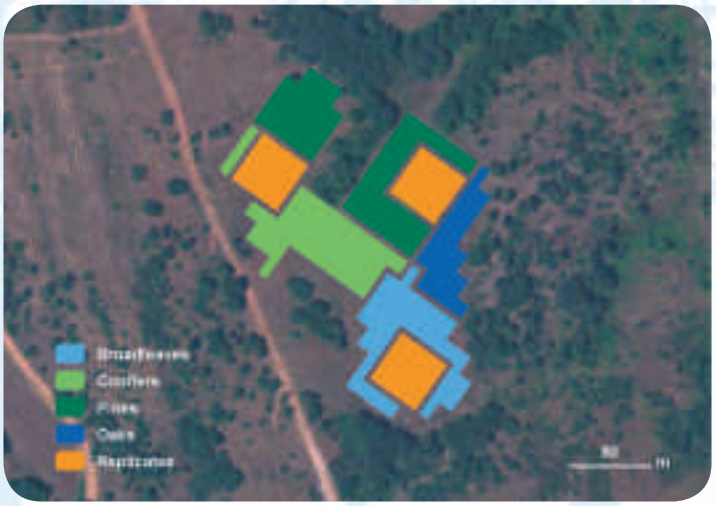
The environment of the plot is currently populated by *Quercus pyrenaica* and dispersed *Pinus pinaster* plants, *Genista hispanica* scrub in areas where the limestone substrate replaces the sandstones, and by *Quercus faginea*. Previously the area was used as cultivation land. The surroundings were reforested by a mixture of *Pinus pinaster* and *Quercus pyrenaica*. Before the planting of the arboretum, the plot was covered by grasslands. The land was cultivated for up to 5 or 6 years, and in August 2003, the area suffered a fire.

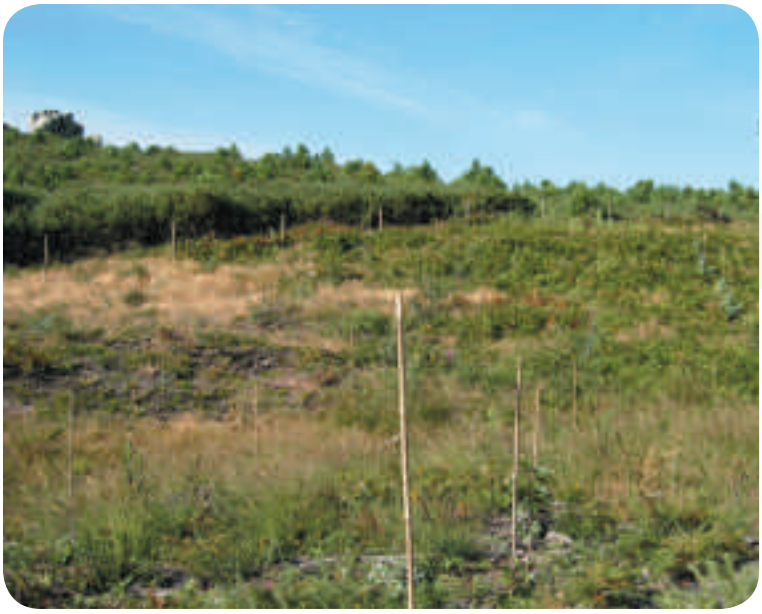
There has been no detection of the existence of particularly virulent pest attacks and other diseases in the area.

El arboreto pertenece al Ayuntamiento de Los Altos.El tipo de vegetación potencial consiste en la serie supra-meso-mediterránea carpetana occidental, orensanosanabriense y leonesa húmedo-hiperhúmeda silicícola de Quercus pyrenaica o roble melojo (Holco mollis-Querceto pyrenaicae sigmetum) y Serie supramediterránea castellano-cantábrica y riojanoestellesa basófila de Quercus faginea o quejigo (Epipactidi helleborines-Querceto fagineae sigmetum), según sustrato. (Fuente: Rivas Martínez, 1987).

Descripción del entorno: el entorno de la parcela está poblado en la actualidad por quercus pyrenaica en matas con pinus pinaster dispersos, por matorral de genista hispanica en las zonas donde el sustrato calizo sustituye a las areniscas, y por quercus faginea. Gestión anterior de la zona: anteriormente la zona se usaba como tierra de cultivo. Los alrededores estaban poblados por una mezcla de pino resinero y rebollo. Estado actual del terreno antes de la plantación del arboreto: zona de pastizal. Hasta 5 o 6 años estuvo cultivada. En agosto de 2003 la zona sufrió un incendio.

Susceptibilidad a plagas y enfermedades: no se ha detectado la existencia de ataques especialmente virulentos de plagas u otras enfermedades.





AR29 - Caamaño-Monte Esperoi

Local name: Caamaño-Monte Esperoi
Municipality: Porto do Son
Region: Galicia / **Country:** Spain
Altitude (m): 217

Department in charge: Centro de Investigación Forestal de Lourizán
Contact e-mail: infolourizan.mr(at)xunta.es

Topography: middle slope
Orientation: SW
Slope (%): 10
Hydrology: middle slope in the sub-basin of Sieira river, in the area of the Tambre river estuary called "Ria de Muros e Noia" open to the Atlantic ocean

pH (soil layer 0 - 30cm): 4.3
Type of Soil: UMBRISOLS
Subtype of Soil: cambic
Bedrock: acid to intermediate plutonic rocks

Mean T (°C): 13.1
Mean T (°C) Coldest Month: 6
Mean Precipitation (mm): 1322
N Frost Days: 0

This forest area was occupied by a young mixed stand of *Eucalyptus globulus* with *Acacia melanoxylon* and *Salix atrocinerea*. The history of this place is marked by repeated wildfires and successive plantations with pines, *Pinus radiata* or *Pinus pinaster*, and *Eucalyptus globulus*. Occasionally some trees were removed mainly for fuel use. Actually, the good forest management of the area keeps fire far from the plantations.

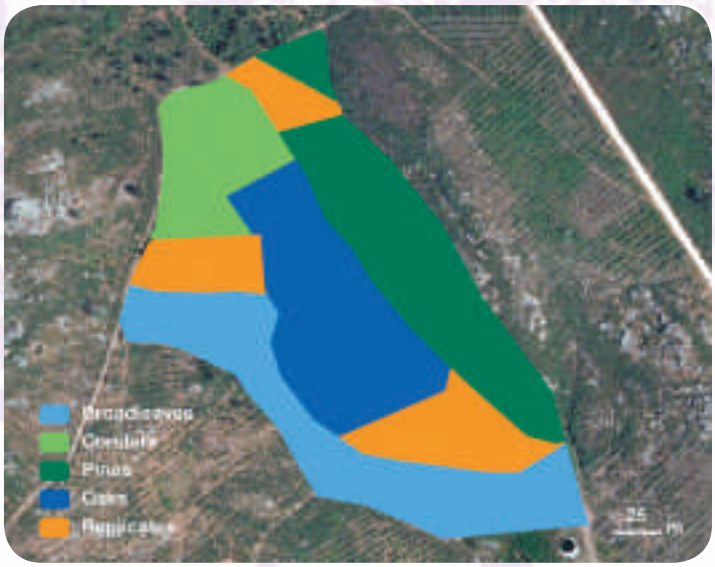
AR29 is placed on a private land. The land is owned and managed by a Neighborhood Forest Association, typical of Galician culture. All the forest area belongs to a territorial demarcation, "parroquia", which joins all the neighborhood members. Each citizen owns a percentage of the whole indivisible forest area and the management must be agreed with all the members of the community by a common consent. In Galicia, this way of forest property is called "Neighborhood Forest in Common Hand".

We asked for the permission to the Neighborhood Forest of Graiade, Marandán and Miguelís, and they, by common consent, gave us a cession to use a 2 ha land during 15 years since June 14th 2011 and according to REINFFORCE project objectives. We selected this place on the basis of an altitude criterion, since the other oceanic arboretum AR31 was established near sea level.

Esta zona forestal estaba ocupada por una masa mixta dominada por Eucalyptus globulus con presencia de Acacia melanoxylon y Salix atrocinerea. El lugar tiene una historia de fuegos repetidos intercalados con repoblaciones de pinos (Pinus radiata or Pinus pinaster) y Eucalyptus globulus, en las que se hacían extracciones periódicas de pies para leña. Actualmente, un manejo forestal adecuado mantiene el fuego alejado de las plantaciones.

La finca es de propiedad privada. Está gestionada por una Comunidad de Montes Vecinales en Mano Común que además tiene la propiedad del terreno y que constituye un régimen de propiedad característico en los montes gallegos. Todo el monte pertenece a la parroquia, que incluye a todos los vecinos. Cada parroquiano posee un porcentaje de toda la superficie forestal indivisible que se gestiona de común acuerdo.

Se ha solicitado permiso para la instalación del arboreto a la CMVMC de Graiade, Marandán y Miguelís y, de común acuerdo, han cedido al CIF el uso de 2ha de superficie forestal durante 15 años con el objetivo de instalar el arboreto REINFFORCE. La selección de esta ubicación está basada en el criterio de altitud, ya que el AR31 ubicado también en una zona de clima oceánico está prácticamente a nivel del mar.



AR30 - A Veiga-Finca Robles

Local name: A Veiga-Finca Robles
Municipality: Pobra de Brollon
Region: Galicia / **Country:** Spain
Altitude (m): 420

Department in charge: Centro de Investigación Forestal de Lourizán
Contact e-mail: infolourizan.mr(at)xunta.es

Topography: terrace
Orientation: SW
Slope (%): 2
Hydrology: terrace situated in the river Cabe basin, included in the Monforte cuaternary depression

pH (soil layer 0 - 30cm): 4.9
Type of Soil: UMBRISOLS
Subtype of Soil: gleyic
Bedrock: acid regional metamorphic rocks

Mean T (°C): 12.8
Mean T (°C) Coldest Month: 2.1
Mean Precipitation (mm): 1051
N Frost Days: 43

'Finca Granxa Robles' was a private land whose owner, José María Gil-Robles (1898-1980) jurist, politician, university professor was the War Ministry in the past. He sold the farm in 1949 to the national State to create a Research Agrarian Centre. Later, in 1993 the land was transferred to the Galician autonomic administration, Xunta de Galicia. Now, is a public property managed by the Agrarian Research Centre of Mabegondo CIAM, subordinated as CIF Lourizán, to the Rural Environment and Sea Department of the autonomic administration, Xunta de Galicia.

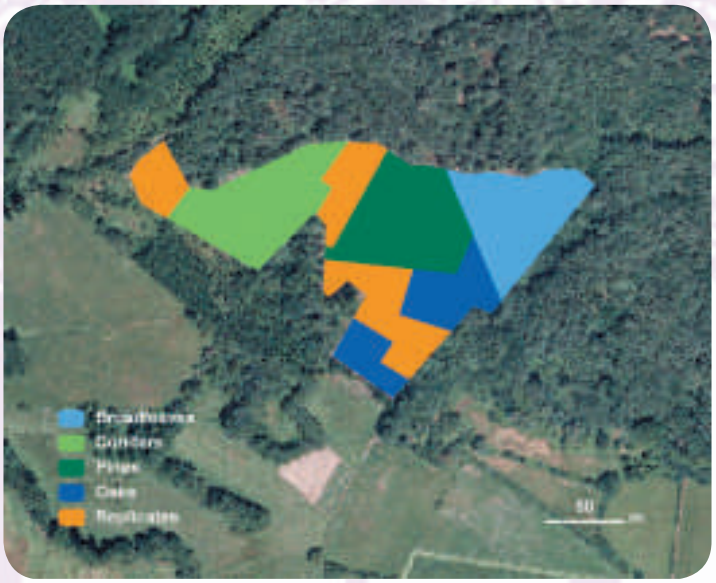
Permission to establish the experimental plot was asked to the responsible of research in this agricultural and livestock farmland. The CIAM, as an institute belonging to the autonomic administration, Xunta de Galicia, is the responsible of the management and conservation of this place, executed by their own CIAM staff. They give us permission to manage a delimited forest area occupying 2ha, inside the farmland. The local area where the arboretum was setting was occupied by a natural shrubland and oakwood forest.

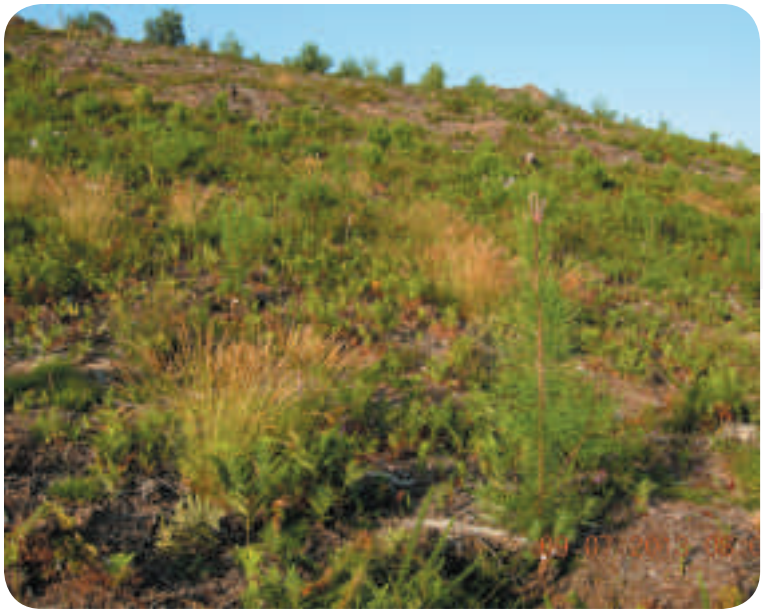
The location was choose because is a representative Mediterranean area of Galicia, with significant summer drought, and more extreme temperatures than in coastal places (AR29 and AR31) due to it continental character. Under a floristic point of view, is included in the boundary area between Eurosiberian and Mediterranean Region.

El predio 'Granxa Robles' fue una propiedad privada de José María Gil-Robles (1898-1980) jurista, político, catedrático de universidad y Ministro de la Guerra en el pasado. Vendió la granja al Estado en 1949 con el fin de crear en ella un centro de investigación agraria. Más tarde, en 1993, la finca fue transferida a la admisnistración autonómica, Xunta de Galicia.

Actualmente, es de propiedad pública y está adscrita al Centro de Investigaciones Agrarias de Mabegondo, subordinado como el CIF de Lourizán, a la Consellería de Medio Rural y Mar de la Xunta de Galicia. Se solicitó el permiso para establecer el arboreto AR30 al responsable de investigación de esta granja agrícola y ganadera. El CIAM, que forma parte de la administración autonómica, es el responsable del manejo y conservación de este predio, para lo cual cuenta con personal propio. El permiso concedido afecta a una superficie de 2ha de terreno forestal incluido en los terrenos de la granja. El arboreto se estableció en una zona forestal constituida por un rodal de rebollo con abundante matorral.

Se eligió esta ubicación por pertenecer a la región mediterránea de Galicia, con sequía estival significativa y temperaturas más extremas debido a su carácter continental, a diferencia de las áreas costeras (AR29 y AR31). Desde el punto de vista florístico, está incluído en el área de transición entre las regiones Eurosiberiana y Atlántica.





AR31 - Lourizán

Local name: Lourizán
Municipality: Pontevedra
Region: Galicia / **Country:** Spain
Altitude (m): 120

Department in charge: Centro de Investigación Forestal de Lourizán
Contact e-mail: infolourizan.mr(at)xunta.es

Topography: middle slope
Orientation: NE
Slope (%): 21
Hydrology: middle slope in the river Lérez basin, in the area of the estuary called "Ria de Pontevedra" open to the Atlantic ocean

pH (soil layer 0 - 30cm): 4.6
Type of Soil: CAMBISOLS
Subtype of Soil: umbric
Bedrock: acid to intermediate plutonic rocks

Mean T (°C): 14.3
Mean T (°C) Coldest Month: 7.0
Mean Precipitation (mm): 1716
N Frost Days: 8

Lourizán REINFFORCE arboretum (AR31) is situated inside the area of the Forest Research Center of Lourizán (CIF). The plot where the arboretum AR31 was established was previously occupied by a eucalyptus forest (mainly, *Eucalyptus linearis*) since 1976. The Botanical Garden was initially created as Lourizán Arboretum in 1943 and includes a Herbarium (50,000 sheets), the School of Forestry Formation and Experimentation and the Forestry Research Centre. Besides the gardens, there are some outstanding collections as the Coniferetum and Eucalyptetum, Castanea alive germoplasm, representative species of the Iberian Peninsula and trees from such diverse provenances as New Zealand, Australia, USA, Taiwan, etc.

The CIF occupies 54 ha under a public property regime and then, permission was implicit to the use of the plot. The administrative organism Secretary to Rural Environment and Forests – Xunta de Galicia, is the responsible of the management and conservation of this place, executed by our own CIF staff. The location was choose because is a representative coastal area, with warm winter and humid weather, were most of the species and provenances could be successful and, also, because it was interesting to join together this experience with a lot of previous experiments in forest research from 1955 to today. Moreover, the access to the plot by other research institutes for further collaborative projects is guaranteed. Under a floristic point of view, is included in the Eurosiberian Region, in the Atlantic province, as a border point of the boundary between Eurosiberian and Mediterranean regions.

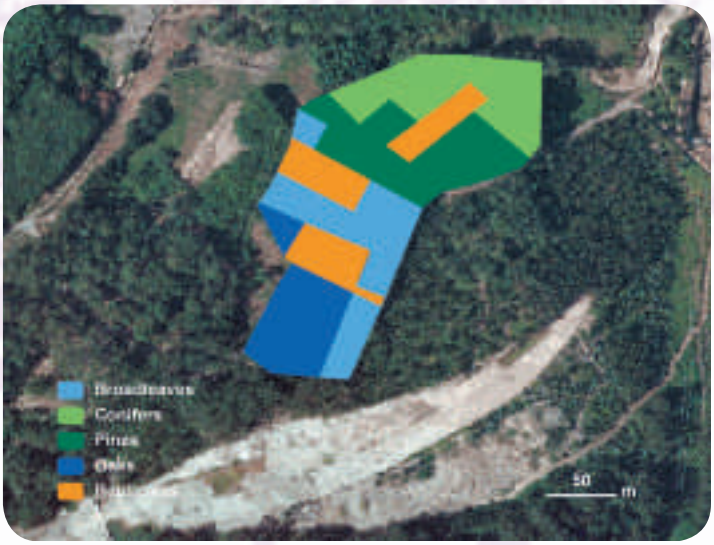
The land belonged to Eugenio Montero Ríos (1832-1914) jurist, politician, university professor and President of the Minister Council, in 1943 was bought by the provincial government 'Diputación de Pontevedra' and since then was transferred to different public institutions, finally was assigned to Autonomic Administration, Xunta de Galicia, for forestry formation and research activities. The Palace of Lourizán, during the time Montero Ríos was the Prime Minister of Spain, became a meeting point for politicians, journalists and relevant personalities of that time.

El arboreto REINFFORCE de Lourizán (AR31) está ubicado en el predio del Centro de Investigación Forestal de Lourizán (CIF). En la parcela que ocupa había un eucaliptal, ocupado mayoritariamente por Eucalyptus linearis que se habían plantado en 1976. El Jardín Botánico fue creado inicialmente como Arboreto de Lourizán en 1943 e incluye un Herbario (50000 pliegos), la Escuela de Formación y Experimentación Agroforestal y el Centro de Investigación Forestal. Además de los jardines, comprende notables colecciones como el Pinetum, el Eucalyptetum, la colección de germoplasma vivo de Castanea, especies representativas de la Península Ibérica y árboles de procedencias tan diversas como Nueva Zelanda, Australia, USA, Taiwan, etc.

El CIF ocupa una superficie de 54 ha bajo un régimen de propiedad pública por lo que el permiso de instalación está implícito en el propio uso de la parcela. El organismo administrativo, Secretaría Xeral de Medio Rural e Montes – Xunta de Galicia, es el responsable del mantenimiento y la conservación del predio, que se ejecuta con personal propio.

La selección del sitio se hizo por su carácter de área costera con inviernos templados y clima húmedo, en la que las especies y procedencias seleccionadas podrían prosperar y por el interés que supone reunir en el mismo Centro de Investigación un conjunto notable de experiencias forestales desde 1955 hasta hoy. Además, permite garantizar el acceso de otros centros de investigación a la parcela de cara a la participación conjunta en futuros proyectos.

El predio perteneció a Eugenio Montero Ríos (1832-1914) jurista, político, profesor de universidad y Presidente del Consejo de Ministros, en 1943 fue adquirida por la Diputación Provincial de Pontevedra y desde entonces cedida a diferentes administraciones públicas, actualmente a la administración autonómica, Xunta de Galicia, para actividades de investigación y enseñanzas forestales. El palacio de Lourizán durante la etapa en la que Montero Ríos fue Presidente del Gobierno, se convirtió en el centro de reunión de políticos, periodistas y personalidades relevantes de la época.



AR32 - Moral de Hornuez

Local name: Moral de Hornuez (Segovia)
Municipality: Moral de Hornuez
Region: Castilla y León / **Country:** Spain
Altitude (m): 1195

Department in charge: Plant Production and Forest Resources. University of Valladolid
Contact e-mail: jdcasero(at)pvs.uva.es

Topography: plane
Orientation: flat
Slope (%): 0
Hydrology: there is no permanent water-course that crosses the plot, although precipitation waters that run through the plot are tributaries of the Duero Basin, and Riaza River subbasin

pH (soil layer 0 - 30cm): 5.58
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: limestone

Mean T (°C): 10.7
Mean T (°C) Coldest Month: -2.3
Mean Precipitation (mm): 500
N Frost Days: 95

The arboretum is owned by the City council of Moral de Hornuez.The potential vegetation consists of: Serie 22a Supramediterranean castellanomaestrazgo-manchega basophilic of *Quercus rotundifolia* (Junipero thuriferae-querceto rotundifoliae sigmetum). (Source: Rivas Martinez, 1987).

The environment is characterized by its morphology observed as a more or less smooth transition between the Sierra de Pradales, (small saw culminating at 1377 m. on the hill called "Peñacuerno"), and Riaza river valleys. Currently there are no trees as a consequence of the fire in August 2008, which burned down about 900 ha. Now the vegetation is limited to the colonizing of herbaceous like the yellow lupine (*Lupinus hispanicus*) and asphodel (*Asphodelus albus*).

In 2010 began the restoration and reforest works on the area affected by the fire. Previously was present stands of *Pinus pinaster* orderly using the method of moving sections. The turn will be articulated in 80 years with an implementation period of 20 years. The stand on which is located the plot was in the Regeneration Group, and the current status of the land before planting the arboretum is a clean burned area with short stumps formed by post-fire cuts.

Until 2008 it was populated with *Pinus pinaster* from natural regeneration. There has been no detection of the existence of particularly virulent pest attacks and other diseases, but there have been sporadic episodes of processionary (*Thaumetopoea pityocampa*).

El arboreto pertenece al Ayuntamiento de Moral de Hornuez. El tipo de vegetación potencial consiste en la serie 22a (Supramediterránea castellanomaestrazgo-manchega basófila de la encina (Quercus rotundifolia).Junipero thuriferae-querceto rotundifoliae sigmetum (Fuente: Rivas Martínez, 1987).

Descripción del entorno: el entorno de la zona objeto de actuación se caracteriza por su morfología de relieve más o menos suave transición entre la denominada sierra de pradales, pequeña sierra que culmina a 1.377 m. en el cerro denominado "peñacuerno", y los valles del riaza. En la actualidad no existe vegetación arbórea como consecuencia del incendio acaecido en agosto de 2008. La vegetación actual se limita a la existencia de herbáceas colonizadoras entre las que destacan el altramuz amarillo (Lupinus hispanicus) y el gamón (Asphodelus albus).

Se ha comenzado en el año 2010 la restauración de la zona quemada. Gestión anterior de la zona: masa de Pinus pinaster ordenada mediante el método de tramo móvil y un turno de 80 años articulado en un periodo de aplicación de 20 años. El rodal en el que se encuentra la parcela estaba en el Grupo de Regeneración. Estado actual del terreno antes de la plantación del arboreto: raso. Hasta 2008 estaba poblado de Pinus pinaster procedente de regeneración natural.

En agosto de 2008 sufrió un incendio y en la actualidad se encuentra raso con los tocones procedentes de la corta posterior al incendio. Susceptibilidad a plagas y enfermedades: no se ha detectado la existencia de ataques especialmente virulentos de plagas u otras enfermedades, si bien, han existido episodios esporádicos de procesionaria (thaumetopoea pityocampa).

Instituto Superior de Agronomia
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AR33 - Vila Real

Local name: Vila Real
Municipality: Trás os Montes e Alto Douro
Region: Norte / **Country:** Portugal
Altitude (m): 400

Department in charge: DRAT - Departamento dos Recursos Naturais, Ambiente e Território
Contact e-mail: reinfforce(at)isa.utl.pt

Topography: middle slope
Orientation: NW
Slope (%): 19
Hydrology: site is situated in the Douro hydrographic basin. The lower part of site is 5-10 m apart from seasonal water course, which flows through parcel 1

pH (soil layer 0 - 30cm): 4.5
Type of Soil: LEPTOSOLS
Subtype of Soil: eutric
Bedrock: acid to intermediate plutonic rocks

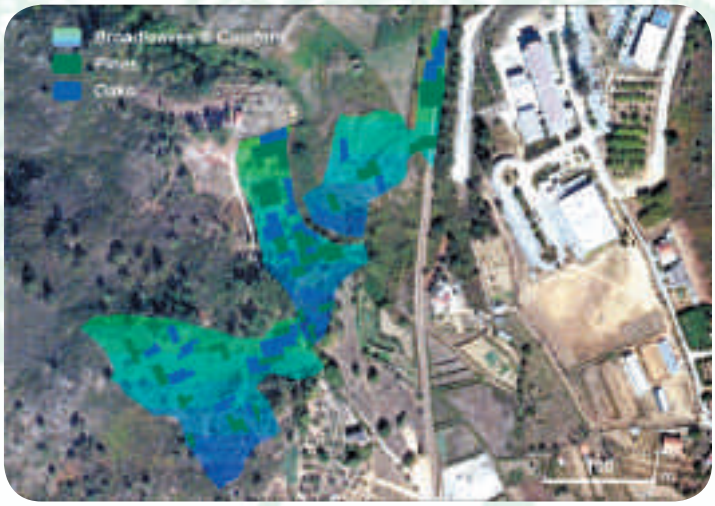
Mean T (°C): 13.4
Mean T (°C) Coldest Month: 2.6
Mean Precipitation (mm): 1128
N Frost Days: 30

The arboretum site is located in Universidade de Trás-os-Montes e Alto Douro (UTAD) terrain, administrated by the University, which showed great interest when presented with the possibility of installing the proposed structure. UTAD is engaged in forestry research and education, so this collaboration guarantees that site management and monitoring tasks are performed more proficiently.

The arboretum is divided into 2 parcels, separated from each other by a 3m wide dirt road. The parcels are: -P1, 1,5 ha, previously occupied by *Castanea sativa* stand and pasture, with seasonal water line running through it ; -P2, 1 ha, previously occupied by *Pinus pinaster* stand. Soil preparation for arboreta installation was initiated in December 2011, consisting mainly in cutting the *C. sativa* and *P. pinaster* trees, and spontaneous vegetation removal/ control. This site was used for forest production and pasture.

Este arboretum encontra-se localizado num terreno propriedade da Universidade de Trás-os-Montes e Alto Douro (UTAD), administrado pela própria Universidade, a qual demonstrou grande interesse perante a proposta de instalação desta estrutura. A UTAD conta com uma grande tradição no ensino e investigação florestal, portanto esta colaboração permite que as tarefas de manutenção e monitorização sejam executadas com grande eficiência.

O arboretum é formado por duas parcelas, separadas por uma estrada de terra batida com 3 m de largura: -P1, de 1.5 ha, ocupada anteriormente por um povoamento de Castanea sativa e pastagem, e cortada a meio por uma linha de água temporária; -P2, de 1 ha, ocupada anteriormente por um povoamento de Pinus pinaster. A preparação das parcelas foi iniciada em Dezembro de 2011, consistindo principalmente nos cortes dos povoamentos de C. sativa e P. pinaster, e controlo da vegetação espontânea. O local onde está instalado actualmente o arboretum foi utilizado anteriormente para produção florestal e pastoreio.



Instituto Superior de Agronomia
Universidade Técnica de Lisboa

AR34 - Sintra

Local name: Sintra
Municipality: Sintra
Region: Centro / **Country:** Portugal
Altitude (m): 400

Department in charge: DRAT - Departamento dos Recursosn Naturais, Ambiente e Território
Contact e-mail: reinfforce(at)isa.utl.pt

Topography: middle slope
Orientation: NW
Slope (%): 19
Hydrology: site is situated in the Tagus hydrographic basin. The lower part of site is 5-10 m apart from seasonal water course, which flows along the site margin

pH (soil layer 0 - 30cm): 4.31
Type of Soil: CAMBISOLS
Subtype of Soil: humic
Bedrock: acid to intermediate plutonic rocks

Mean T (°C): 13.6
Mean T (°C) Coldest Month: 5.4
Mean Precipitation (mm): 1019
N Frost Days: 1

The arboretum site is located in the Sintra – Cascais Natural Park. The terrain is public property, administrated by Parques de Sintra – Monte da Lua (PSML). PSML showed great interest when presented with the possibility to install the proposed structure. Collaborating with PSML, which has several ongoing projects in forestry research and environmental education, allows for the structure to be properly maintained, for educational and REINFFORCE research purposes.

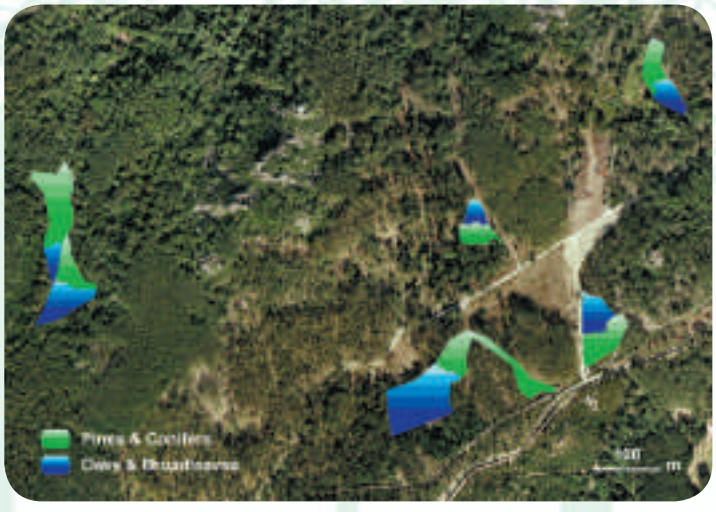
The arboretum is divided in 2 groups of parcels, located inside 2 walled sites : -P1, in Tapada das Roças, previously occupied by *Acacia sp.* and *Pitosporum undulatum*. -P2, in Tapada do Mouco, previously occupied by *Eucalyptus globulus*, *Acacia sp.* and *Pitosporum undulatum*.

Soil preparation for arboretum installation was initiated in June 2012, consisting mainly in cutting *Acacia sp., Pitosporum undulatum*, and spontaneous vegetation removal/ control.

O arboretum está localizado no Parque Natural de Sintra – Cascais. O terreno é propriedade pública, gerido pela empresa Parques de Sintra – Monte da Lua (PSML). A colaboração da PSML, que está envolvida em vários projectos de investigação florestal e educação ambiental, assegura a manutenção das parcelas, tanto para fins educativos, como de investigação, no âmbito do REINFFORCE.

O arboretum encontra-se dividido em 2 grupos de parcelas, sitadas em 2 áreas muradas, que se encontram a 500m de distância: -P1, na Tapada das Roças, com ocupação anterior por s, Acacia sp. e Pitosporum undulatum.; -P2, na Tapada do Mouco, com ocupação anterior por Eucalyptus globulus, Acacia sp., Pitosporum undulatum..

A preparação das parcelas iniciou-se em Junho de 2012, e consistiu principalmente no corte e controlo de Acacia sp., Pitosporum undulatum, e vegetação espontânea.



Instituto Superior de Agronomia
Universidade Técnica de Lisboa

AR35 - Tapada da Ajuda

Local name: Tapada da Ajuda
Municipality: Lisboa
Region: Lisboa / **Country:** Portugal
Altitude (m): 106

Department in charge: DRAT - Departamento dos Recursosn Naturais, Ambiente e Território
Contact e-mail: reinfforce(at)isa.utl.pt

Topography: middle slope
Orientation: E
Slope (%): 8
Hydrology: site is situated in the Tagus hydrographic basin. The lower part of site is 10-15 m apart from seasonal water course, which flows some 250m along the site margin

pH (soil layer 0 - 30cm): 6.44
Type of Soil: LEPTOSOLS
Subtype of Soil: vertic
Bedrock: basic to ultrabasic volcanic rocks

Mean T (°C): 17.5
Mean T (°C) Coldest Month: 7.2
Mean Precipitation (mm): 823
N Frost Days: 0

The arboretum site is located at Tapada da Ajuda, which is a walled Public Property covering 100 ha, where Instituto Superior de Agronomia (ISA) is located. The area is managed by ISA, mainly for educational and research purposes. ISA proffers teaching and research excellence in agronomy, forestry, biology, environment, food, zootechnics and landscape architecture, and includes the climate change impact theme as one of its major action topics. ISA board promptly accepted the possibility to install an arboretum in its intramural area. Nowadays, "Tapada da Ajuda" has an area of approximately 100 hectares. Since the XVI century it was used as a royal hunting reserve. In 1910, with the establishment of the Republic, this area was given to the Institute of Agronomy (ISA) "for the educational benefit of farmers or any other visitors, as well as for tuition of children and students of all schools" as specifically mentioned in the conveyance deed.

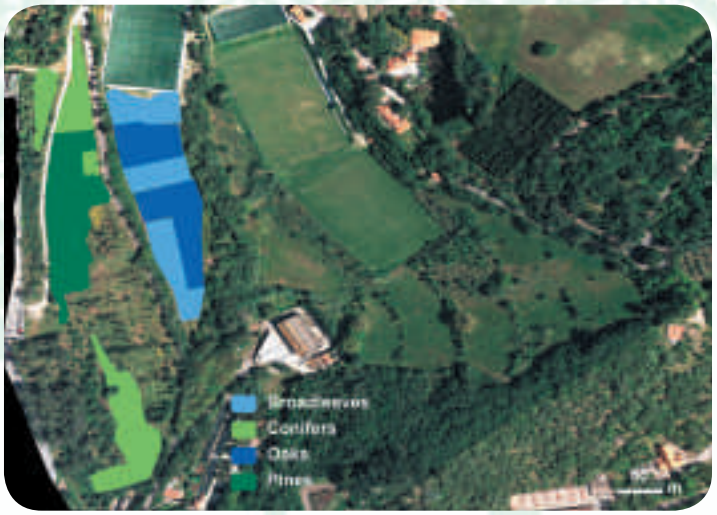
Awareness of the heritage value of "Tapada da Ajuda" led to the classification of the existing intramural structures as Property of Public Interest under a protection law (nº5/2002, Official Bulletin No.42 of 19th February, 2002). This location coincides with REINFFORCE's Portuguese Team headquarters, allowing for more frequent monitoring.

The Tapada da Ajuda arboretum is the most Southern arboretum of the network. The arboretum is divided into 2 parcels, separated from each other by a 6m wide road. The parcels are: -P1, 1 ha, which was fully occupied with *Acacia sp.*, since the 1940's, but where conifers are now installed; -P2, 1 ha, previously used for grazing, where broadleaves are now installed. Soil preparation for the arboretum installation was initiated in September 2011, consisting mainly in Acacia and spontaneous vegetation removal/ control.

Este arboretum está situado dentro da zona murada da Tapada da Ajuda. Trata-se de um terreno público, completamente vedado, de acesso controlado, com cerca de 100 ha, gerido pelo Instituto Superior de Agronomia (ISA). Esta escola da Universidade Técnica de Lisboa, que comemorou, em 2010, os 100 anos de existência, oferece ensino e investigação de excelência nas seguintes áreas: agronómica, florestal, biológica, ambiental, alimentar, zootécnica e arquitetura paisagista, que abordam o tema das alterações climáticas e seus efeitos. Desde o final do sec XVI a Tapada da Ajuda foi terreno vedado dedicado exclusivamente à utilização Real para caça. Com a implantação da República, este espaço foi cedido ao Instituto Superior de Agronomia (ISA) "para instrução dos agricultores ou de quaisquer outros visitantes, bem como para a lição de coisas às crianças e alunos de todas as escolas".

O reconhecimento do valor patrimonial da Tapada da Ajuda conduziu à sua classificação como Imóvel de Interesse Público (conjunto intramuros) encontrando-se sob um regime de protecção de acordo com o Decreto n.º 5/2002, Diário da República n.º 42 de 19 Fevereiro de 2002. A localização deste arboretum coincide com a sede da equipa coordenadora do REINFFORCE em Portugal.

Salienta-se ainda que este é o arboretum situado mais a Sul da rede do REINFFORCE. O arboretum encontra-se dividido em duas parcelas, separadas por uma estrada alcatroada de 6 m de largura. As parcelas são: -P1, de 1 ha, que se encontrava ocupada por Acacia sp. desde 1940, onde estão presentemente instaladas as coníferas; -P2, de 1 ha, utilizada para ensaios de pastagem, onde estão presentemente instaladas as folhosas. A preparação das parcelas foi iniciada em Setembro de 2011, e consistiu essencialmente na remoção de acácias e controlo da vegetação espontânea.



AR36 - Cachaços

Local name: Cachaços
Municipality: Ribeira Grande
Region: Açores / **Country:** Portugal
Altitude (m): 520

Department in charge: Direção Regional dos Recursos Florestais
Contact e-mail: Info.drrf(at)azores.gov.pt

Topography: high to middle slope
Orientation: 8
Slope (%): 50
Hydrology: none

pH (soil layer 0 - 30cm): 6.5
Type of Soil: ANDOSOLS
Subtype of Soil: vitric
Bedrock:

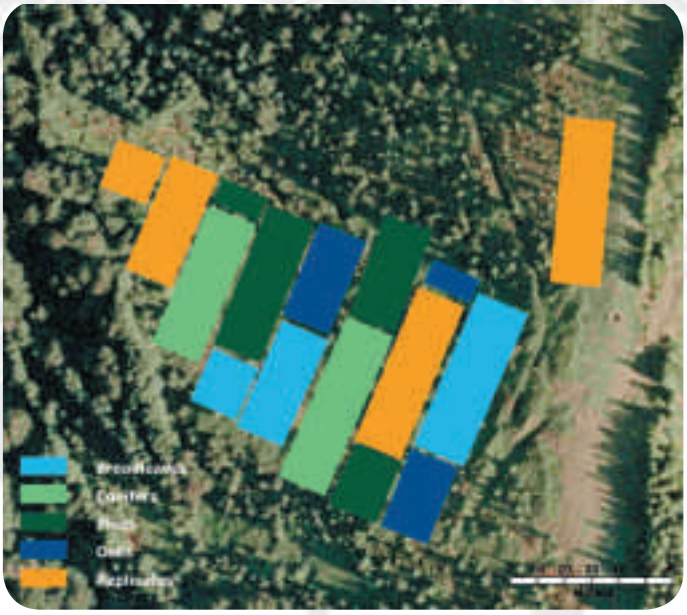
Mean T (°C): 17
Mean T (°C) Coldest Month: 7
Mean Precipitation (mm): 2290
N Frost Days: 0

This area was used for cattle grazing. Initially the site was occupied by forest which was transformed into grassland in the nineteen's. With intense changes which occurred due to soil mechanization, the regional government decided to purchase the property to stop this process.

At the moment, not only is the area in question used for the REINFFORCE project arboreta, but it also has a descending trial of *Cryptomeria japonica* that belongs to a breeding program as well as forestry plantations with several endemic woody species of Azores, like *Prunus azorica*, *Juniperus brevifolia*, *Frangula azorica* and *Ilex azorica*, grown for future seed orchards.

Os Cachaços foram adquiridos pelo Governo Regional dos Açores nos anos 90. O proprietário anterior tinha intenção de transformar esta área florestal em pastagem, e com este intuito alterou o relevo superficial recorrendo a uma profunda mobilização do solo Com a aquisição da propriedade pelo Governo este processo de pastoreio terminou.

Neste momento a área em questão para além do "Arboretum" do projeto REINFFORCE, também tem um ensaio de descendência de Cryptoméria japonica do Programa de Melhoramento Florestal dos Açores e várias plantações de espécies endémicas lenhosas dos Açores: Prunus azorica, Juniperus brevifolia, Frangula azorica e Ilex azorica, com o objetivo de serem futuramente pomares produtores de sementes.



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AR37 - Vanzinho

Local name: Vanzinho
Municipality: Furnas civil Parish
Region: Açores / **Country:** Portugal
Altitude (m): 500

Department in charge: Furnas Monitoring and Research Centre
Contact e-mail: miguel.gc.ferreira(at)azores.gov.pt

Topography: high slope
Orientation: NW
Slope (%): 17
Hydrology: good drainage

pH (soil layer 0 - 30cm): 5
Type of Soil: ANDOSOLS
Subtype of Soil:
Bedrock: pumicite

Mean T (°C): 12.5
Mean T (°C) Coldest Month: -3.2
Mean Precipitation (mm): 2400
N Frost Days: 0

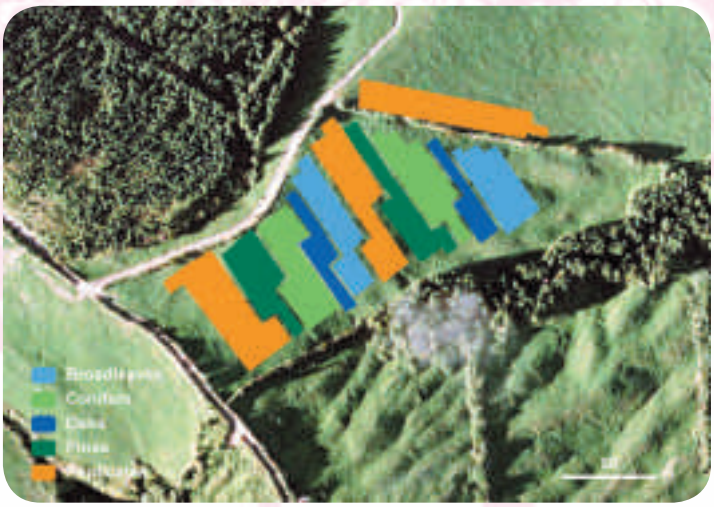
This site was initially covered with natural forest, which was later removed for pastureland with a semi-intensive dairy farm with heavy fertilizations for the past three decades. After purchasing the area, from privates, to implement Furnas Lake watershed basin ecological restoration, cows were removed and fertilizations completely stopped. There was a control of invasive species in the center and borders of the parcel, which was invaded by rubus and other species (*Pittosporum undulatum, Solanum mauritianum*, etc.), only native species were left along the borders.

This site was chosen due to its good drainage and soil type, with nutrient rich top soil and pumice stones at lower levels. It also assures an easy accessibility due to its proximity to a tarmac road. Later the pastureland was planted with the REINFFORCE arboreta, therefore integrating Furnas Landscape Laboratory. Permission to use new forestry species was conceded by the Regional Directorate for Nature Conservation, and reconfirmed by the regional director of environment.

Esta pastagem que inicialmente estaria coberta por vegetação natural, que mais tarde removida para a criação de pastagem com uma agricultura semi intensiva, recorrendo a fortes fertilizações ao longo das três últimas décadas. Após a compra da área, a provados, para a implementação do Plano de Ordenamento da Bacia Hidrográfica da Lagoa das Furnas (POBHLF), as vacas foram removidas e as fertilizações completamente banidas. Houve um controlo e espécies invasoras no centro e bordaduras da pastagem, que estava consideravelmente invadida por silvados entre outras espécies ((Pittosporum undulatum, Solanum mauritianum, etc) permaneceram apenas as espécies nativas ao longo das bordaduras da pastagem.

Este local foi escolhido devido à sua boa drenagem e tipo de solo, rico em nutrientes na cama superior e pedra pomos nos níveis inferiores. Assegura também um fácil acesso devido à sua proximidade da estrada corrente. Mais tarde a pastagem foi plantada com o arboreto do REINFFORCE, integrando assim o Laboratório de Paisagem das Furnas.

A autorização para testar algumas novas espécies florestais foi cedida pela Direcção De Serviços de Conservação da Natureza, e reconfirmada pelo Director Regional do Ambiente.



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Sociedade de Gestão Ambiental e Conservação da Natureza, SA

AR38 - Pasto dos Trevos

Local name: Pasto dos Trevos
Municipality: Furnas civil Parish
Region: Açores / **Country:** Portugal
Altitude (m): 515

Department in charge: Furnas Monitoring and Research Centre
Contact e-mail: miguel.gc.ferreira(at)azores.gov.pt

Topography: low slope
Orientation: NW
Slope (%): 3
Hydrology: medium drainage

pH (soil layer 0 - 30cm): 5.4
Type of Soil: ANDOSOLS
Subtype of Soil:
Bedrock: pumicite

Mean T (°C): 12.5
Mean T (°C) Coldest Month: -3.2
Mean Precipitation (mm): 2400
N Frost Days: 0

This site was initially covered with natural forest, which was later removed, and heavy machinery eliminated its preexistent micro-topography for pastureland, therefore creating erosion problems due to the concentration of water across the pasture. For the past three decades, this pasture was part of a semi-intensive dairy farm with heavy fertilizations. At the lower part of the pasture there was also a concrete construction where the cattle were milked and fed. This concentration resulted in a large degradation of part of the pasture, which needed to be avoided, in order to not influence the arboretum results.

After purchasing the area, from privates, to implement Furnas Lake watershed basin ecological restoration, cows were removed, fertilizations completely stopped, all litter cleaned up and part of the cow dung was also removed. There was a control of invasive species in the center (ex. rumex) and borders (ex. rubus, etc) of the parcel, which was only mildly invaded. Afterwards the entire pasture was seeded with a flowering meadow, where clovers were the dominant species, in order to experiment phosphorous removal from the soil and sustainably increase grass yields.

This site was chosen due to its large extension and possibility to increase the arboretum in the future, and its deep rich soils. It also assures a reasonably easy accessibility due to its proximity to a dirt road. Later the pastureland was planted with the REINFFORCE arboreta, therefore integrating Furnas Landscape Laboratory.

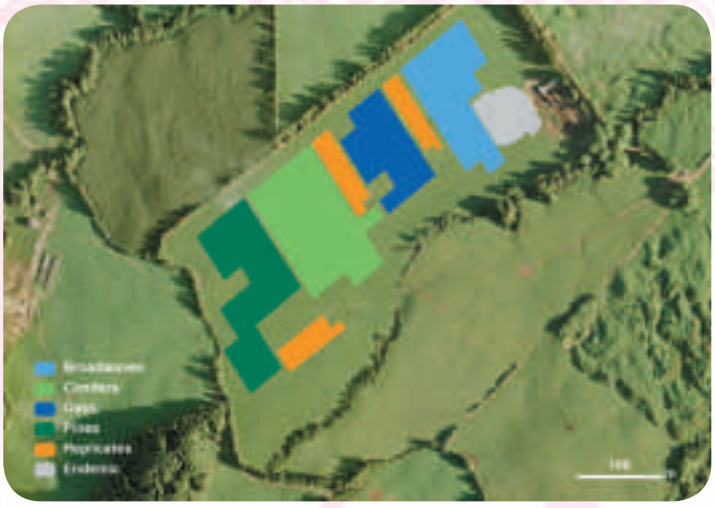
Each provenance counts for 50 plants, on a compass of 3x4 m. Permission to make use of new forestry species was conceded by the Regional Directorate for Nature Conservation, and reconfirmed by the regional director of environment.

Esta pastagem que inicialmente estaria coberta por vegetação natural, mais tarde foi removida, e consequentemente houve a terraplanagem eliminando assim a microtopgrafia preexistente nesta pastagem, dando origem a problemas de erosão devido à concentração de água ao longo da parcela. Esta pastagem era parte de uma exploração de leite com actividade semi intensiva, com forte recurso a fertilizações ao longo das últimas três décadas.

Na parte mais baixa desta pastagem existem construções em betão onde era feita a ordenha do gado. Esta concentração diária dos animais resultou numa considerável degradação ambiental de parte da pastagem, que teve de ser evitada de forma a não influenciar os resultados do arboreto. Após a compra da área, a provados, para a implementação do Plano de Ordenamento da Bacia Hidrográfica da Lagoa das Furnas (POBHLF), as vacas foram removidas, as fertilizações completamente banidas, todos os resíduos removidos e parte do estrume acumulado também removido. Houve um controlo e espécies invasoras no centro (ex. rumex) e bordaduras (silvados) da pastagem, que estava ligeiramente infestada.

Consequentemente toda a pastagem foi semeada com um prado florido, onde predominaram os trevos, de forma a testar a remoção de fósforo dos solos e sustentadamente aumentar a produção de erva. Este local foi escolhido devido à sua larga extensão e possibilidade de crescimento do arboreto no futuro, e aos seus solos ricos. Assegura também um acesso relativamente fácil, com uma estrada de terra junto à parcela. Mais tarde a pastagem foi plantada com o arboreto de REINFFORCE, integrando assim o Laboratório de Paisagem das Furnas. Cada proveniência conta com 50 plantas, num compasso de 3x4 m.

A autorização para testar algumas novas espécies florestais foi cedida pela Direcção De Serviços de Conservação da Natureza, e reconfirmada pelo Director Regional do Ambiente.



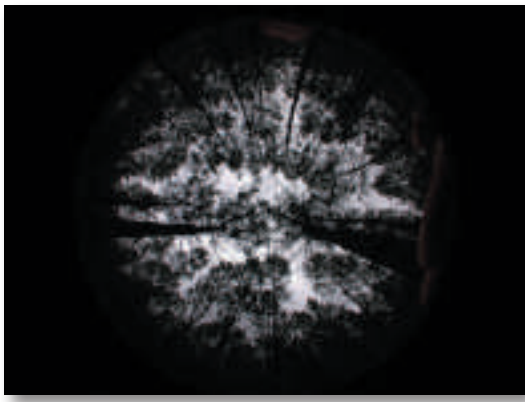
FOREST DEMONSTRATION SITE

OBJECTIVES

The main aim of the demonstration site is to test and demonstrate the efficiency of different adaptive management techniques.

Considering the future climate changes, we can identify positive effects for trees such as:

- increase in the mean temperature: in most cases, it means that winter is warmer, that low temperatures are not limiting the biochemical processes, that the leaves can appear sooner and stay longer, increasing the growing period.
- increase in the CO_2 concentration that is a fertilizer for trees and makes trees grow faster.



LAI measurements (Leaf Area Index), Maritime Pine plantation, INRA Pierroton Site (F. Lagane, INRA)

Demonstration site DS03, Central Portugal (L. Di Lucchio, EFIATLANTIC)

But on the other hand, climate change may also have many negative impacts such as :

- drought: more frequent severe and long periods of drought,
- more extreme events such as strong winds, heavy rains, very hot days,...
- less limitations for pathogens: some insects and diseases are limited by some climatic parameters, and can move more north to contaminate trees.

After a bibliographic review, we have identified some management options that can limit this adverse effect of climate change, and we implement them in a stand where on one side we do management as usual and on the other side, we apply an adaptive management.

DIFFERENT MANAGEMENT OPTIONS

- The different site preparations tested are mainly different types of ploughing to see the impact on the rooting; it will contribute mainly to improve stability.

Saint Paul en Born, DS26, Eucalyptus & Rebeca Cordero Debets (C.Orazio, EFIATLANTIC)

Maritime Pine Root System, INRA Pierroton Site (B. Carnus, EFIATLANTIC)

- The density management strategy aims to reduce the competition between trees and to see if when the water becomes scare, it can avoid diebacks or growth losses. This strategy assumes that under-storey is controlled, and is similar to the under-storey management strategies.
- The edges of the stands play a role in avoiding insect spry, making a reserve of predators and chemical masking; they can also play a role in increasing the resilience to some abiotic risks such as wind and fire.
- The stand structure and the stand composition are parameters that have to be tested; the assumption is that all species of a mixture or all trees of different sizes/ages will not be affected in the same way in case of adverse conditions due to climate change.
- As drought is an issue in many cases, soil water capacity improvement is also tested, for example by spreading charcoal.

Site preparation with water distribution, Arengosse Demonstration site (R. Cordero Debets, EFIATLANTIC).

Management options for Demonstration Sites

The adaptive management options implemented in the frame of the REINFFORCE project are listed in the table below.

Climatic risk addressed/ Management alternative	Demonstration site ID	Wind risk	Growth	Regeneration loss	Drought	Frost	Biotic
Site preparation (ploughing, discing...)	**DS25**	X					
Change in forest management (intensity, tree stock...)	**DS02 DS06 DS07 DS08 DS09 DS11 DS12 DS14 DS15 DS16 DS17 DS18 DS22 DS23 DS24 DS26 DS30 DS31 DS32 DS33 DS34 DS35 DS37**	X	X	X	X		
Edge management	**DS27**	X					X
Species switch / comparison / mixture/ provenance selecting, combining and comparing the potentially best suited species and/or provenances	**DS01 DS04 DS05 DS28 DS29**		X	X	X	X	X
Stand structure (even-aged and uneven-aged stands)	**DS10 DS13 DS36 DS38 DS39 DS40 DS41**	X	X	X			X
Improvement of soil water capacity (biochar...)	**DS19 DS20 DS21**				X		
Understorey management	**DS03**				X		

Measurements using coring, Christophe Orazio, Pontenx (R. Cordero Debets, EFIATLANTIC)

Subsoil site preparation, DS25 (R. Cordero Debets, EFIATLANTIC)

Planting Machine, DS25 (R. Cordero Debets, EFIATLANTIC)

Site preparation, DS25 (R. Cordero Debets, EFIATLANTIC)

FOREST DEMONSTRATION SITE DESCRIPTIONS

For all Demonstration Sites, even though the types of management options were decided commonly amongst the Network partners, each site presents individual characteristics.

In orther words, even though the aim to anticipate future climates is common, each trial is managed differently with its own unique local-regional issues and opportunities.

Therefore this has lead to more heterogeneous protocols, and you will find the detailed description of these in the following pages.

Instituto Superior de Agronomia
Universidade Técnica de Lisboa

DS01 - Herdade de Monte Fava

Local name: Herdade de Monte Fava
Municipality: Santiago do Cacém
Region: Alentejo / **Country:** Portugal
Altitude (m): 79

Department in charge: DRAT - Departamento dos Recursos Naturais, Ambiente e Território
Contact e-mail: reinfforce(at)isa.utl.pt

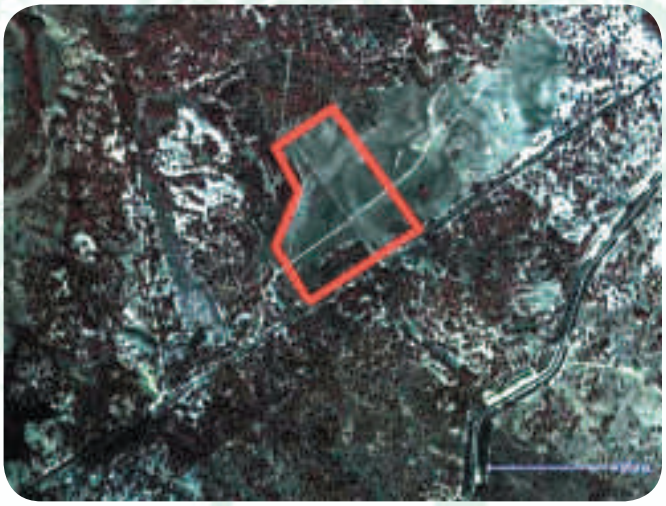
Topography: plateau
Orientation: flat
Slope (%): 4
Hydrology: nearest waterline is 1.5 km apart from trial site

pH (soil layer 0 - 30cm): 5.05
Type of Soil: PODZOLS
Subtype of Soil: ortic
Bedrock: limestone

Mean T (°C): 15.8
Mean T (°C) Coldest Month: 4.4
Mean Precipitation (mm): 564
N Frost Days: 33

"Herdade de Monte Fava", classified as public property and owned by Direcção Regional de Agricultura do Alentejo, has been used for agricultural and forestry research. Monte Fava's 1998 *Quercus suber* provenance trial is managed by ISA staff and part of a multi-locality provenance test carried-out within a network set up by concerted action : "European Network for the Evaluation of Genetic Resources of Cork Oak for Appropriate Use in Breeding and Gene Conservation Strategies" where 35 cork oak populations from its natural distribution area are represented (Portugal – 9; Spain – 7; Italy – 5; France – 4;Tunisia – 2; Morocco – 6; Algeria – 1; and 1 on the Portuguese/Spanish border).

Cork oak adaptability to environmental conditions is poorly understood vis-à-vis climate change scenarios forecasting more frequent and longer water deficits in the Mediterranean region. In order to allocate the most adequate seed sources to each set of climatic conditions in future afforestation activities, and considering that an important source of variation in the characteristics related to adaptability may be found at the provenance level, REINFFORCE evaluated inter-provenance variability of growth, phenology and health, and assessed correlation between bud burst and pest damage.



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Universidade Técnica de Lisboa

DS02 - Perímetro florestal da Contenda

Local name: Perímetro florestal da Contenda
Municipality: Barrancos
Region: Alentejo / **Country:** Portugal
Altitude (m): 500

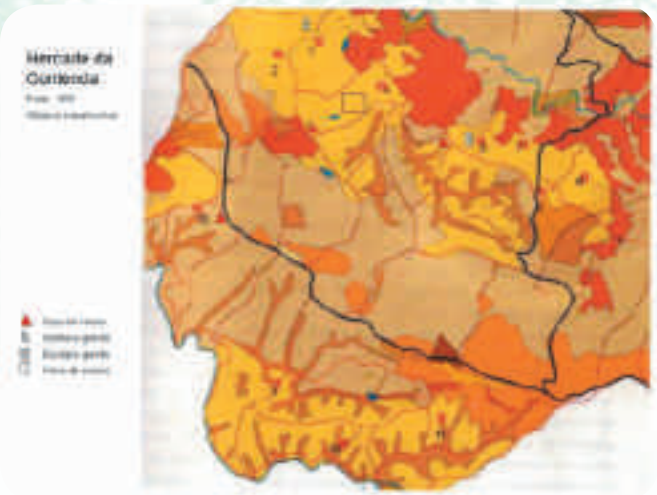
Department in charge: DRAT - Departamento dos Recursos Naturais, Ambiente e Território
Contact e-mail: reinfforce(at)isa.utl.pt

Topography: middle slope
Orientation: SE
Slope (%): 48
Hydrology: the site is situated in the Guadiana river hydrographic basin. It is characterized by a temporary regime or temporary torrential regime.

pH (soil layer 0 - 30cm): 5.6-6.5
Type of Soil: LEPTOSOLS
Subtype of Soil: utric
Bedrock: micaschist

Mean T (°C): 16.2
Mean T (°C) Coldest Month: 4.5
Mean Precipitation (mm): 689
N Frost Days: 7

"Perímetro florestal da Herdade da Contenda", a public property owned by the Moura municipality, has been used for agro-forestry research. The debarking coefficient/intensity trial installed in 2003 is managed by ISA staff, and is part of a larger network of permanent plots from the institution where tree and cork growth are being monitored in the long term and related to climate, soil and silviculture management practices. Cork and cork oak adaptation/response to environmental conditions is poorly understood. This response is also related to management practices, that must be adapted to the growing conditions of trees, especially in a climate change scenario and in high water deficits regions in the Mediterranean region, such as the Barrancos County where the CONTENDA site is located. In order to research and quantify the impact of debarking intensities at tree level in water deficit conditions, REINFFORCE evaluated tree growth, cork growth, cork quality, tree mortality rates, and cork pest damage (*Coroebus undatus*).



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DS03 - Herdade da Chaminé

Local name: Herdade da Chaminé
Municipality: Mora
Region: Centro / **Country:** Portugal
Altitude (m): 128

Department in charge: DRAT - Departamento dos Recursos Naturais, Ambiente e Território
Contact e-mail: reinfforce(at)isa.utl.pt

Topography: plateau
Orientation: flat
Slope (%): 0
Hydrology: the site is situated not far from the Montargil dam (Sôr River), included in the Tejo river hydrographic basin. Although characterized by flat terrain.

pH (soil layer 0 - 30cm): 5.6-6.5
Type of Soil: LEPTOSOLS
Subtype of Soil: utric
Bedrock: micaschist

Mean T (°C): 16.1
Mean T (°C) Coldest Month: 7
Mean Precipitation (mm): 617
N Frost Days: 30

"Herdade da Chaminé", a private property in Alentejo region, has been used for research on the effect of understory management on cork and cork oak growth.

The trial installed in 2003 is managed by ISA staff. The collaboration with the forest owner was essential from the beginning of the trial, since he was responsible for the application of treatments between 2003 and 2012, under ISA supervision.

The options regarding understory management in cork oak stands are important, particularly in a climate change scenario and in shallow and low fertile soils. In order to research 3 different alternatives of understory management (understory growth for a complete cork debarking rotation - 9 years -, understory removal and organic matter soil incorporation, regular lupine pasture installation), REINFFORCE evaluated tree growth, cork growth, cork quality and tree mortality rates.

Instituto Superior de Agronomia
Universidade Técnica de Lisboa

DS04 - Mata Nacional das Virtudes

Local name: Mata Nacional das Virtudes
Municipality: Azambuja
Region: Lisboa / **Country:** Portugal
Altitude (m): 42

Department in charge: DRAT - Departamento dos Recursos Naturais, Ambiente e Território
Contact e-mail: reinfforce(at)isa.utl.pt

Topography: plateau
Orientation: flat
Slope (%): 4
Hydrology: the site is situated in Tejo hydrographic basin

pH (soil layer 0 - 30cm): 4.6
Type of Soil: CAMBISOLS
Subtype of Soil: eutric
Bedrock: limestone

Mean T (°C): 16.7
Mean T (°C) Coldest Month: 7.3
Mean Precipitation (mm): 645
N Frost Days: 0

Mata Nacional das Virtudes", classified as public property, managed acording to the National forest Regime, has been used for forestry production and research. Virtudes's 1998 *Quercus suber* provenance trial is managed by ISA staff and is part of a multi-locality provenance test carried-out within a network set up by concerted action : "European Network for the Evaluation of Genetic Resources of Cork Oak for Appropriate Use in Breeding and Gene Conservation Strategies" where 35 cork oak populations from its natural distribution area are represented (Portugal – 9; Spain – 7; Italy – 5; France – 4; Tunisia – 2; Morocco – 6; Algeria – 1; and 1 on the Portuguese/Spanish border).Cork oak adaptability to environmental conditions is poorly understood vis-à-vis climate change scenarios forecasting more frequent and longer water deficits in the Mediterranean region. In order to allocate the most adequate seed sources to each set of climatic conditions in future afforestation activities, and considering that an important source of variation in the characteristics related to adaptability may be found at provenance level, REINFFORCE evaluated inter-provenance variability of growth, phenology and fruit sanitary status, correlation between phenology and pest damage is beeing carried out.

Instituto Superior de Agronomia
Universidade Técnica de Lisboa

DS05 - Vale de Cavalos

Local name: Vale de Cavalos
Municipality: Viseu
Region: Norte / **Country:** Portugal
Altitude (m): 385

Department in charge: DRAT - Departamento dos Recursos Naturais, Ambiente e Território
Contact e-mail: reinfforce(at)isa.utl.pt

Topography: plateau
Orientation: flat
Slope (%): 4
Hydrology: the site is situated in the Paiva hydrographic basin

pH (soil layer 0 - 30cm): 4.6-5.5
Type of Soil: CAMBISOLS
Subtype of Soil: humic
Bedrock: micaschist

Mean T (°C): 13.4
Mean T (°C) Coldest Month: 3
Mean Precipitation (mm): 1200
N Frost Days: 41

Vale de Cavalos Demonstration site is installed on public property, owned by Instituto da Conservação da Natureza e das Florestas. The site was previously used for plant production, as it belonged to a Forest services' tree nursery. The site management is performed by ISA.

Quercus robur adaptability to environmental conditions is poorly understood vis-à-vis climate change scenarios forecasting more frequent and longer water deficits in the Mediterranean region. In order to allocate the most adequate seed sources to each set of climatic conditions in future afforestation activities, and considering that an important source of variation in the characteristics related to adaptability may be found at provenance level, REINFFORCE evaluated inter-provenance variability of growth and survival.

DS06 - Moral de Hornuez

Local name: Moral de Hornuez (Segovia)
Municipality: Moral de Hornuez
Region: Castilla y León / **Country:** Spain
Altitude (m): 1195

Department in charge: Plant Production and Forest Resources. University of Valladolid
Contact e-mail: jdcasero(at)pvs.uva.es

Topography: plane
Orientation: flat
Slope (%): 0
Hydrology: there is no permanent water-course that crosses the plot, although precipitation waters that run through the plot are tributaries of the Duero Basin, and Riaza River subbasin.

pH (soil layer 0 - 30cm): 5.70
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: limestone

Mean T (°C): 10.7
Mean T (°C) Coldest Month: -2.3
Mean Precipitation (mm): 500
N Frost Days: 95

The demonstration site is located next to the installation of the arboretum, making the use of the data from the weather station possible.

The main sylvicultural option demonstrated here is a new mixed plantation of *Pinus pinaster* and *Quercus ilex* using systematic designs in concentric circles with different grids of plant positions, varying the spacing from low to high density and the degree of composition of both species. The demonstration sites are plantations based on Nelder Wheels (Nelder, 1962) designed to evaluate the influence of the density on the mortality, the size, the pathogenic damages and the biomass allocation of each plant.

The data analysis will be performed using logistic regression and spatial analysis.

DS07 - Santiago de Loureiro

Local name: Santiago de Loureiro
Municipality: Cotobade
Region: Galicia / **Country:** Spain
Altitude (m): 480

Department in charge: Centro de Investigación Forestal de Lourizán
Contact e-mail: infolourizan.mr(at)xunta.es

Topography: middle slope
Orientation: W
Slope (%): 30
Hydrology: middle slope in the river Lérez basin and 20 km far from Atlantic coast

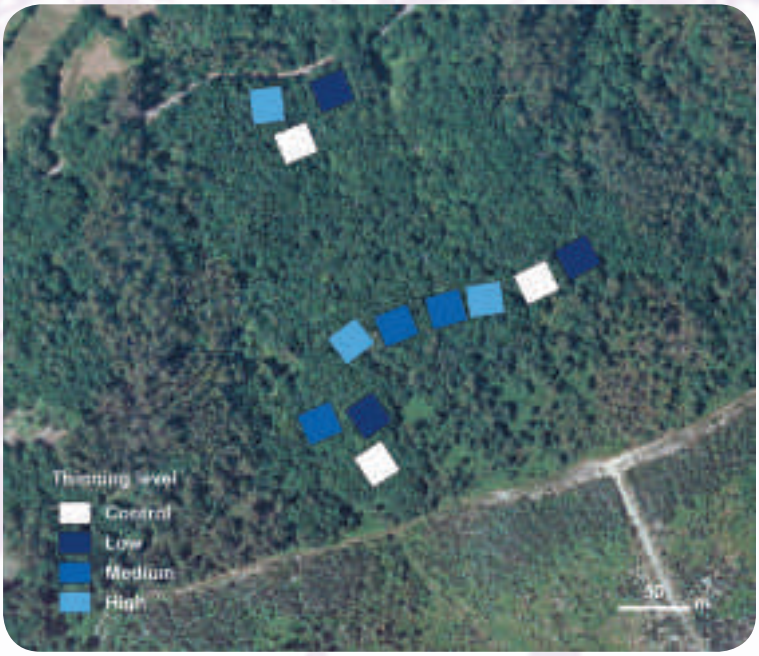
pH (soil layer 0 - 30cm): 4.96
Type of Soil: UMBRISOLS
Subtype of Soil: cambic
Bedrock: acid regional metamorphic rocks

Mean T (°C): 12.3
Mean T (°C) Coldest Month: 1.1
Mean Precipitation (mm): 1673
N Frost Days: 37

The stand shows an uneven-aged oak (*Quercus robur* L.) canopy covering a sparse understory mainly with grasses and some shrubs (holly trees, chestnuts, heaths and gorses). Initially, tree stand characteristics were: Age (32 years), Mean DBH (22.5 cm), Mean Height (14.8 m), Density (1000 tree/ha).

Thinning treatments were applied in 1999-2000.The stand is surrounded by pastures and orchards and occasionally some trees were removed mainly for fuel by the nearest neighbors. DS07 is placed on a private land. The land is owned and managed by a Neighborhood Forest Association, typical of Galician culture. All the forest area belongs to a territorial demarcation, "parroquia", which joins all the neighborhood members. Each citizen owns a percentage of the whole indivisible forest area and the management must be agreed with all the members of the community by a common consent. In Galicia, this way of forest property is called "Neighborhood Forest in Common Hand".

We asked for the permission to the Neighborhood Forest of Loureiro, and they, by common consent, gave us a permission to establish the experience.



DS08 - Vidanes

Local name: Vidanes (León)
Municipality: Cistierna
Region: Castilla y León / **Country:** Spain
Altitude (m): 965

Department in charge: Plant Production and Forest Resources. University of Valladolid
Contact e-mail: jdcasero(at)pvs.uva.es

Topography: plane
Orientation: flat
Slope (%): 0
Hydrology: plot next to the Esla River, to the upper irrigation channel of Payuelos, and the valley of Valdehontanos stream.

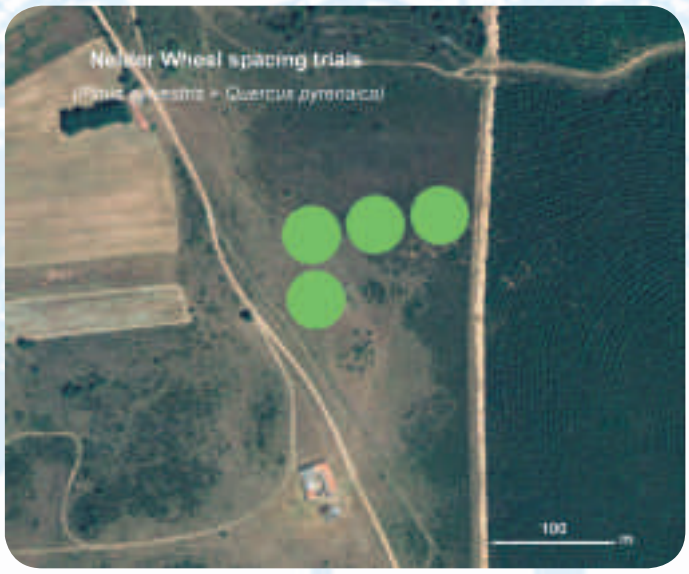
pH (soil layer 0 - 30cm): 5.04
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: conglomerate

Mean T (°C): 9
Mean T (°C) Coldest Month: -1.6
Mean Precipitation (mm): 800
N Frost Days: 90

The demonstration site is located next to the installation of the arboretum, making the use of the data from the weather station possible. The main objective is to reveal optimal planting densities of test species through the study of the available space for the development of each plant and the alignments between them.

The main sylvicultural option demonstrated here is a new mixed plantation of *Pinus sylvestris* and *Quercus pyrenaica* using systematic designs in concentric circles with different grids of plant positions, varying the spacing from low to high density and the degree of composition of both species.

The demonstration sites are plantations based on Nelder Wheels (Nelder, 1962) designed to evaluate the influence of the density on the mortality, the size, the pathogenic damages and the biomass allocation of each plant. The data analysis will be performed using logistic regression and spatial analysis.



DS09 - Moreira

Local name: Moreira
Municipality: Cervantes
Region: Galicia / **Country:** Spain
Altitude (m): 1400

Department in charge: Centro de Investigación Forestal de Lourizán
Contact e-mail: infolourizan.mr(at)xunta.es

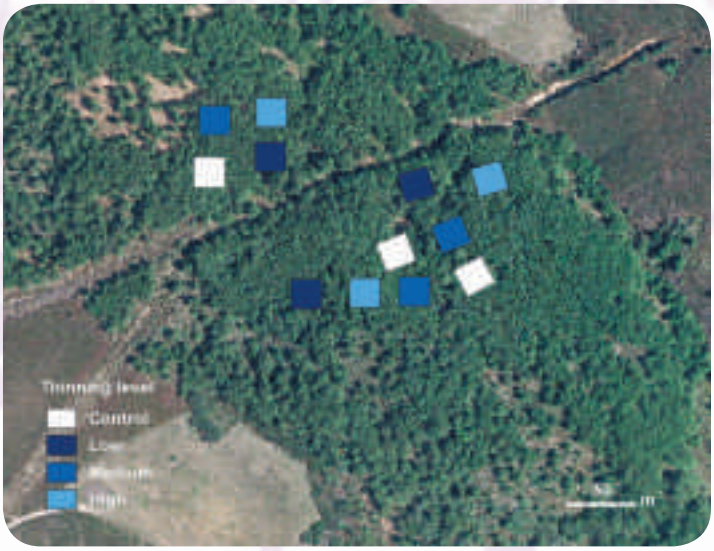
Topography: high slope
Orientation: NE
Slope (%): 28
Hydrology: high slope in the mountain chain "Serra de Ancares", the eastern limit of Galicia, faced to the river Navia basin, with the stream "Rego do Cespedosa" flowing across the plot

pH (soil layer 0 - 30cm): 4.4
Type of Soil: REGOSOLS
Subtype of Soil: dystric-eutric
Bedrock: acid to intermediate plutonic rocks

Mean T (°C): 8.3
Mean T (°C) Coldest Month: -0.9
Mean Precipitation (mm): 1144
N Frost Days: 66

In the municipality, pastures (5% usable area) and forests (87% usable area) provide almost the total incomes for the sparse inhabitants. The traditional practice of raising cattle, mainly with bovine autochthonous races like "Rubia galega", supplies milk and beef for their own consumption. Forest afforestations with Scots pine are placed where grasslands cannot be established. Oaks, birches, beeches and hazels make up the natural woodlands in the valleys and in the stream banks. The mountain chain "Serra de Ancares" is a protected area for conservation included in Nature 2000 net and a National Reserve for Game Hunting. Roe deer, wild boar and ibex are the most valuable species.

DS09 is placed on a private land. The land is owned and managed by the Neighborhood Forest of Xunquiñas, typical of Galician culture. All the forest area belongs to a territorial demarcation, "parroquia", which joins all the neighborhood members. Each citizen owns a percentage of the whole indivisible forest area and the management must be agreed with all the members of the community by a common consent. In Galicia, this way of forest property is called "Neighborhood Forest in Common Hand". The stand shows an even-aged birch (*Betula alba*) canopy from natural regeneration covering understory mainly with grasses and some shrubs (blackberry and heaths). Thinning treatments were applied in 2001. Tree stand characteristics before treatments were: Age (28 years), Mean DBH (8.4 cm), Dominant Height (11.1 m), Density (3477 tree/ha).



DS10 - Sierra de Aralar

Local name: Sierra de Aralar
Municipality: Not applicable
Region: Navarra / **Country:** Spain
Altitude (m): 1000

Department in charge: European Projects
Contact e-mail: info(at)ganasa.es

Topography: plateau
Orientation: NW
Slope (%): 30
Hydrology: basically underground network

pH (soil layer 0 - 30cm): 5
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: calcareous rocks

Mean T (°C): 6.8
Mean T (°C) Coldest Month: -1.7
Mean Precipitation (mm): 1165
N Frost Days: 52

The global objective is to develop a new silviculture to slow the impacts of climate change while being compatible with the production of quality Beech wood and with sustainable cost. The main aim of this demonstration trial is to see if uneven-aged forests (new silviculture) are more resistant to multiple climate change risks (strong winds, new pests and pathogens and less water availability) than even-aged forests, managed since 1904 (shelterword method).

This demonstration site is located in Aralar forest, and is included in the "Catalogue of Public Utility Mountains of Navarra" with the number 8.

The forest management system and the sylvicultural treatment will be changed to get an uneven-aged forest: Forest Management System: from Periodic Block Method to Management System by Stands Silvicultural Treatment: from Shelterwood method to individualized stands method These changes are being made in a plot that is part of the AFI (Association Futaie Irrégulière) plots network, where the objective is to use the PROSILVA management resulting in an irregular stand.

In addition to that AFI plot, a control plot is being installed in a part of Aralar where the forest cover is going to be regular at least during the next one hundred years. The main objective of this demonstration trial is to see if uneven-aged forests are more resistant to multiple climate change risks than even-aged forests. The main climate change risks for forests are: strong winds, new pests and pathogens and less water-availability. The hypothesis is that uneven-aged forests should be more resistant and resilient to those risks because: Their relation between height and diameter used to be lower in this kind of forest structure and it supposes bigger resistance to strong winds.

An uneven-aged forest, with different ages and species within it, is more resistant to pest and pathogen outbreaks. These forests have a better use of ground water.

Location of the demonstration sites in Aralar forest.

DS11 - Gatzaga

Local name: Gatzaga
Municipality: Leintz Gatzaga
Region: Basque Country / **Country:** Spain
Altitude (m): 800

Department in charge: Diputación Foral de Gipuzkoa / Gipuzkoako Foru Aldundia
Contact e-mail: forestal(at)hazi.es

Topography: high slope
Orientation: SW
Slope (%): 7-50
Hydrology: flat soil, without rivers

pH (soil layer 0 - 30cm): 4.4
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: pelite lutite or argillite

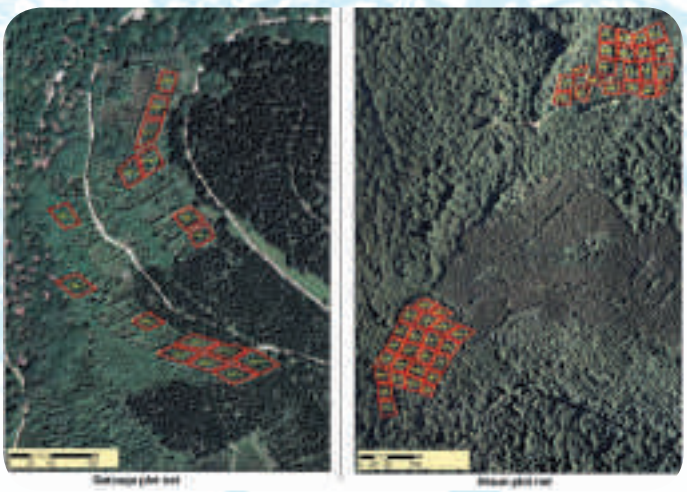
Mean T (°C): 11.6
Mean T (°C) Coldest Month: 8.6
Mean Precipitation (mm): 930
N Frost Days: 13

In the Gatzaga plot network 45 plots were installed (15 provenances*3 blocks) of 81 plants, each plot measuring 729 m^2.

In 2012, only 16 plots were still alive and ready to be measured (568 trees in total). In the Ataun plot network 45 plots were installed (15 provenances*3 blocks) of 81 plants, each plot measuring 729 m^2. In 2012, all the plots were alive and ready to be measured (2.014 trees in total).The first step was the data collection of the same trees along the years.

A database was created with these data. During the REINFFORCE project, all the 2.582 trees were measured by diameter and total height. All the trees are located by row and column in each plot. An analysis with all this data is expected in the final year of the project.

Relationships between provenances, growth and climatic damages will also be studied.



DS12 - Aitzarte

Local name: Aitzarte
Municipality: Ataun
Region: Basque Country / **Country:** Spain
Altitude (m): 721

Department in charge: Diputación Foral de Gipuzkoa / Gipuzkoako Foru Aldundia
Contact e-mail: forestal(at)hazi.es

Topography: middle slope
Orientation: N
Slope (%): 10-30
Hydrology: flat soil, without rivers

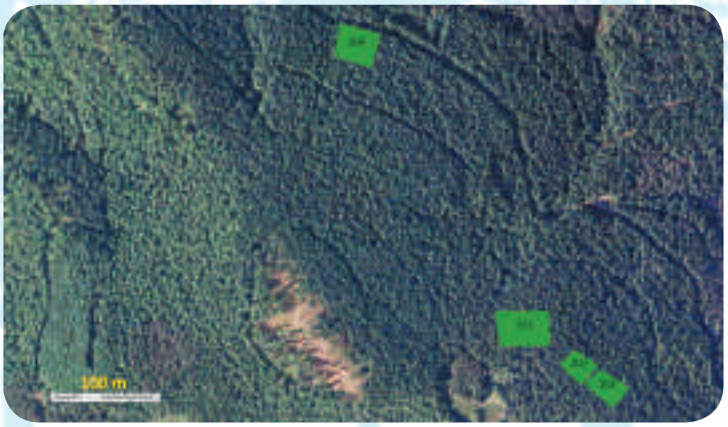
pH (soil layer 0 - 30cm): 4.9
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: sandstone

Mean T (°C): 10.6
Mean T (°C) Coldest Month: 3.9
Mean Precipitation (mm): 1050
N Frost Days: 23

Douglas-fir silviculture plot networks were installed in 1990 in the public forest of "Aitzarte", in Ataun by Diputación Foral of Gipuzkoa. After five mensurations (1990, 1997, 1998, 2005 and 2011), several types of Douglas-firs proved to be better adapted to the climate of the mounts from Gipuzkoa than others.

The first step was the data collection of the same trees along the years. A database was created with these data. During the REINFFORCE project, all the 450 trees were measured by diameter and total height. All the numeric and metallic brands were renewed for each tree. In each of these 8 plots, 10 average trees were selected to measure the wood quality: first by core extraction, and then with further laboratory measures by X-ray (ring width and density), by the Hitman ST300 and the Fakopp tools (two measures in the basal log of each selected tree).

An analysis with all these data is expected in the final year of the project. Relationships between thinning regime, growth and climatic damages will alsobe studied.



DS13 - Jauntsarats

Local name: Jauntsarats
Municipality: Basaburúa
Region: Navarra / **Country:** Spain
Altitude (m): 550

Department in charge: European Projects
Contact e-mail: info(at)ganasa.es

Topography: plain
Orientation: flat
Slope (%): 3.5
Hydrology: drainage basin: Areta river, which belongs to Aragon river drainage basin (Mediterranean watershed)

pH (soil layer 0 - 30cm): 6
Type of Soil: FLUVISOLS
Subtype of Soil: dystric-eutric
Bedrock: siltstone

Mean T (°C): 10.7
Mean T (°C) Coldest Month: -0.2
Mean Precipitation (mm): 1291
N Frost Days: 77

The global objective is to develop a new silviculture to slow the impacts of climatic change compatible with the production of quality wood of oak and with sustainable cost. The main objective of this demonstration trial is to study if uneven-aged forests (new silviculture) are more resistant to multiple climate change risk (strong winds, new pest and pathogens and less availability of water) than even-aged forest.

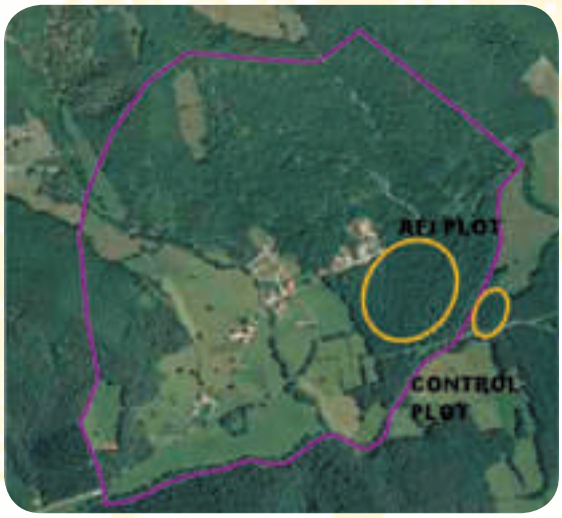
This demonstration site is located in Jauntsarats, in the Northwest of Navarra. The forest is part of two M.U.P (Montes de Utilidad Pública = Public Use Forest) of Navarra. Therefore, the management of these is done by the Government of Navarra. Jauntsarats forest belongs to the Southern humid valleys of Navarra, with hard winters and hot summers. The average annual precipitation is 1273 mm (from 1999 to 2007). Orography is not very steep, with slopes no more than 30%, and flat terrain next to Basaburua river. Soils are deep and not very rocky with predominance of marl and limestone and fine silty texture. Waterlogging problems can appear. The main species are *Quercus robur* L. (38,15 ha), *Fagus sylvatica* (19,87 ha) and *Quercus pyrenaica* (11,82 ha), with *Rubus sp.* and *Ilex sp.* in the scrubland. The first Technical Management Plan for this forest was approved in 2009, and there is no information available about its managing before 2002.

The main specie in this demonstration site is *Quercus robur* L., both in the control plot and in the AFI trial. The existing forest mass is characterized by a high number of young trees which belong to the lowest diameter class. The quality of trees is not very high, but there are enough young trees with the potential to produce quality timber. Due to the current state of the mass the growth of *Fagus sylvatica* L. is more favored than oak growth, but this is supposed to change with the new sylvicultural treatment. Through this demonstration site a change in the sylviculture will be studied, from a regular high forest system, to an individualized tree sylviculture for the *Quercus robur* L. specie.

These changes are being made in a plot that is part of the AFI (Association Futaie Irrégulière) plots network, where the objective is to use the PROSILVA management resulting in an irregular stand. In addition to that AFI plot, a control plot is being installed in the Jauntsarats forest where no actuation is planned for at least the next ten years, so the forest will not change in a short term. The main climate change risks for forest are: strong winds, new pest and pathogens and less water availability.

The hypothesis is that uneven-aged forests should be more resistant and resilient to those risks because: Their relation between height and diameter used to be lower in this kind of forest structure and it supposes bigger resistance to strong winds. An uneven-aged forest, with different ages and species within it, is more resistant to pest and pathogen outbreaks.

These forests have a better use of ground water. In the AFI plot located in Jauntsarats the aim is to carry out the transition from a regular stand to an irregular stand where different species and diameters are mixed, maintaining pedunculate oak dominance and producing high quality trees.



Location of the demonstration sites in Jauntsarats.

DS14 - San Pedro de Labio

Local name: San Pedro de Labio
Municipality: Lugo
Region: Galicia / **Country:** Spain
Altitude (m): 655

Department in charge: Centro de Investigación Forestal de Lourizán
Contact e-mail: infolourizan.mr(at)xunta.es

Topography: plain
Orientation: SW
Slope (%): 8
Hydrology: plain area in the river Miño basin, 60 km far from Cantabric coast

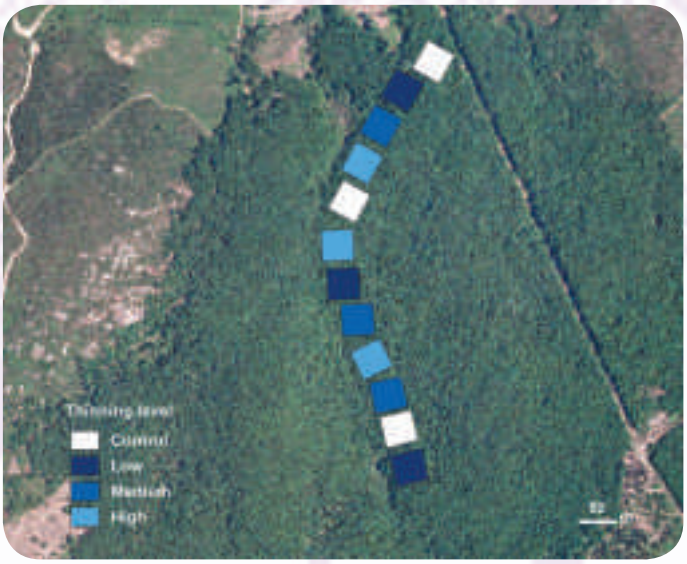
pH (soil layer 0 - 30cm): 4.6
Type of Soil: UMBRISOLS
Subtype of Soil: cambic
Bedrock: acid to intermediate plutonic rocks

Mean T (°C): 11.8
Mean T (°C) Coldest Month: 0.6
Mean Precipitation (mm): 873
N Frost Days: 39

The oakwood area covers 65 ha, surrounded by pine reforestations. It is close to a recreational park area "Lagos de Teixeiro". Traditionally, the area is structured as coppice woodland, mainly for fuel extraction purposes. It is also an area for game hunting, mainly roe deer and wild boar. DS14 is placed on a private land. The land is owned and managed by the Neighborhood Forest of San Pedro de Labio, typical of Galician culture.

All the forest area belongs to a territorial demarcation, "parroquia", which joins all the neighborhood members. Each citizen owns a percentage of the whole indivisible forest area and the management must be agreed with all the members of the community by a common consent. In Galicia, this way of forest property is called "Neighborhood Forest in Common Hand". The stand shows an even-aged oak (Quercus robur) canopy covering an understory mainly with heaths and other shrubs as alder buckthorn and bilberries. Thinning treatments were applied in 1999.

Initially, this even aged tree stand showed the following characteristics: Age (38 years), Mean DBH (15.8 cm), Mean Height (12.5 m), Density (1028 tree/ha).



DS15 - Potes

Local name: Potes
Municipality: Potes
Region: Cantabria / **Country:** Spain
Altitude (m): 525

Department in charge: Plant Production and Forest Resources. University of Valladolid
Contact e-mail: jdcasero(at)pvs.uva.es

Topography: high slope
Orientation: NW
Slope (%): 50
Hydrology: waters under river Deva basin

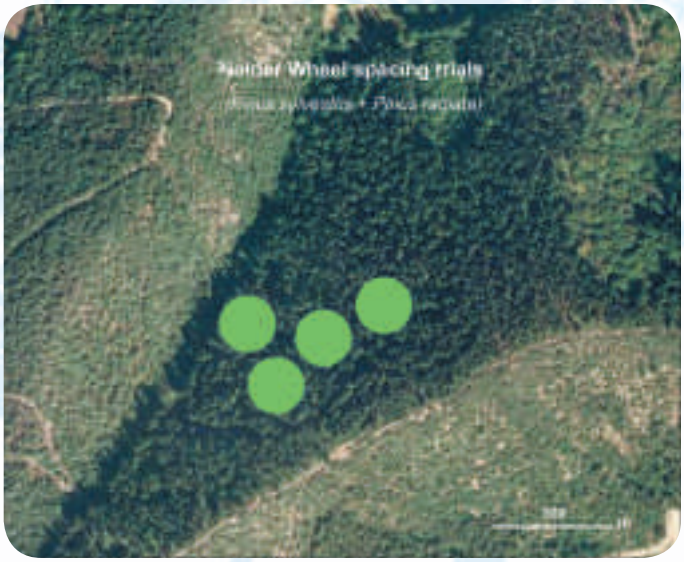
pH (soil layer 0 - 30cm): 4.89
Type of Soil: CAMBISOLS
Subtype of Soil: umbric
Bedrock: sandstone

Mean T (°C): 13
Mean T (°C) Coldest Month: 0.1
Mean Precipitation (mm): 900
N Frost Days: 70

The demonstration site is located next tothe installation of the arboretum, making the use of the data from the weather station possible. The main objective is to reveal optimal planting densities of test species through the study of the available space for the development of each plant and the alignments between them.

The main sylvicultural option demonstrated here is a new mixed plantation of *Pinus sylvestris* and *Pinus radiata* using systematic designs in concentric circles with different grids of plant positions, varying the spacing from low to high density and the degree of composition of both species.

The demonstration sites are plantations based on Nelder Wheels (Nelder, 1962) designed to evaluate the influence of the density on the mortality, the size, the pathogenic damages and the biomass allocation of each plant. The data analysis will be performed using logistic regression and spatial analysis.



DS16 - Alava and Bizkaia

Local name: Alava and Bizkaia
Municipality: Abadiño
Region: Basque Country / **Country:** Spain
Altitude (m): 168

Department in charge: Asociación de Propietarios Forestales de Bizkaia y Álava / Bizkaia and Álava Forest Owners Association
Contact e-mail: forestal(at)hazi.es

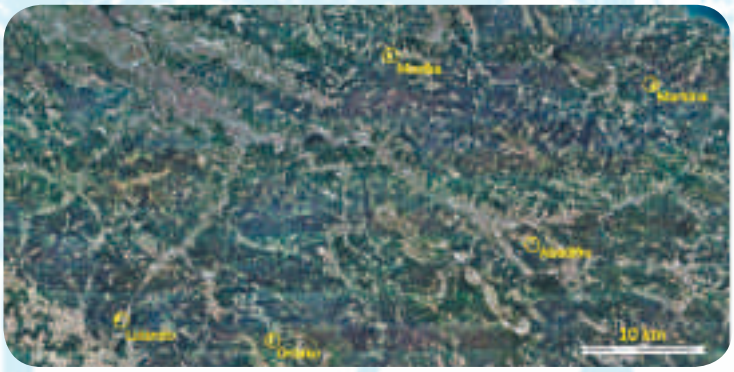
Topography: high slope
Orientation: S
Slope (%): 15-50
Hydrology: flat soil, without rivers

pH (soil layer 0 - 30cm): 4.7
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: pelite lutite or argillite

Mean T (°C): 12.2
Mean T (°C) Coldest Month: 6.4
Mean Precipitation (mm): 1075
N Frost Days: 14

Growth and Adaptation of the species to the Drought under several thinning treatments: Radiata pine silviculture plot networks were installed in 1998 in five private properties in Álava and Bizkaia by the Forest Owners Association of the Basque Country. After four mensurations (1998, 2000, 2003 and 2012), several types of Radiata pine proved to be better adapted to the climate of the mounts from the Basque Country than others. The first step was the data collection of the same trees along the years. A database was created with these data. During the REINFFORCE project, all the 570 trees were measured by diameter and total height. To avoid the use of numeric and metallic brands, all the trees were located by GPS. In the case of some Markina and Muxika plots, 10 average trees were selected to measure the wood quality by the Hitman ST300 and the Fakopp tools (two measures in the basal log of each selected tree).

An analysis with all these data is expected along the final year of the project. Relationships between thinning regime, growth and climatic damages will be studied.



DS17 - Amasa

Local name: Amasa
Municipality: Villabona
Region: Basque Country / **Country:** Spain
Altitude (m): 471

Department in charge: Diputación Foral de Gipuzkoa / Gipuzkoako Foru Aldundia
Contact e-mail: forestal(at)hazi.es

Topography: high slope
Orientation: S
Slope (%): 15-50
Hydrology: flat soil, without rivers

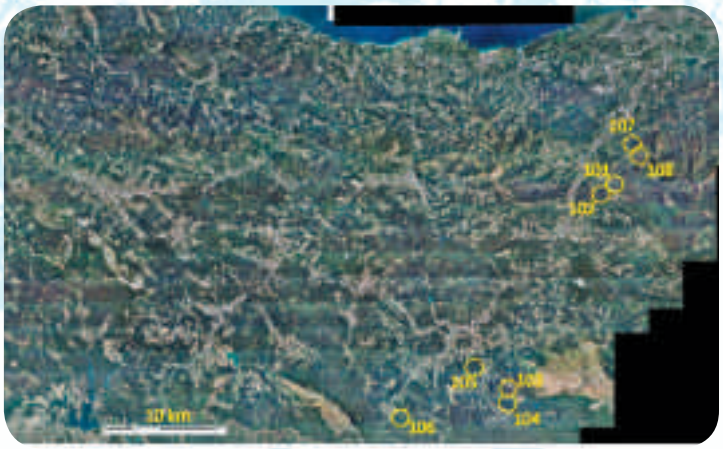
pH (soil layer 0 - 30cm): 6.2
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: marly limestone

Mean T (°C): 13.7
Mean T (°C) Coldest Month: 8.6
Mean Precipitation (mm): 1300
N Frost Days: 24

Growth and Adaptation of the species to the Drought under several thinning treatments: Eight Laricio pine silviculture plot networks were installed in 1990 in several public forests by Diputación Foral of Gipuzkoa. After five mensurations (1990, 1996, 2002, 2006 and 2011), several types of Laricio pine proved to be better adapted to the climate of the mounts from Gipuzkoa than others.The first step was the data collection of the same trees along the years. A database was created with these data.

During the REINFFORCE project, all the 1.470 trees were measured by diameter and total height. All the numeric, metallic brands were renewed for each tree. In each of these 8 plots, 10 average trees were selected to measure the wood quality: first, by core extraction and then with further laboratory measures by X-ray (ring width and density), by the Hitman ST300 and the Fakopp tools (two measures in each selected tree in its basal log) An analysis with all these data is expected along the final year of the project.

Relationships between thinning regime, growth and climatic damages will be studied.



DS18 - Santiago de Trasparga

Local name: Santiago de Trasparga
Municipality: Guitiriz
Region: Galicia / **Country:** Spain
Altitude (m): 525

Department in charge: Centro de Investigación Forestal de Lourizán
Contact e-mail: infolourizan.mr(at)xunta.es

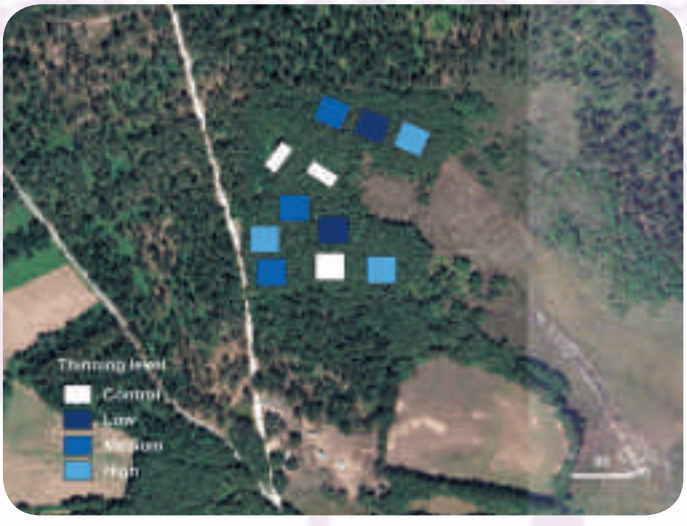
Topography: plain
Orientation: W
Slope (%): 5
Hydrology: plain area of the Parga river catchment, flowing into the Miño River, 35 km far from the Atlantic coast

pH (soil layer 0 - 30cm): 4.9
Type of Soil: UMBRISOLS
Subtype of Soil: alumic
Bedrock: acid to intermediate plutonic rocks

Mean T (°C): 10.7
Mean T (°C) Coldest Month: 0.4
Mean Precipitation (mm): 919
N Frost Days: 54

The site is included in a protected area classified as the Biosphere Reserve "Terras do Miño" (UNESCO). Terras do Miño is a traditional cultural landscape with many highly important natural habitats and erosive accumulation of terraces systems associated to specific sections of the Miño River. It plays an important role in hydric regulation of the whole region. It comprises evergreen forests, woodlands and scrublands, lagoons, alluvial forests, blanket bogs, raised bogs and fens. It also includes wetlands in the plains and valleys, agricultural land and mountains. Inhabitants are mostly engaged in cattle grazing, commerce and traditional agro systems in a particular form of ancient agrarian organization.

DS18 is placed on a private land. The land is owned and managed by the Neighborhood Forest of Trasparga, typical of Galician culture. All the forest area belongs to a territorial demarcation, "parroquia", which joins all the neighborhood members. Each citizen owns a percentage of the whole indivisible forest area and the management must be agreed with all the members of the community by a common consent. In Galicia, this way of forest property is called "Neighborhood Forest in Common Hand". The surrounding land is occupied by pine reforestations. The stand shows a reforested birch (*Betula alba*) forest covering a sparse understory mainly with blackberry, grasses and some ferns. Resprouting from birch is also noticed. Thinning treatments were applied in 2001. Initial tree stand characteristics were: Age (24 years), Mean DBH (13.5 cm), Dominant Height (13.5 m), Density (2257 tree/ha).



DS19 - Huerto semillero

Local name: Huerto semillero
Municipality: Karrantza
Region: Basque Country / **Country:** Spain
Altitude (m): 250

Department in charge: Forestry Unit
Contact e-mail: basozaintza(at)neiker.net

Topography: middle slope
Orientation: NW
Slope (%): 20
Hydrology:

pH (soil layer 0 - 30cm): 5.0
Type of Soil: CAMBISOLS
Subtype of Soil: dystric
Bedrock: clayey sandstone

Mean T (°C): 12.7
Mean T (°C) Coldest Month: 4.5
Mean Precipitation (mm): 1073
N Frost Days: 55

The sylvicultural option to be demonstrated is the application of biochar (B) to forest soils to improve soil water-holding capacity in order to adapt to Climate Change. A randomized complete block design was used to establish the experiment (3 blocks and 3 replicates per block) and the experimental treatments consist of 9 Mg C/ha of B, 3 Mg C/ha of B, 9 Mg C/ha of B + 200kg of ammonium nitrate. Each plot covered 64 m2 with 4 trees inside.

The demonstration site is located in the radiata pine seed orchard that was established in 1996. It is owned by the municipality and managed by the forestry service of the Provincial Council of Bizkaia (BFA).

The climate data comes from WORLDCLIM- Global Climate data for the reference period 1950-2000, except for the "frost days" figure, that has been recorded from the closest point in the CRU_CL_2.0 gridded datasets. It has to be pointed out that WORLDCLIM underestimates precipitation for the region and that CRU overestimates the number of frost days.

Monitoring planned for the future:

Temperature, precipitation and throughfall: A weather station is established in the demonstration site and several rain gauges under the canopy.

Soil water content: Soil moisture will continuously be monitored using soil moisture sensors.

Soil water holding capacity: Low and erratic rainfall could be a major constraint for forestry in any Climate Change scenario. Besides, a big amount of this rainfall disappears as runoff. Addition of biochar to soils could improve the ability of the soil to absorb and store water and therefore avoid this surface runoff. One of the most important physical characteristics of the soil is the capacity to store the acquired moisture in the root zone and release it to plant roots, referred to as soil water-holding capacity.

Toxicity: The potential of biochar to be a source of soil contamination needs to be evaluated, not only with respect to the biochar product itself, but also to soil type and environmental conditions.

Growth: One of the best documented consequences of water stress is stomatal closure as a result of loss of turgor in leaf cells: this leads to a reduction in photosynthesis, hence reduced growth.

Aggregate stability: The aggregate stability of a soil is the resistance of soil structure against mechanical or physicochemical destructive forces. Among the mechanical destructive forces is the raindrop splash that could gain importance with extreme events due to Climate Change increase. Soil structure is one of the main factors controlling plant growth by its influence on root penetration, soil temperature and gas diffusion, water transport and seedling emergence and therefore it is an important soil characteristic for foresters.

Nutrients status: Nutrients and their relative proportions to each other in trees are important for tree vitality. Trees subjected to nutrient imbalances continue to grow, but the plant must divert more resources in translocation of critical nutrients and may become more sensitive to environmental stress, for instance frost and drought. Environmental stress changes physiological and chemical conditions within the trees which predisposes the trees to lethal attacks by opportunistic pathogenic organisms.

DS20 - Huerto semillero

Local name: Huerto semillero
Municipality: Karrantza
Region: Basque Country / **Country:** Spain
Altitude (m): 250

Department in charge: Forestry Unit
Contact e-mail: basozaintza(at)neiker.net

Topography: middle slope
Orientation: NW
Slope (%): 20
Hydrology:

pH (soil layer 0 - 30cm): 4.9
Type of Soil: CAMBISOLS
Subtype of Soil: dystric
Bedrock: clayey sandstone

Mean T (°C): 12.7
Mean T (°C) Coldest Month: 4.5
Mean Precipitation (mm): 1073
N Frost Days: 55

The sylvicultural option to be demonstrated is the application of wood ash to forest soils to improve the nutrient status of trees and increase tree drought resistance in order to adapt to Climate Change. A randomized complete block design was used to establish the experiment (3 blocks and 3 replicates per block) and the experimental treatments consist of 4.5 Mg/ha of wood ash, 1.5 Mg/ha of wood ash, 4.5 Mg/ha of wood ash + 200kg of ammonium nitrate. Each plot covered 64 m2 with 4 trees inside.

The demonstration site is in the radiata pine seed orchard established in 1996 owned by the municipality and managed by the forestry service of the Provincial Council of Bizkaia (BFA).

The climate data comes from WORLDCLIM- Global Climate data for the reference period 1950-2000, except for the "frost days" figure, that has been recorded from the closest point in the CRU_CL_2.0 gridded datasets. It has to be pointed out that WORLDCLIM underestimates precipitation for the region and that CRU overestimates the number of frost days.

Monitoring planned for the future:

Temperature, precipitation and throughfall: A weather station is established in the demonstration site and several rain gauges under the canopy.

Soil water content: Soil moisture will continuously be monitored using soil moisture sensors.

Soil water holding capacity: Low and erratic rainfall could be a major constraint for forestry in any Climate Change scenario. Besides, a big amount of this rainfall disappears as runoff. Addition of biochar to soils could improve the ability of the soil to absorb and store water and therefore avoid this surface runoff. One of the most important physical characteristics of the soil is the capacity to store the acquired moisture in the root zone and release it to plant roots, referred to as soil water-holding capacity.

Toxicity: The potential of biochar to be a source of soil contamination needs to be evaluated, not only with respect to the biochar product itself, but also to soil type and environmental conditions.

Growth: One of the best documented consequences of water stress is stomatal closure as a result of loss of turgor in leaf cells: this leads to reduction in photosynthesis, hence reduced growth.

Aggregate stability: The aggregate stability of soil is the resistance of soil structure against mechanical or physicochemical destructive forces. Among the mechanical destructive forces is the raindrop splash that could gain importance with extreme events due to Climate Change increase. Soil structure is one of the main factors controlling plant growth by its influence on root penetration, soil temperature and gas diffusion, water transport and seedling emergence and therefore it is an important soil characteristic for foresters.

Nutrients status: Nutrients and their relative proportions to each other in trees are important for tree vitality. Trees subjected to nutrient imbalances continue to grow, but the plant must divert more resources in translocation of critical nutrients and may become more sensitive to environmental stress, for instance frost and drought. Environmental stress changes physiological and chemical conditions within the trees which predisposes the trees to lethal attacks by opportunistic pathogenic organisms.

DS21 - Huerto semillero

Local name: Huerto semillero
Municipality: Karrantza
Region: Basque Country / **Country:** Spain
Altitude (m): 250

Department in charge: Forestry Unit
Contact e-mail: basozaintza(at)neiker.net

Topography: middle slope
Orientation: NW
Slope (%): 20
Hydrology:

pH (soil layer 0 - 30cm): 4.8
Type of Soil: CAMBISOLS
Subtype of Soil: dystric
Bedrock: clayey sandstone

Mean T (°C): 12.7
Mean T (°C) Coldest Month: 4.5
Mean Precipitation (mm): 1073
N Frost Days: 55

Business as usual in order to compare the adaptation capacity of the traditional forest management with the application of biochar or wood ashes.

The demonstration site is in the radiata pine seed orchard established in 1996 owned by the municipality and managed by the forestry service of the Provincial Council of Bizkaia (BFA).

The climate data comes from WORLDCLIM- Global Climate data for the reference period 1950-2000, except for the "frost days" figure, that has been recorded from the closest point in the CRU_CL_2.0 gridded datasets. It has to be pointed out that WORLDCLIM underestimates precipitation for the region and that CRU overestimates the number of frost days.

Monitoring planned for the future:

Temperature, precipitation and throughfall: A weather station and several rain gauges under the canopy are located in the demonstration site.

Soil water content: Soil moisture will continuously be monitored using soil moisture sensors.

Soil water holding capacity: Low and erratic rainfall could be a major constraint for forestry in any Climate Change scenario. Besides, a big amount of this rainfall disappears as runoff. Addition of biochar to soils could improve the ability of the soil to absorb and store water and therefore avoid this surface runoff. One of the most important physical characteristics of the soil is the capacity to store the acquired moisture in the root zone and release it to plant roots, referred to as soil water-holding capacity.

Toxicity: The potential of biochar to be a source of soil contamination needs to be evaluated, not only with respect to the biochar product itself, but also to soil type and environmental conditions.

Growth: One of the best documented consequences of water stress is stomatal closure as a result of loss of turgor in leaf cells: this leads to a reduction in photosynthesis, hence reduced growth.

Aggregate stability: The aggregate stability of a soil is the resistance of soil structure against mechanical or physicochemical destructive forces. Among the mechanical destructive forces is the raindrop splash that could gain importance with extreme events due to Climate Change increase. Soil structure is one of the main factors controlling plant growth by its influence on root penetration, soil temperature and gas diffusion, water transport and seedling emergence and therefore it is an important soil characteristic for foresters.

Nutrients status: Nutrients and their relative proportions to each other in trees are important for tree vitality. Trees subjected to nutrient imbalances continue to grow, but the plant must divert more resources in translocation of critical nutrients and may become more sensitive to environmental stress, for instance frost and drought. Environmental stress changes physiological and chemical conditions within the trees which predisposes the trees to lethal attacks by opportunistic pathogenic organisms.

DS22 - Monte Corona

Local name: Monte Corona
Municipality: Valdáliga
Region: Cantabria / **Country:** Spain
Altitude (m): 245

Department in charge: Plant Production and Forest Resources. University of Valladolid
Contact e-mail: jdcasero(at)pvs.uva.es

Topography: low slope
Orientation: E
Slope (%): 10
Hydrology: waters under river Saja basin

pH (soil layer 0 - 30cm): 4.65
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: siltstone

Mean T (°C): 13
Mean T (°C) Coldest Month: 4
Mean Precipitation (mm): 1300
N Frost Days: 5

The demonstration site is located next to the installation of the arboretum, making the use of the data from the weather station possible. The main objective is to reveal optimal planting densities of test species through the study of the available space for the development of each plant and the alignments between them.

The main sylvicultural option demonstrated is a new mixed plantation of two codes of *Eucalyptus nitens* in an area affected by *Micosphaerella* sp. using systematic designs in concentric circles with different grids of plant positions, varying the spacing from low to high density and the degree of composition of both species. The demonstration sites are plantations based on Nelder Wheels (Nelder, 1962) designed to evaluate the influence of the density on the mortality, the size, the pathogenic damages and the biomass allocation of each plant. The data analysis will be performed using logistic regression and spatial analysis.

DS23 - San Mamede de Grañas do Sor

Local name: San Mamede de Grañas do Sor
Municipality: Mañón
Region: Galicia / **Country:** Spain
Altitude (m): 475

Department in charge: Centro de Investigación Forestal de Lourizán
Contact e-mail: infolourizan.mr(at)xunta.es

Topography: middle slope
Orientation: W
Slope (%): 41
Hydrology: middle slope of the "Serra da Faladoira" Mountains, placed in the river Sor catchment with the stream "Rego do Abeledo" flowing through the forest, and 15 km far from the Atlantic coast

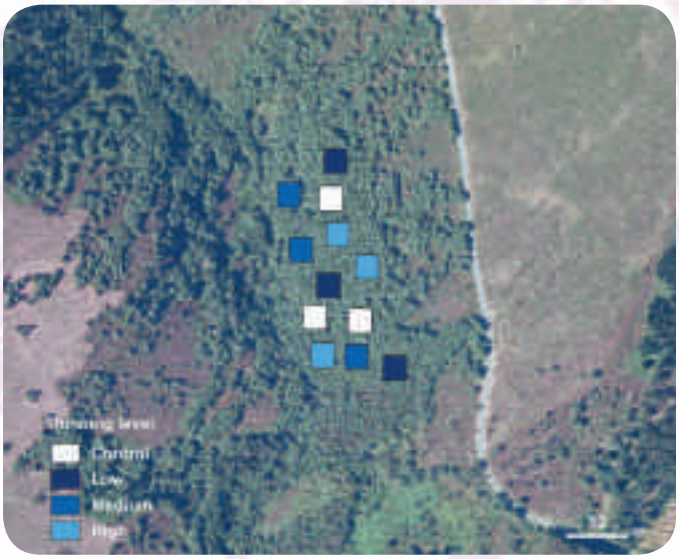
pH (soil layer 0 - 30cm): 4.7
Type of Soil: REGOSOLS
Subtype of Soil: umbric
Bedrock: acid regional metamorphic rocks

Mean T (°C): 10.4
Mean T (°C) Coldest Month: 3.5
Mean Precipitation (mm): 1343
N Frost Days: 9

The surrounding land is occupied by a patch landscape of pastures and small pine afforested areas. Local population has incomes mainly from the livestock and the forest management. Recently, and due to the optimal geographic position, wind farms were placed at the top of "Serra da Faladoira" mountain chain and now the wind turbines provide a different landscape.

DS23 is placed on a private land. The land is owned and managed by the Neighborhood Forest of Grañas do Sor, typical of Galician culture. All the forest area belongs to a territorial demarcation, "parroquia", which joins all the neighborhood members. Each citizen owns a percentage of the whole indivisible forest area and the management must be agreed with all the members of the community by a common consent. In Galicia, this way of forest property is called "Neighborhood Forest in Common Hand". The stand shows an even-aged birch (*Betula alba*) canopy from natural regeneration, almost without understory, only a few grasses are present.

Livestock, mainly wild horses, are commonly present inside the stand, decreasing the understory cover. Thinning treatments were applied in 2003, when tree stand characteristics were: Age (22 years)Mean DBH (8.6 cm), Dominant Height (9.9 m), Density (2618 tree/ha).



DS24 - San Andrés de Boimente

Local name: San Andrés de Boimente
Municipality: Viveiro
Region: Galicia / **Country:** Spain
Altitude (m): 415

Department in charge: Centro de Investigación Forestal de Lourizán
Contact e-mail: infolourizan.mr(at)xunta.es

Topography: middle slope
Orientation: W
Slope (%): 35
Hydrology: middle slope in the river Landro basin, 10 km far from the Cantabric coast

pH (soil layer 0 - 30cm): 4.3
Type of Soil: UMBRISOLS
Subtype of Soil: cambic
Bedrock: acid to intermediate plutonic rocks

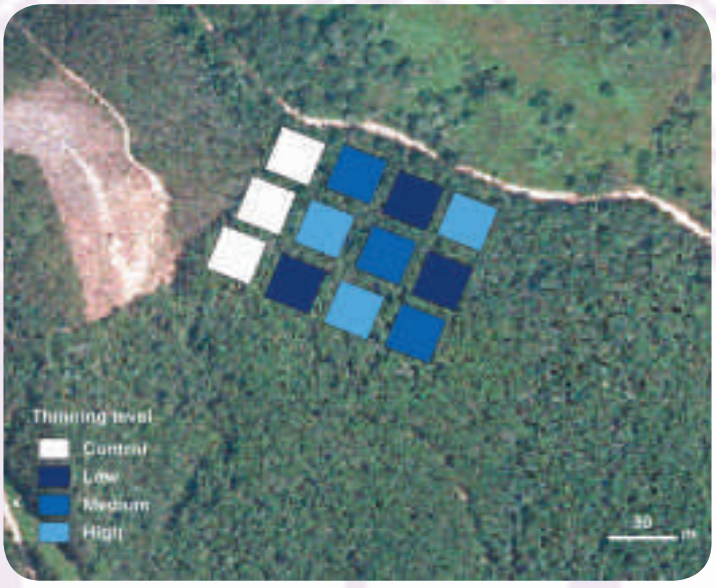
Mean T (°C): 10.5
Mean T (°C) Coldest Month: 5.3
Mean Precipitation (mm): 1001
N Frost Days: 6

The oakwood area covers 45 ha, called "Fraga das Saimas". The area is managed as a silvopastoral system with livestock, mainly cattle and horses, under low carrying capacities. It is also an area for game hunting, with roe deer and wild boar. Recreational uses are common due to the proximity of the touristic village of Viveiro.

A good equilibrium was achieved through the different uses of the land. The surroundings are included in the list of Nature 2000 sites in the Atlantic region because of its high biodiversity value. A stream flows by the forest and tropical relictic ferns (*Woodwardia radicans, Dryopteris guanchica*) growth on their banks. DS24 is placed on a private land. The land is owned and managed by the Neighborhood Forest of San Andrés de Boimente, typical of Galician costumes.

All the forest area belongs to a territorial demarcation, "parroquia", which joins all the neighborhood members. Each citizen owns a percentage of the whole indivisible forest area and the management must be agreed with all the members of the community by a common consent. In Galicia, this way of forest property is called "Neighborhood Forest in Common Hand".

The stand shows an even-aged oak (*Quercus robur*) canopy covering a dense understory mainly with blackberry and some ferns. Thinning treatments were applied in 1998. Initial tree stand characteristics were: Age (60 years), Mean DBH (19.6 cm), Mean Height (13.7 m), Density (860 tree/ha).



DS25 - Les Pins de Toulouse

Local name: Les Pins de Toulouse
Municipality: Arengosse
Region: Aquitaine / **Country:** France
Altitude (m): 84

Department in charge: CRPF Aquitaine
Contact e-mail: a.castro(at)crpfaquitaine.fr

Topography: plateau
Orientation: flat
Slope (%): 1
Hydrology: arengosse is part of the river basin of the Bès, tributary of the Midouze river. No stream can be found near the demonstration site which is located in a poorly drained area. Several ditches regulate the water table level in winter.

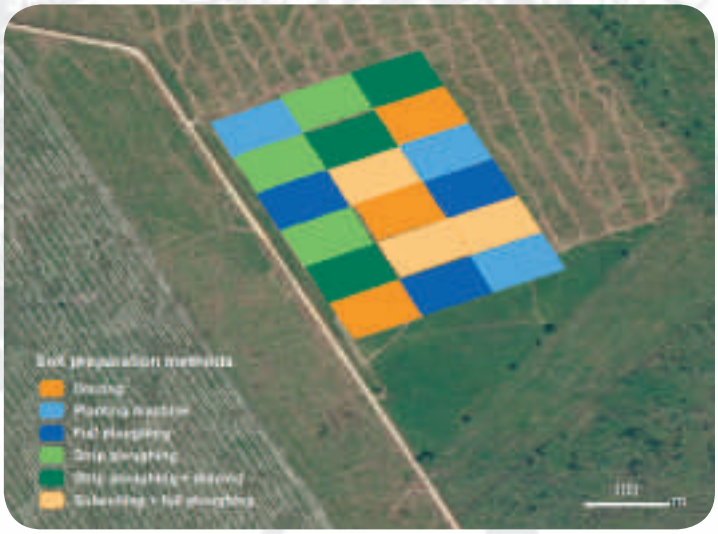
pH (soil layer 0 - 30cm): 4.5
Type of Soil: PODZOLS
Subtype of Soil: umbric
Bedrock: eolian sands

Mean T (°C): 12.6
Mean T (°C) Coldest Month: 5.8
Mean Precipitation (mm): 1090
N Frost Days: 58

The main sylvicultural option demonstrated is the comparison of different soil preparation methods. Factors of interest related to climate change: effect of soil preparation on root development/stand stability effect of soil preparation on water supply/ sensitivity to drought.

There is a new plantation of maritime pine, on a clear-cut unit. The stand is located in the area most damaged by the Klaus storm. The wood remnants were grinded. This demonstration site will be integrated in the GIS Pin Maritime du Futur (CRPF-CPFA, INRA, ONF, FCBA), and data shared with GIS PMF partners. Growth measurement campaigns will take place every 3 years. The first survey took place in winter 2012/2013.

The site will be used in information meetings organized for forest owners by CRPF-CPFA when sufficient data are available. Results will be used for technical information leaflet and papers on sylvicultural practices.



DS26 - La Brouquette

Local name: La Brouquette
Municipality: Saint-Paul-en-Born
Region: Aquitaine / **Country:** France
Altitude (m): 35

Department in charge: CRPF Aquitaine
Contact e-mail: a.castro(at)crpfaquitaine.fr

Topography: plateau
Orientation: flat
Slope (%): 1
Hydrology: the site is situated in the river basin of the Montaut, a small right bank tributary of the Canteloup river near its mouth in the Aureilhan lake. No stream can be found near the demonstration site which is located in a poorly drained area. the level of the water table in winter is regulated by ditches.

pH (soil layer 0 - 30cm): 4.5
Type of Soil: PODZOLS
Subtype of Soil: umbric
Bedrock: eolian sands

Mean T (°C): 13
Mean T (°C) Coldest Month: 7
Mean Precipitation (mm): 1053
N Frost Days: 29

The main sylvicultural option demonstrated is a short term sylviculture in maritime pine and eucalyptus. Factors of interest related to climate change in a short production cycle (25 years) with no thinning for risk limitation:

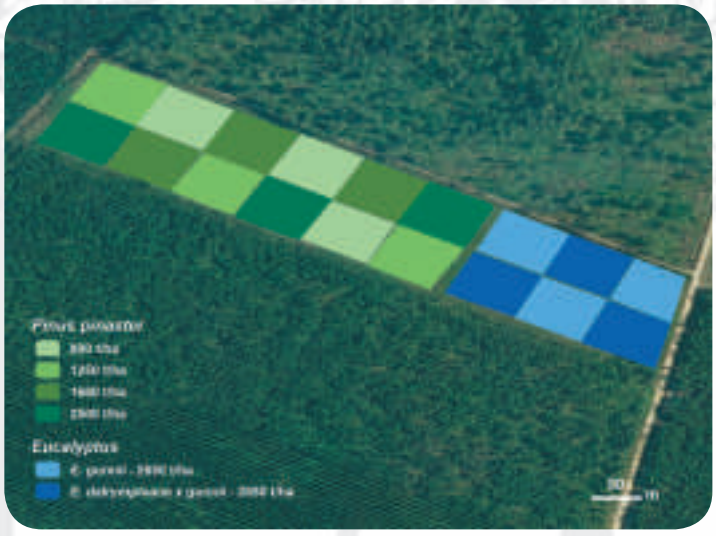
- sensitivity to drought
- stand stability.

There are three types of stand:

- Plantation of maritime pine, on a clear-cut area (3,05 ha)
- Plantation of Eucalyptus dalrympleana x gunnii ("Gundal"), on a clear-cut area (0,76 ha)

This demonstration site will be integrated in the GIS Pin Maritime du Futur (CRPF-CPFA, INRA, ONF, FCBA), and data shared with GIS PMF partners. Growth measurement campaigns will take place every 3 years (first height measurement will take place in autumn 2013). First survey (dead/alive) took place in spring 2012. The site will be used in information meetings organized for forest owners by CRPF-CPFA when sufficient data are available. Results will be used for technical information leaflet and papers on sylvicultural practices.

A similar demonstration site for pine has been planted in the municipality of Salles (Aquitaine) since winter 2012, since short rotation plantations are likely to extend in the coming years and are rather poorly documented.



DS27 - La Courrège

Local name: La Courrège
Municipality: Belin-Beliet
Region: Aquitaine / **Country:** France
Altitude (m): 60

Department in charge: CRPF Aquitaine
Contact e-mail: a.castro(at)crpfaquitaine.fr

Topography: plateau
Orientation: flat
Slope (%): 1
Hydrology: the site is situated in the river basin of the Craste de la Serre stream, a small left bank tributary of the Hountine stream. The demonstration site is located at 200 m east of the stream.

pH (soil layer 0 - 30cm): 4.5
Type of Soil: PODZOLS
Subtype of Soil: umbric
Bedrock: eolian sands

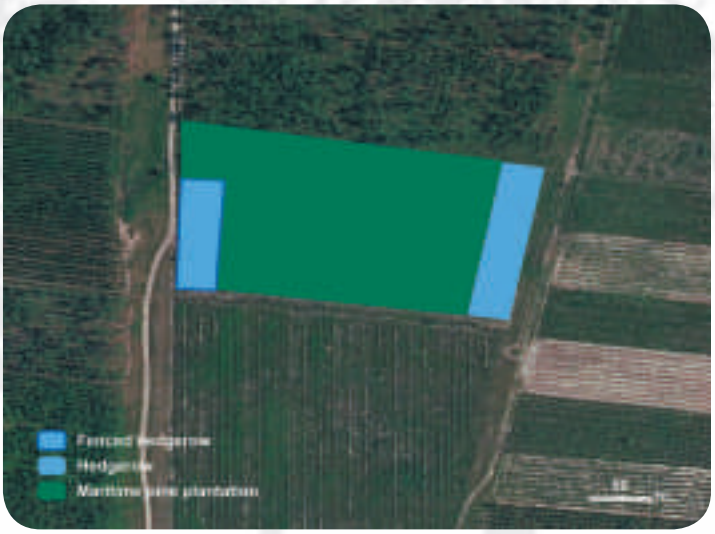
Mean T (°C): 12.6
Mean T (°C) Coldest Month: 5.9
Mean Precipitation (mm): 1011
N Frost Days: 55

Main sylvicultural option demonstrated : installing and managing a broadleaved hedgerow on the margin of a maritime pine plantation. The proposed plot fits into the creation of a network of demonstration sites designed to compare current sylviculture with other adaptative techniques to global change.

Conservation, reinforcement or installation of broadleaf species stands, inserted as groves or hedgerows into the pine stands matrix, have a strong functional interest. In particular, this technique enables to reduce the vulnerability of the Landes of Gascony forest to pests. Under certain conditions, these stands may have a positive effect on forest fire risk management. It is a convenient investment in the prospect of global change, that may induce an increase in sanitary attacks of existing pests and diseases as well as the possible emergence of new pathogens.

As it is difficult to successfully install broadleaved stands on the sandy podzols of the Landes of Gascony, we are testing different treatments with common oak (*Quercus robur*), which is the most common broadleaf specie. Besides, part of the plot aims to evaluate the possibility of a spontaneous growth of those species, as well as the impact of game on this vegetation. Creation of a plantation edge: counting on the natural growth of vegetation.

There is no current evaluation for this treatment, planting broadleaved species at low density. We are testing the climatic effect of protection techniques such as techniques using mulching or protection nets. Game damages, particularly cervidae, is a major threat for the development of broadleaf seedlings. Plantations must be protected which implies high installation costs. It is then convenient to evaluate the profitability of fencing a planted edge.



DS28 - Bouyssonnat

Local name: Bouyssonnat
Municipality: Lamonzie-Montastruc
Region: Aquitaine / **Country:** France
Altitude (m): 110

Department in charge: CRPF Aquitaine
Contact e-mail: a.castro(at)crpfaquitaine.fr

Topography: plateau with small dale
Orientation: flat
Slope (%): 6
Hydrology: situated in the river basin of La Louyre river. Located 1300m south from the stream

pH (soil layer 0 - 30cm): 5
Type of Soil: CAMBISOLS
Subtype of Soil: dystric
Bedrock: acid to intermediate plutonic rocks

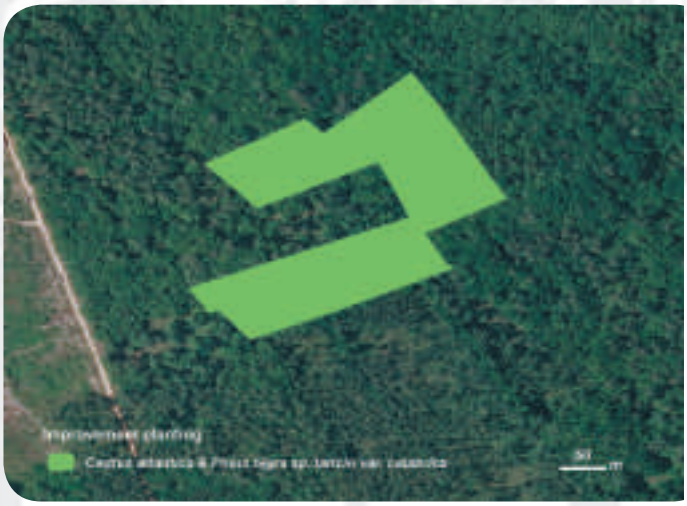
Mean T (°C): 12.5
Mean T (°C) Coldest Month: 5.2
Mean Precipitation (mm): 905
N Frost Days: 59

The main sylvicultural option demonstrated here is the gradual transformations of existing forest stand critical conditions, in order to mitigate the effects of global change. The site is a bad quality chestnut tree coppice on a sand-clay soil. The device is made up of 3 ha in total of Atlas Cedar and Black Pine (*Pinus nigra sp. Laricio var. calabrica*). For the comparison, another site has been installed in the same department of Dordogne (Saint Martin le Pin) on acid soil: 3 ha of which 1 ha with sessile oak, 1 ha with cedar et 1 ha with Corsican pine.

The operations consisted in the opening of 10m wide strips, where the coppice sprouts were cut and a forest grinder passed, alterning with untouched coppice strips of 8m wide.

Inside the 10m wide strip, the soil preparation was made with heavy disk ploughing and a plantation of two rows of seedlings, separated by 3m from the border of the coppice strip. The planting space is 4 * 2 m. In the row, the seedlings are placed every 2 m in order to obtain a global density of 555 trees/ha.

The department of Dordogne presents large areas of coppice, mainly of chestnut trees or oaks. Among these stands quite a lot are of mediocre quality, growing from ageing and exhausted stumps. Furthermore, the sensitivity to drought is likely to increase with the global climatic change. Those stands must be replaced if we want to maintain an interesting production capacity. A complete transformation (clear-cut, stump removal and full planting) would be far too expensive in most cases. Thus, the objective as part of the REINFFORCE project is to try out a gradual transformation technique by planting drought-tolerant forest species in strips
within the coppice stand.



DS29 - La Chapoulie

Local name: La Chapoulie
Municipality: Saint Martin le Pin
Region: Aquitaine / **Country:** France
Altitude (m): 271

Department in charge: CRPF Aquitaine
Contact e-mail: a.castro(at)crpfaquitaine.fr

Topography: crest-top
Orientation: flat
Slope (%): 4
Hydrology: the site is situated in the river basin of the stream Ruisseau de Combas, a small left bank tributary of the river La Doue. The demonstration site is located at 200 m east from the stream.

pH (soil layer 0 - 30cm): 5
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: accid to intermediate plutonic rocks

Mean T (°C): 11.8
Mean T (°C) Coldest Month: 4.3
Mean Precipitation (mm): 1056
N Frost Days: 69

The main sylvicultural option demonstrated is the gradual transformation of existing forest stand in critical conditions, in order to mitigate the effects of global change.

The site is on acid soil with bad quality chestnut tree coppice with a few common oak standards, damaged in 1999 by the "Martin" tempest. This device is made up of 3ha in total , 1ha of which is sessile oak, 1 ha with cedar and 1 ha with Corsican pine.

The operations were the opening of 10 m wide strips, where the coppice sprouts were cut and a forest grinder passed, alternating with untouched coppice strips of 8 m wide.

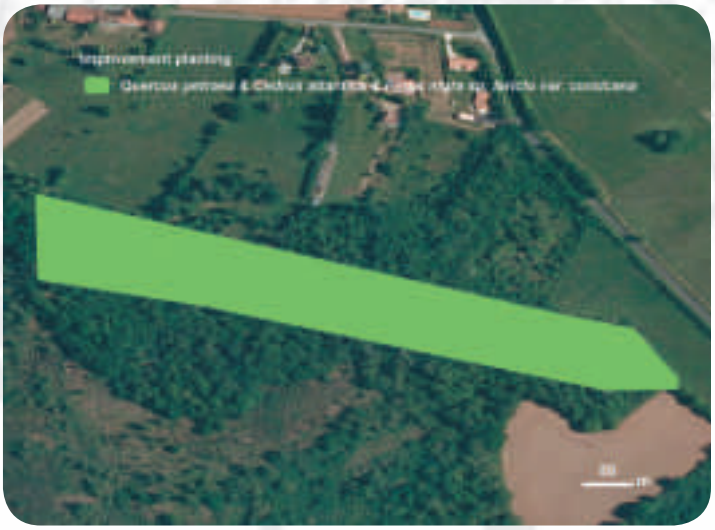
Inside the 10 m wide strip, soil preparation was made with heavy disk plough and plantation of two rows of seedlings, separated by 3 m from the border of the coppice strip. The planting space is 4 x 2 m. On the row, the seedlings are placed every 2 m in order to obtain a global density of 555 trees/ha.

On better soils, suitable for oak timber production, a similar treatment had been applied with small adaptations to the specie.

The sessile oak, less drought-sensitive than the common oak, is to replace it in a coppice with standards system.

Opening of 7 m wide strips, by logging of the coppice sprouts and passing of a forest grinder, alternating with the keeping of 8 m wide strips of the coppice.

In the middle of the 7m wide strip, plantation of a single row of sessile oak seedlings. On the row, the seedlings are placed every 2 m in order to obtain a global density of 333 trees/ha. All seedlings are protected from game damage by individual protections of 1,20 m height.



As a comparison, another site has been installed in the same department of Dordogne (Lamonzie- Montastruc) on a sandy-clay soil, using Atlas Cedar and Black Pine (*Pinus nigra* sp. *laricio* var. *calabrica*).

DS30 - Verrue

Local name: Verrue
Municipality: Verrue
Region: Poitou-Charentes / **Country:** France
Altitude (m): 84

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

Topography: plateau
Orientation: flat
Slope (%): 0
Hydrology: none

pH (soil layer 0 - 30cm): 5.5
Type of Soil: STAGNOSOLS
Subtype of Soil: dystric-eutric
Bedrock: marine and estuarine sands

Mean T (°C): 12.1
Mean T (°C) Coldest Month: 1.8
Mean Precipitation (mm): 627
N Frost Days: 45

The global objective is to develop a new silviculture to slow down the impacts of climatic changes and to maintain the high quality wood production of oak.

The objective of the demonstration site is to study the impact of the late thinning on the sanitary state (oak dieback problem) of oak stands (*Quercus robur*).The demonstration site is installed in the high sensibility area for oaks in France.

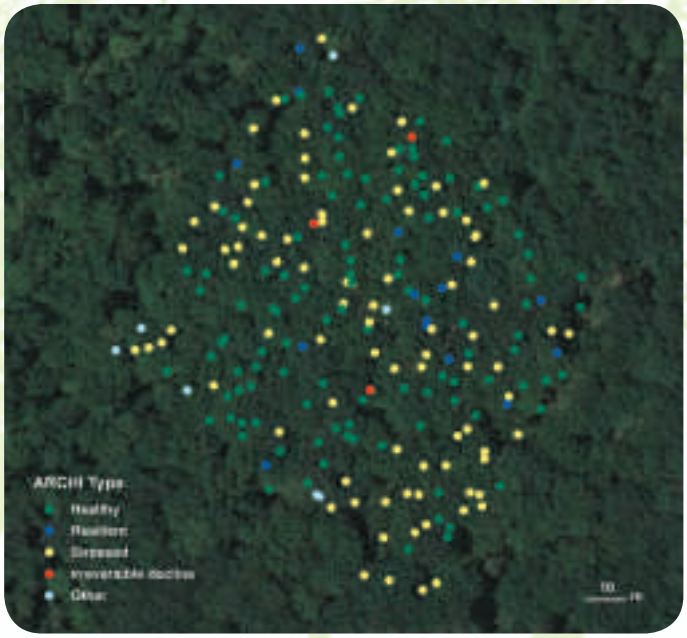
This high sensibility area was validated in the project : "Climate Change: The risks for the oak stands in the Atlantic region" in France managed by the CNPF – IDF (Lemaire et al., 2010). This stand is about 80 years old and is affected by dieback due to climate change. The studies conducted in France (Protocol ARCHI by Drenou et al., 2011) demonstrate that it is possible to distinguish oaks able to surmount stress (tree in the reversible sanitary state) from those which are not able to (tree in the irreversible sanitary state).

This diagnostic (with four different sanitary states) turns out to be indispensable to help foresters select the most resistant trees in the context of climate change. The sanitary state of each oak in the demonstration site is identified.

A localized thinning is then tested for each of the different sanitary states.The sanitary state of this thinned oak stand will be compared with the sanitary state of a non-thinned oak stand. The demonstration site s composed of two devices:

1 control device = no thinning,

1 thinning device.



DS31 - Bois de Noirpin

Local name: Bois de Noirpin
Municipality: Saint Maurice la Fougereuse
Region: Poitou-Charentes / **Country:** France
Altitude (m): 125

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

Topography: plateau
Orientation: flat
Slope (%): 0
Hydrology: none

pH (soil layer 0 - 30cm): 5.7
Type of Soil: STAGNOSOLS
Subtype of Soil: skeletic
Bedrock: andesite

Mean T (°C): 11.8
Mean T (°C) Coldest Month: 1.87
Mean Precipitation (mm): 724
N Frost Days: 44

The global objective is to develop a new silviculture to slow down the impacts of climatic changes and to maintain the high quality wood production of oak. The objective of the demonstration site is to study the impact of the late thinning on the sanitary state (oak dieback problem) of oak stands (*Quercus robur*).

The demonstration site is installed in the high sensibility area for oaks in France. This high sensibility area was validated in the project : "Climate Change: The risks for the oak stands in the Atlantic region" in France, managed by the CNPF – IDF (Lemaire et al., 2010). This stand is about 80 years old and is affected by dieback due to climate change.

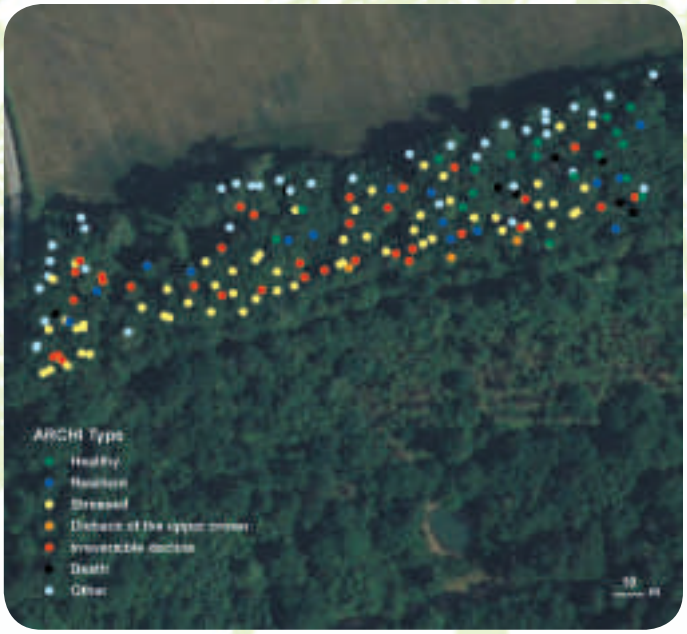
The studies conducted in France (Protocol ARCHI by Drenou et al., 2011) demonstrate that it is possible to distinguish oaks able to surmount stress (tree in the reversible sanitary state) from those which are not able to (tree in the irreversible sanitary state). This diagnostic (with four different sanitary states) turns out to be indispensable to help foresters select the most resistant trees in the context of climate change. The sanitary state of each oak in the demonstration site is identified.

Then for all the different sanitary states, the forester tests a localized thinning. The sanitary state of this thinned oak stand will be compared with the sanitary state of the not thinned oak stand.

Each demonstration site is composed of two devices:

1 control device = no thinning

1 device with thinning.



DS32 - Raslay

Local name: Raslay
Municipality: Raslay
Region: Poitou-Charentes / **Country:** France
Altitude (m): 41

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

Topography: plateau
Orientation: flat
Slope (%): 0
Hydrology: none

pH (soil layer 0 - 30cm): 4.5
Type of Soil: CAMBISOLS
Subtype of Soil: dystric
Bedrock: marine and estuarine sands

Mean T (°C): 12.4
Mean T (°C) Coldest Month: 2.2
Mean Precipitation (mm): 600
N Frost Days: 39

The global objective is to develop a new silviculture to slow down the impacts of climatic changes and to maintain the high quality wood production of oak. The objective of the demonstration site is to study the impact of the late thinning on the sanitary state (oak dieback problem) of oak stands (*Quercus robur*).

The demonstration site is installed in the high sensibility area for oaks in France. This high sensibility area was validated in the project : "Climate Change: The risks for the oak stands in the Atlantic region" in France, managed by the CNPF – IDF (Lemaire et al., 2010). This stand is about 80 years old and is affected by dieback due to climate change. The studies conducted in France (Protocol ARCHI by Drenou et al., 2011) demonstrate that it is possible to distinguish oaks able to surmount stress (tree in the reversible sanitary state) from those which are not able to (tree in the irreversible sanitary state).

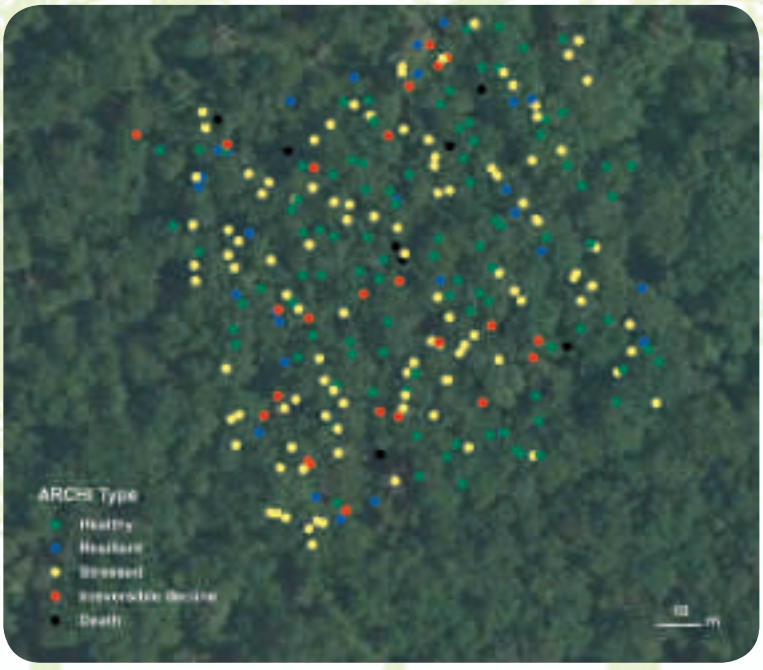
This diagnostic (with four different sanitary states) turns out to be indispensable to help foresters select the most resistant trees in the context of climate change. The sanitary state of each oak in the demonstration site is identified.

Then for all the different sanitary states, the forester tests a localized thinning. The sanitary state of this thinned oak stand will be compared with the sanitary state of the not thinned oak stand.

Each demonstration site is composed of two devices:

1 control device = no thinning

1 device with thinning.



DS33 - Forêt de Malpaire

Local name: Forêt de Malpaire
Municipality: Précigné
Region: Pays de la Loire / **Country:** France
Altitude (m): 40

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

Topography: plateau
Orientation: flat
Slope (%): 0
Hydrology: brook at 500m

pH (soil layer 0 - 30cm): 4.5
Type of Soil: STAGNOSOLS
Subtype of Soil: dystric-eutric
Bedrock: limestone

Mean T (°C): 11.7
Mean T (°C) Coldest Month: 1.7
Mean Precipitation (mm): 688
N Frost Days: 52

The global objective is to develop a new silviculture to slow down the impacts of climatic changes and to maintain the high quality wood production of oak. The objective of the demonstration site is to study the impact of the late thinning on the sanitary state (oak dieback problem) of oak stands *(Quercus robur*).

The demonstration site is installed in the high sensibility area for oaks in France. This high sensibility area was validated in the project : "Climate Change: The risks for the oak stands in the Atlantic region" in France, managed by the CNPF – IDF (Lemaire et al., 2010). This stand is about 80 years old and is affected by dieback due to climate change. The studies conducted in France (Protocol ARCHI by Drenou et al., 2011) demonstrate that it is possible to distinguish oaks able to surmount stress (tree in the reversible sanitary state) from those which are not able to (tree in the irreversible sanitary state).

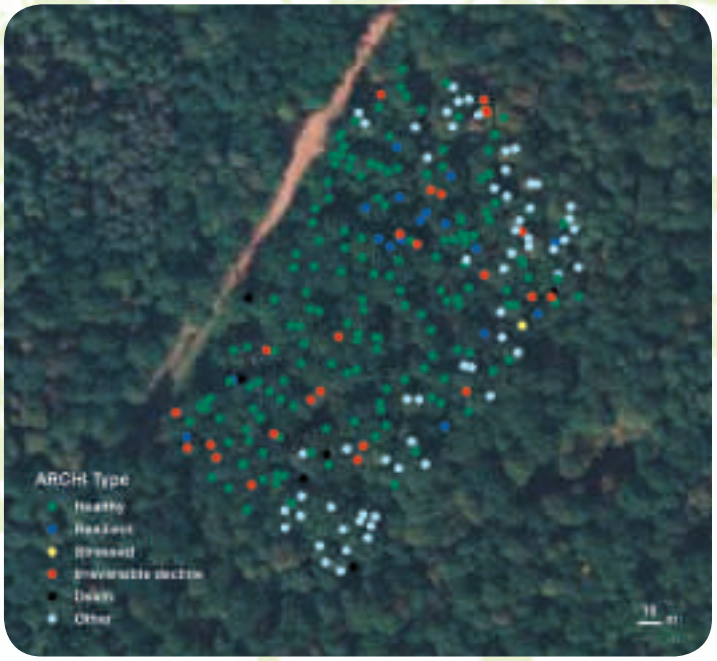
This diagnostic (with four different sanitary states) turns out to be indispensable to help foresters select the most resistant trees in the context of climate change. The sanitary state of each oak in the demonstration site is identified.

Then for all the different sanitary states, the forester tests a localized thinning. The sanitary state of this thinned oak stand will be compared with the sanitary state of the not thinned oak stand.

Each demonstration site is composed of two devices:

1 control device = no thinning

1 device with thinning .



DS34 - Bois de Pêcheseul

Local name: Bois de Pêcheseul
Municipality: Avoise
Region: Pays de la Loire / **Country:** France
Altitude (m): 54

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

Topography: plateau
Orientation: flat
Slope (%): 4
Hydrology: river at 1500m

pH (soil layer 0 - 30cm): 5.0
Type of Soil: CAMBISOLS
Subtype of Soil: skeletic
Bedrock: river terrace sand or gravel

Mean T (°C): 11.6
Mean T (°C) Coldest Month: 1.7
Mean Precipitation (mm): 693
N Frost Days: 48

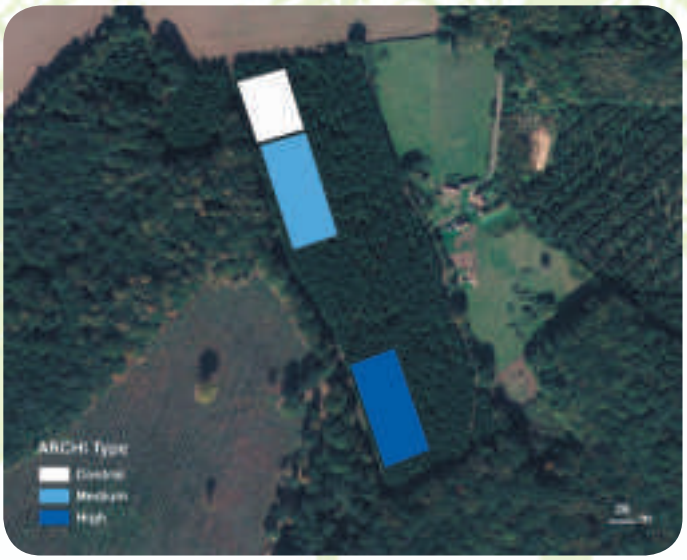
The global objective is to develop a new silviculture to slow down the impacts of climatic changes and to maintain the high quality wood production of Douglas-fir.

The objective of this demonstration site on Douglas fir is to evaluate effects of sylviculture (thinning) on potential water stress.

The Douglas-fir stand is 15 years old, and is localised in a sensibility climatic area for Douglas-fir in France. The initial density is 1142 trees/ha.

This demonstration site has 3 experimental plots :

- Control, with no thinning
- Low thinning in 2012 (sampling rate of 35%)
- High thinning in 2012 (sampling rate of 55%).



DS35 - Forêt de Corbières

Local name: Forêt de Corbières
Municipality: La Bouëxière
Region: Bretagne / **Country:** France
Altitude (m): 100

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

Topography: low slope
Orientation: flat
Slope (%): 5
Hydrology: brook at 140m

pH (soil layer 0 - 30cm): 4.5
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: sandstone

Mean T (°C): 11.5
Mean T (°C) Coldest Month: 2.3
Mean Precipitation (mm): 833
N Frost Days: 36

The global objective is to develop a new silviculture to slow down the impacts of climatic changes and to maintain the high quality wood production of oak. The objective of the demonstration site is to study the impact of the late thinning on the sanitary state (oak dieback problem) of oak stands (*Quercus robur*).

The demonstration site is installed in the high sensibility area for oaks in France. This high sensibility area was validated in the project : "Climate Change: The risks for the oak stands in the Atlantic region" in France, managed by the CNPF – IDF (Lemaire et al., 2010). This stand is about 80 years old and is affected by dieback due to climate change. The studies conducted in France (Protocol ARCHI by Drenou et al., 2011) demonstrate that it is possible to distinguish oaks able to surmount stress (tree in the reversible sanitary state) from those which are not able to (tree in the irreversible sanitary state).

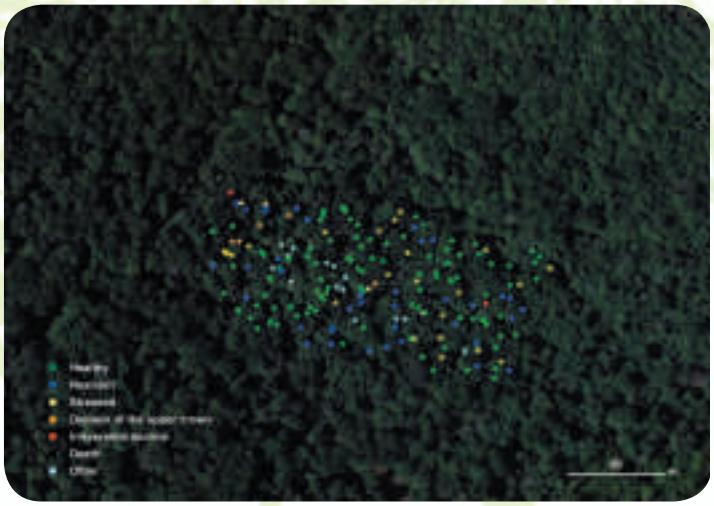
This diagnostic (with four different sanitary states) turns out to be indispensable to help foresters select the most resistant trees in the context of climate change. The sanitary state of each oak in the demonstration site is identified.

Then for all the different sanitary states, the forester tests a localized thinning. The sanitary state of this thinned oak stand will be compared with the sanitary state of the not thinned oak stand.

Each demonstration site is composed of two devices:

1 control device = no thinning

1 device with thinning.



DS36 - Saint-Sulpice

Local name: Saint-Sulpice
Municipality: Saint-Sulpice-la-Forêt
Region: Bretagne / **Country:** France
Altitude (m): 80

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

Topography: plateau
Orientation: flat
Slope (%): 2
Hydrology: none

pH (soil layer 0 - 30cm): 4.5
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: loamy loess

Mean T (°C): 11.7
Mean T (°C) Coldest Month: 2.4
Mean Precipitation (mm): 769
N Frost Days: 35

The global objective is to develop a new silviculture to slow down the impacts of climatic changes and to maintain the high quality wood production of Douglas-fir. The objective of this demonstration site is to present different types of forest management in changing climatic conditions.

The stand is about 40 years old, composed on the one hand of silver fir and on the other hand of other various species. The demonstration site has 3 experimental plots :

- A regular stand of silver fir, where a low thinning will be done
- A mixed and irregular stand with oak, chestnut, sylvestris pine, sylver fir, where nothing will be done
- A mixed and irregular stand with oak, chestnut, sylvestris pine, sylver fir where an enrichment (local plantation) with some more adapted species to climate changes (for example cedrus) will be done.

DS37 - Moussonvilliers

Local name: Moussonvilliers
Municipality: Moussonvilliers
Region: Basse-Normandie / **Country:** France
Altitude (m): 250

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

Topography: plateau
Orientation: flat
Slope (%): 1
Hydrology: brook at 700m

pH (soil layer 0 - 30cm): 5.1
Type of Soil: LUVISOLS
Subtype of Soil: stagnic
Bedrock: clay with flints

Mean T (°C): 10
Mean T (°C) Coldest Month: 0.2
Mean Precipitation (mm): 800
N Frost Days: 65

The global objective is to develop a new silviculture to slow down the impacts of climatic changes and to maintain the high quality wood production of oak. The objective of the demonstration site is to study the impact of the late thinning on the sanitary state (oak dieback problem) of oak stands (*Quercus robur*).

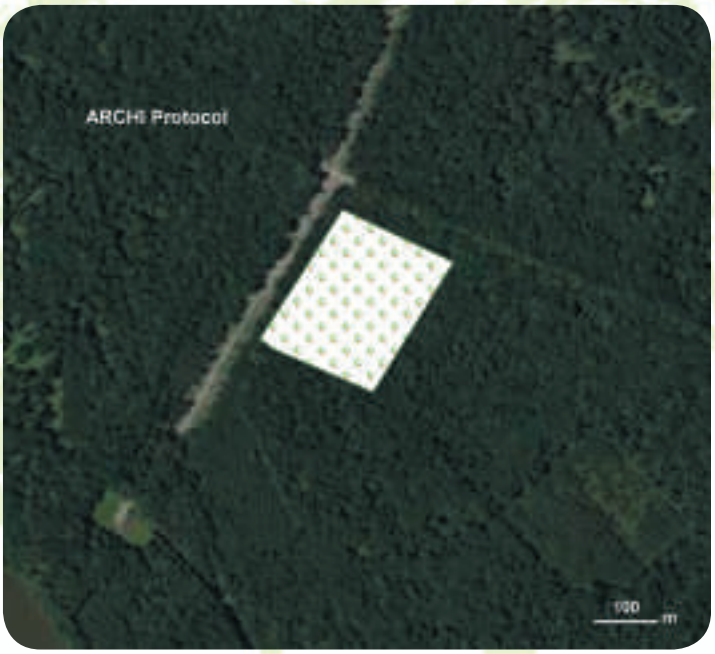
The demonstration site is installed in the high sensibility area for oaks in France. This high sensibility area was validated in the project : "Climate Change: The risks for the oak stands in the Atlantic region" in France, managed by the CNPF – IDF (Lemaire et al., 2010). This stand is about 80 years old and is affected by dieback due to climate change. The studies conducted in France (Protocol ARCHI by Drenou et al., 2011) demonstrate that it is possible to distinguish oaks able to surmount stress (tree in the reversible sanitary state) from those which are not able to (tree in the irreversible sanitary state).

This diagnostic (with four different sanitary states) turns out to be indispensable to help foresters select the most resistant trees in the context of climate change. The sanitary state of each oak in the demonstration site is identified.

Then for all the different sanitary states, the forester tests a localized thinning. The sanitary state of this thinned oak stand will be compared with the sanitary state of the not thinned oak stand. Each demonstration site is composed of two devices:

1 control device = no thinning

1 device with thinning.



DS38 - Caorche-Saint-Nicolas

Local name: Caorche-Saint-Nicolas
Municipality: Caorche-Saint-Nicolas
Region: Haute-Normandie / **Country:** France
Altitude (m): 170

Department in charge: CNPF-IDF
Contact e-mail: eric.paillassa(at)cnpf.fr

Topography: plateau (P1) and high slope (P2)
Orientation: flat (P1) and S (P2)
Slope (%): 0 (P1) and 10 (P2)
Hydrology: none

pH (soil layer 0 - 30cm): 5.0 (P1) and 4.2 (P2)
Type of Soil: CAMBISOLS
Subtype of Soil:
endoskeletic (P1) and episkeletic (P2)
Bedrock:
clay with flints (P1) and colluvial deposit (P2)

Mean T (°C): 10.6
Mean T (°C) Coldest Month: 0.7
Mean Precipitation (mm): 812
N Frost Days: 62

The main silvicultural option demonstrated here is the study of Douglas fir behavior to climate change, according to two potentially different soils (particularly water stress), within the same forest ownership.

The Douglas-fir stand concerned is 25 years old, and is localised in a sensibility climatic area for Douglas-firs in France.

This demonstration site has 2 experimental plots :

- Plot 1 = soil without potential water stress risk
- Plot 2 = soil with potential water stress risk.

DS39 - Clocaenog

Local name: Clocaenog
Municipality: Ruthin
Region: Denbighshire / **Country:** Wales, UK
Altitude (m): 280

Department in charge: Center for Sustainable Forestry and Climate Change
Contact e-mail: victoria.stokes(at)forestry.gsi.gov

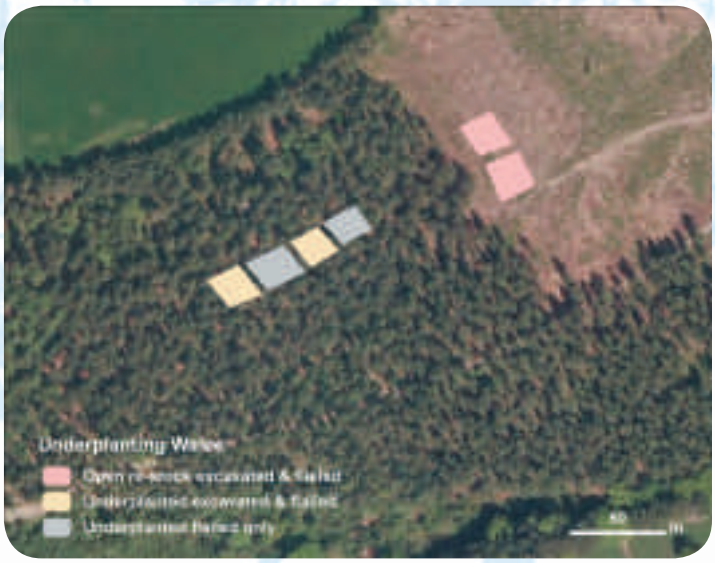
Topography: middle slope
Orientation: SE
Slope (%): 20
Hydrology: free draining

pH (soil layer 0 - 30cm):
Type of Soil: CAMBISOLS
Subtype of Soil: dystric-eutric
Bedrock: siltstone

Mean T (°C): 7.7
Mean T (°C) Coldest Month: -0.8
Mean Precipitation (mm): 1067
N Frost Days: 110

Under conditions of climate change restocking is likely to become increasingly challenging and require more intensive silvicultural care. This experiment examines the impact of microclimate on growth and survival of planted Douglas fir trees. Seedlings have been planted on open clearfell sites and under an irregular shelterwood to identify relationships between microclimate conditions and growth and survival of seedlings.

The forested compartment comprises of Sitka spruce, planted in 1946 as an even-aged stand. During the 6 years before planting the stand had been undergoing transformation to a uniform shelterwood. The stand was thinned in 2010. There was little understorey natural regeneration and a relatively dense vegetation of grasses and bramble. The nearby open restocking area was previously Sitka spruce and was due for replanting in 2012. The ground vegetation at planting was a dense vegetation of grasses and willowherb with a large amount of harvesting residue on the site. There was some natural regeneration occurring on the site.



DS40 - Wythop

Local name: Wythop
Municipality: Allerdale
Region: Cumbria / **Country:** England, UK
Altitude (m): 280

Department in charge: Center for Sustainable Forestry and Climate Change
Contact e-mail: victoria.stokes(at)forestry.gsi.gov

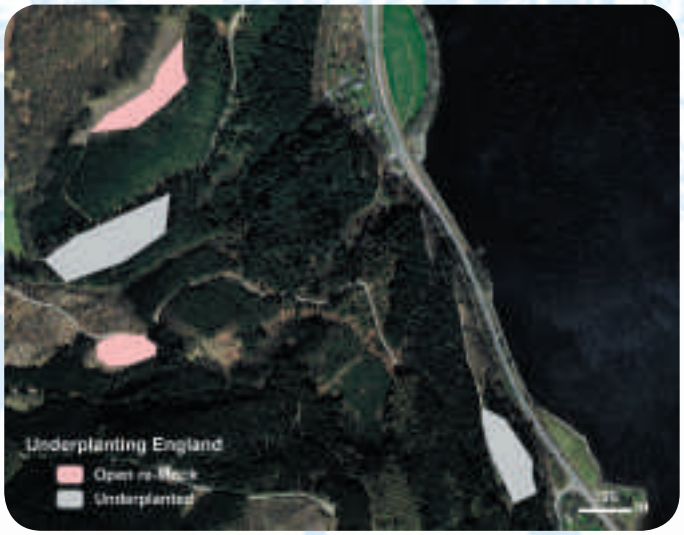
Topography: middle slope
Orientation: SE
Slope (%): 40
Hydrology: free draining

pH (soil layer 0 - 30cm):
Type of Soil: UMBRISOLS
Subtype of Soil: dystric-eutric
Bedrock: siltstone

Mean T (°C): 7.3
Mean T (°C) Coldest Month: -1.2
Mean Precipitation (mm): 1169
N Frost Days: 129

Under conditions of climate change restocking is likely to become increasingly challenging and require more intensive silvicultural care. This experiment examines the impact of microclimate on growth and survival of planted Douglas fir trees. Seedlings have been planted on open clearfell sites and under an irregular shelterwood to identify relationships between microclimate conditions and growth and survival of seedlings.

The two forested compartments comprise of Douglas fir planted in 1927 as an even-aged stand. During the 10 years before planting, the stands have been undergoing transformations to irregular shelterwood. One of the stands was thinned in 1996/7 and again in 2009/10 and had patchy understorey regeneration of 10-15 years old. The other stand was thinned in 1993/4 and 2006/7 and had less understorey regeneration. Parts of this stand have already been underplanted with Douglas fir. The two restocking areas were previously Sitka spruce, planted in 1963 and felled in 2006/7. These sites were mounded prior to replanting with Douglas fir.



DS41 - Great Glen

Local name: Great Glen
Municipality: Inverness
Region: Highland / **Country:** Scotland, UK
Altitude (m): 75

Department in charge: Center for Sustainable Forestry and Climate Change
Contact e-mail: victoria.stokes(at)forestry.gsi.gov

Topography: middle slope
Orientation: SE
Slope (%): 20
Hydrology: free draining

pH (soil layer 0 - 30cm):
Type of Soil: HISTOSOLS
Subtype of Soil: dystric-eutric
Bedrock: acid regional metamorphic rocks

Mean T (°C): 6.7
Mean T (°C) Coldest Month: -2.4
Mean Precipitation (mm): 1377
N Frost Days: 131

Under conditions of climate change restocking is likely to become increasingly challenging and require more intensive silvicultural care. This experiment examines the impact of microclimate on growth and survival of planted Douglas fir trees. Seedlings have been planted on open clearfell sites and under an irregular shelterwood to identify relationships between microclimate conditions and growth and survival of seedlings.

The forested compartment comprises of Douglas fir planted in 1927 as an even-aged stand and now managed as a seed stand. The stand was thinned in 2011. There is some natural regeneration of Douglas fir, and the ground vegetation comprised of grasses and mosses. The nearby open restocking area was cleared of dense natural regeneration in 2001 and is now managed as a plantation on ancient woodland site (PAWS). The site was unvegetated and had a large amount of harvesting residue.

ANNEXES

Short description of reports and materials produced:

Climate change in the regions

This 125 page report written by the REINFFORCE partners aimed at making a state of the art report on climate change issue related to forests in the project regions. This document helped partners have a mutual understanding of forestry and climate change issues from one region to another. In addition to basic information on forestry in the Atlantic regions, this report gave an overview of the main climatic changes expected in the area and the ongoing work which took place in 2009 on this issue. Scientific resources and existing initiatives in countries are listed, and the first outcomes of projects are screened.

Common protocol

The common protocol, or REINFFORCE arboretum field manual, is the bible for the project data collections; it gives recommendations on how to set up and manage the field trials. It also lists all the data collected and the procedure for data collection. This document guarantees homogeneity of the data collected and represents the strength of the network.

Tree species cards for selection

The tree species selection was a key step in the design of the arboretum network. The procedure described in the report combines many approaches such as; empirical knowledge of experts, exiting results, bibliography analysis. A set of tree species was identified and scored according to its characteristics. The set of scores given to each tree species can be consulted on the REINFFORCE website.

FORESTRIALS database

The FORESTRIALS database was set up in the frame of the REINFFORCE project. The main aim was to capitalise on existing forest trials, and to identify species of interest for the project. At the end of the project, the whole scientific community will be able to benefit from this tool which will be available online for free, and can be updated or completed by any organisation (even non project members) to advertise existing long term forest trials in Europe. This database provides site characteristics, species list, and can also inform on stand characteristics when this data is provided.

Photo Credits

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REINFFORCE Network. Page 2 & 3.
Forest Research. *AR01, AR02, AR03, DS39, DS40, DS41.*
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MAP CREDITS

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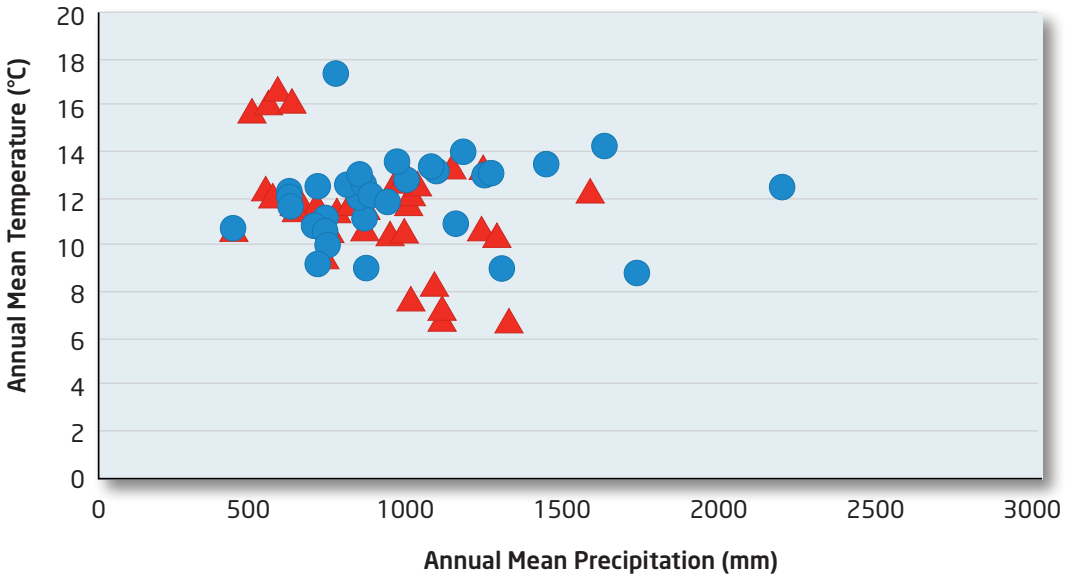
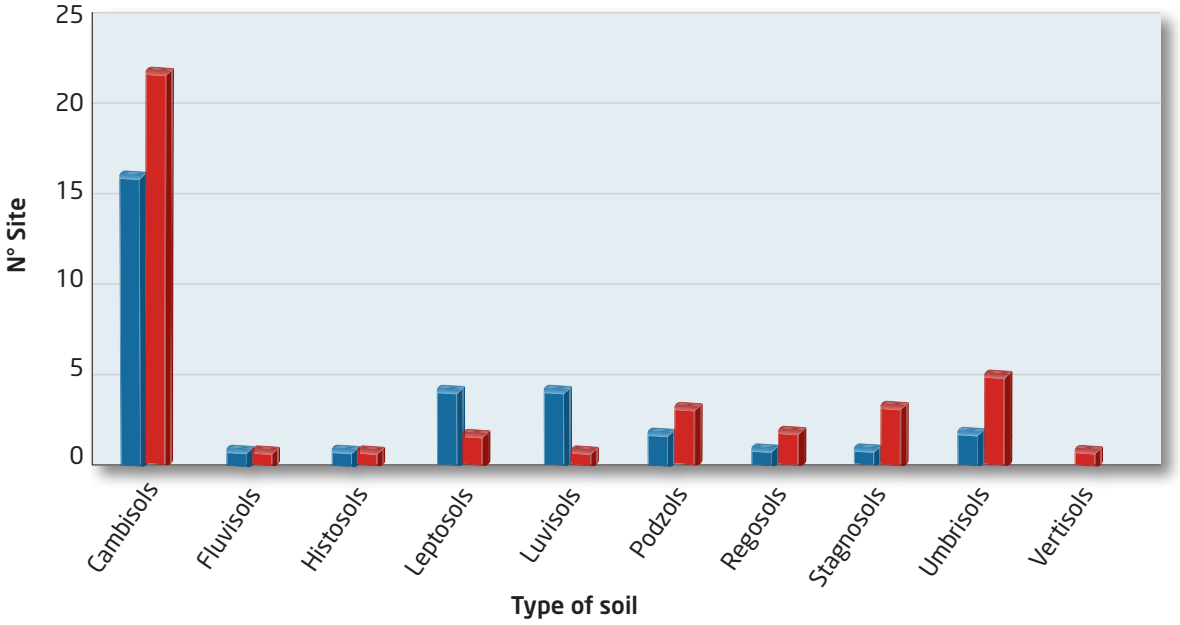
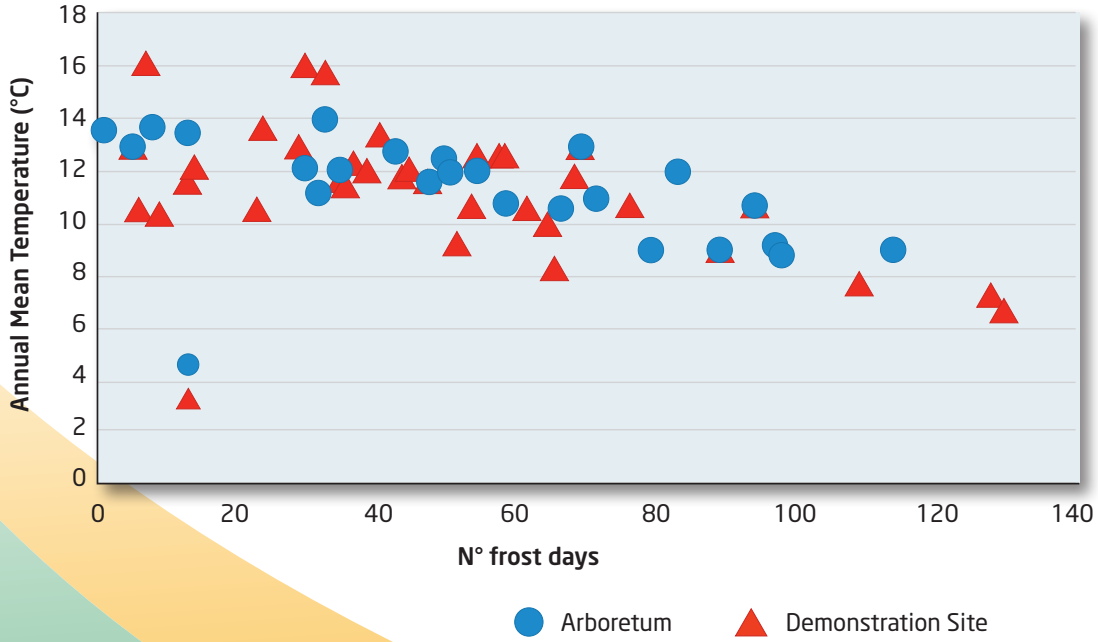
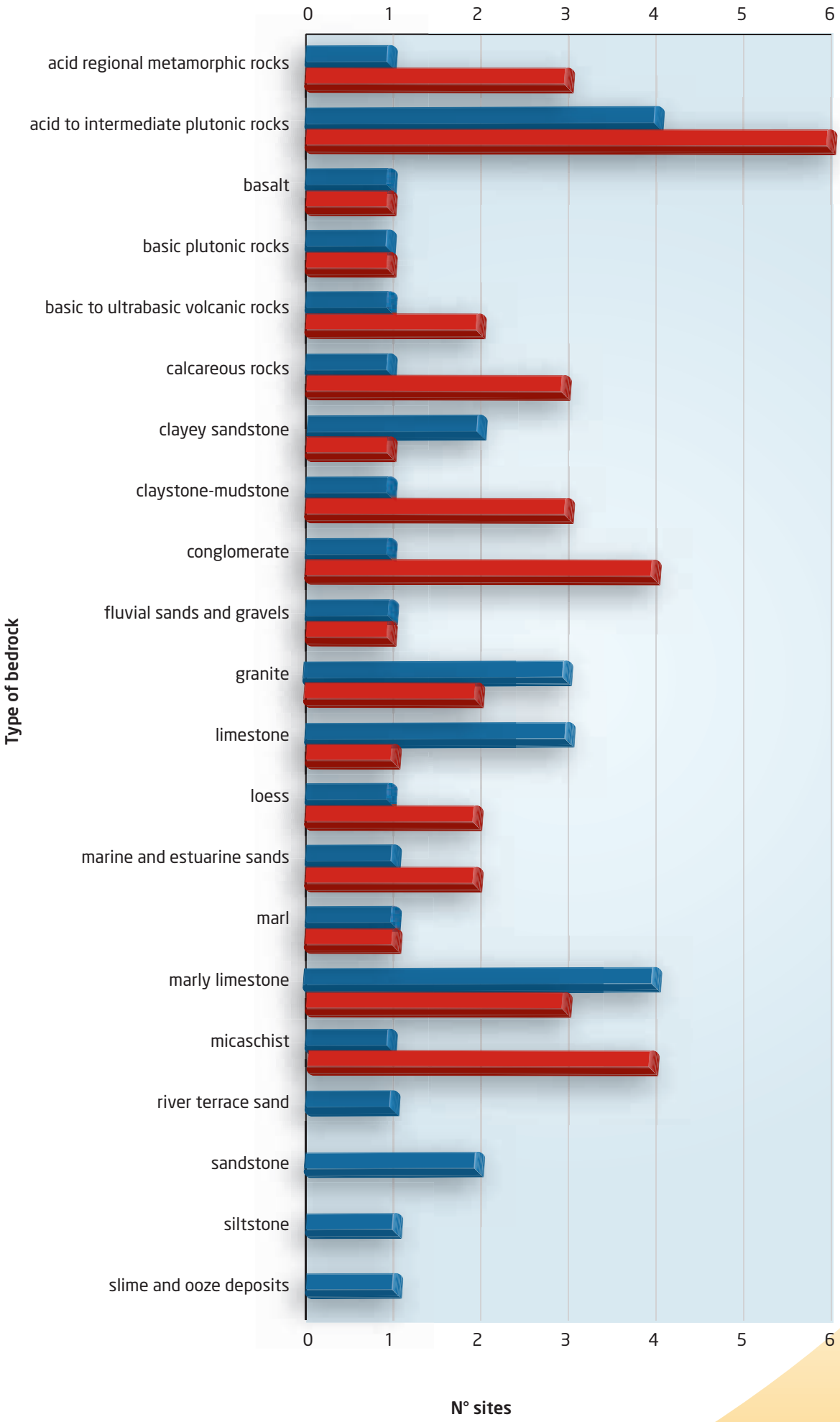
ISA. *DS01 to DS05.*
GAN. *DS10, DS13.*
Alejandro Cantero. HAZI. *DS11, DS12, DS16, DS17.*

Arboretum & Demonstration Site Characteristics








0
1
2
3
4
5
6
acid regional metamorphic rocks
acid to intermediate plutonic rocks
basalt
basic plutonic rocks
basic to ultrabasic volcanic rocks
calcareous rocks
clayey sandstone
claystone-mudstone
conglomerate
fluvial sands and gravels
granite
limestone
loess
marine and estuarine sands
marl
marly limestone
micaschist
river terrace sand
sandstone
siltstone
slime and ooze deposits
Type of bedrock
N° sites
Arboretum
Demonstration Site

Arboretum Genetic Material

Code	Arboretum																																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
BEPE-NORD	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
BEPE-KRAL	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
BEPE-UNIT	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
BEPE-CZAR																✔		✔	✔	✔					✔												✔	✔
BEPE-POLO																													✔	✔	✔						✔	
CEAT-LUBE																																					✔	
CEAT-VISF	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CEAT-ALGE																					✔		✔				✔	✔	✔	✔	✔	✔					✔	
CEAT-SAUM	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CEAT-MENE	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CADE-NOCA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔		✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CADE-CECA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔	✔		✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CADE-SOCA	✔	✔	✔															✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CELI-ADAN							✔		✔			✔						✔	✔	✔	✔		✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔
CELI-POZA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	
CELI-TURK	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	
CELI-LEBH				✔		✔		✔	✔			✔	✔	✔	✔	✔	✔												✔	✔	✔							
CEBR-CYPR																																						
CUSE-FRAN	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔
CUSE-ITAL	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	
CUSE-ANTA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CUSE-ANDA													✔	✔	✔	✔	✔				✔		✔				✔	✔				✔						
CESI-ITAL	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CESI-HVAR	✔	✔	✔										✔	✔	✔	✔	✔	✔	✔	✔		✔		✔					✔	✔	✔		✔	✔	✔	✔	✔	✔
CESI-SPAI	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
FAOR-SINO	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
FAOR-ORDU	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
FAOR-MARM	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
LADE-STRA				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
LADE-THEI	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
LADE-ALPE	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
LADE-SLOV				✔	✔	✔	✔	✔	✔	✔	✔	✔																									✔	✔
LAEU-LAVE	✔	✔											✔			✔	✔												✔	✔	✔						✔	✔
LAEU-REVE	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔	✔	✔			✔	✔				✔						
LAEU-TRUU	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔					✔		✔													
LIST-MARY	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔						✔	✔	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔
LIST-ARKA				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	
LIST-MISS				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔			✔	✔	✔	✔	✔	✔	✔		✔	✔	✔				✔					✔	✔
LIST-GEOR	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔		✔					✔	✔	✔					✔	✔	✔
LIST-ITAL				✔	✔	✔	✔	✔	✔	✔	✔	✔																	✔	✔	✔					✔	✔	✔
PIBU-ELDA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIBU-MARM	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	?	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIBU-TAUO	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIBU-CRIM																					✔	✔							✔	✔	✔							
PIBU-CYPR				✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔				✔		✔				✔	✔				✔						
PIEL-LOUI	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIEL-GEOR	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIEL-SOUT	✔	✔	✔															✔	✔	✔			✔															
PICA-HOND	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PSME-WASH	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PSME-LUZE	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PSME-CECA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PSME-CALI				✔	✔	✔	✔	✔	✔	✔	✔	✔				✔					✔		✔				✔	✔				✔						
PSME-ORSI	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔					✔		✔				✔	✔				✔						
PSME-ARIZ				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔						✔		✔									✔			✔	✔
PSME-ORCA				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔					✔		✔				✔	✔	✔	✔	✔	✔						
PSME-ORCO	✔	✔	✔										✔			✔		✔	✔	✔	✔		✔		✔		✔		✔	✔	✔	✔						
PSME-NOCA				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔				✔		✔				✔	✔				✔						
PSME-POAN				✔	✔	✔		✔	✔	✔	✔	✔										✔		✔													
PSME-COLO				✔	✔	✔	✔	✔	✔	✔	✔	✔									✔	✔	✔	✔			✔	✔				✔						
PSME-NMEX				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔		✔													
PINI-VAYR	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PINI-SIVE	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PINI-CUEN	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			
PINI-CORS				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔		✔				✔	✔				✔						
PINI-SORI														✔	✔	✔	✔				✔	✔	✔	✔	✔	✔	✔	✔				✔						
PINI-BESS				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔		✔				✔	✔				✔						
PINI-CAZO															✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔						
PIPE-GODE			✔						✔			✔	✔			✔	✔	✔	✔	✔	✔								✔	✔	✔	✔	✔	✔	✔		✔	
PIPE-MACE			✔				✔						✔					✔	✔	✔			✔							✔			✔	✔	✔	✔	✔	
PIPT-LAND	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIPT-LACO	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIPT-TAMJ	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIPT-LEIR													✔	✔	✔	✔	✔	✔	✔	✔									✔	✔	✔		✔	✔	✔		✔	✔
PIPT-CORD													✔	✔	✔	✔		✔	✔	✔					✔	✔			✔	✔	✔							
PIPT-CUEN				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔									✔	✔	✔		✔	✔	✔		✔	✔
PIPT-GRED				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔									✔	✔	✔							
PIPT-LEVA				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔																					
PIPI-CAST		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIPI-ITAL	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	?	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIPI-FRAN		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIPI-VEND														✔	✔			✔	✔	✔					✔	✔							✔	✔	✔		✔	✔
PIPI-LEVA														✔	✔						✔		✔				✔	✔	✔	✔	✔	✔	✔					
PIPI-MALA															✔						✔		✔				✔	✔				✔						

Code	Arboretum																																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
PIPO-MEXI	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIPO-CALI	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIPO-OREG	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PIPO-DAKO																																						
PIPO-COLO				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔		✔				✔	✔	✔	✔	✔	✔						
PIPO-IDAH				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔		✔	✔			✔	✔				✔						
PISY-VALS	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			
PISY-SLOV	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PISY-TURK	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PISY-SERR															✔	✔	✔	✔	✔	✔					✔	✔							✔	✔	✔		✔	✔
PISY-SCOT	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔						✔	✔	✔	✔		✔				✔	✔	✔	✔	✔	✔						
PISY-POLA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔		✔	✔	✔	✔		✔				✔	✔				✔						
PISY-UNIV													✔	✔	✔	✔		✔	✔	✔		✔		✔		✔			✔	✔	✔							
PISY-HAGE				✔	✔	✔	✔	✔	✔	✔	✔	✔									✔		✔				✔	✔	✔	✔	✔	✔						
PITA-GEOR	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔		✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PITA-SOUT	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PITA-VIRG	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PITA-TEXA																																						
PITA-LOUS				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔		✔				✔	✔										
PITA-MISS				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔						✔	✔				✔						
QUIL-EXTR	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QUIL-SPAN	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QUIL-CROA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QUIL-BARR														✔	✔		✔	✔	✔	✔	✔		✔		✔	✔	✔	✔				✔	✔	✔	✔		✔	✔
QUIL-SUDO														✔	✔		✔				✔		✔		✔	✔	✔	✔				✔						
QUIL-ITAL																																						
QUIL-OTEI				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔		✔	✔	✔	✔				✔						
QUIL-DUNE													✔	✔	✔	✔													✔	✔	✔							
QUPE-GASC	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QUPE-CHAR				✔	✔	✔	✔	✔	✔	✔	✔	✔						✔	✔	✔	✔		✔		✔		✔	✔				✔					✔	✔
QUPE-UNIT	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QUPE-ARBA				✔	✔	✔	✔	✔	✔	✔	✔	✔						✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔						
QUPE-GRES	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QUPE-GERO				✔	✔	✔	✔	✔	✔	✔	✔	✔									✔		✔				✔	✔				✔						
QUPE-PIRI				✔	✔	✔	✔	✔	✔	✔	✔	✔						✔	✔	✔		✔		✔														
QURO-FRAN	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QURO-PAGO	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QURO-SZLI	✔	✔	✔										✔			✔	✔	✔	✔	✔					✔	✔			✔	✔	✔						✔	✔
QURO-ITAL				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔		✔	✔												
QURO-UNIT	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QURO-POSA																		✔	✔	✔									✔	✔	✔		✔	✔	✔		✔	✔
QURO-SUDO	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔																				✔	✔
QURU-FEST	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QUSH-TEXA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QURU-VANA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	?	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QUSU-ALCA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QUSU-PYRE	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
QUSU-VILL	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔
QUSU-EXTR																																	✔	✔	✔				
QUSU-TETT																								✔					✔	✔	✔							
QUSU-LAND														✔	✔	✔		✔	✔	✔					✔	✔			✔	✔	✔		✔	✔	✔		✔	✔
QUSU-CATA														✔	✔	✔		✔	✔	✔													✔	✔	✔		✔	✔
ROPS-PUZT	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔				✔		
ROPS-KULE	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔				✔		
ROPS-ROMA	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔				✔		
ROPS-NYRS													✔	✔	✔	✔	✔				✔		✔				✔	✔				✔						
ROPS-KOZA				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔	✔	✔	✔			✔	✔				✔						
ROPS-SLOV				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔					✔		✔		✔		✔	✔				✔						
ROPS-MACE				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔																						
ROPS-IZMI				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔								✔				✔	✔	✔							
SESE-NOCA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔		✔	✔	✔		✔	✔			✔	✔	✔	✔	✔		✔	
SESE-COCA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔
SESE-CALI	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	
THPL-IDAH	✔	✔	✔				✔	✔		✔	✔		✔	✔		✔							✔	✔						✔						✔	✔	✔
THPL-OLYM	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
THPL-DARR	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔						✔	✔	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔				✔	✔	✔
THPL-OREG	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
THPL-MONT		✔	✔																		✔		✔						✔	✔	✔	✔					
THPL-BRIT													✔			✔								✔			✔				✔				✔		✔
EUNI-RUBI	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
EUGO-WIEL	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
EUGU-GUN1	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
EUNI-TAGA													✔	✔	✔	✔	✔				✔						✔	✔	✔	✔	✔	✔					✔	✔
EUNI-MCAL													✔	✔	✔	✔	✔				✔	✔	✔	✔			✔	✔				✔						
EUNI-NEWZ													✔	✔	✔	✔	✔				✔		✔				✔	✔				✔						
ACPS-VANA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		
ACPS-ALPS	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		
ACPS-WALE	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔		✔		✔		✔		✔	✔	✔	✔		✔	✔	✔	✔		
ACPS-NORD																					✔		✔				✔	✔	✔	✔	✔	✔						
ACPS-SLOV																					✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔						
ACPS-PAPU													✔	✔	✔	✔	✔				✔		✔		✔	✔	✔	✔	✔	✔	✔	✔						
ACPS-HUNG													✔			✔		✔	✔	✔	✔		✔				✔	✔				✔						
CASA-MEDI	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CASA-PARI	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CASA-CORD	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CASA-GALI	✔		✔	✔	✔			✔	✔	✔	✔	✔												✔				✔	✔	✔							
CASA-ITAL													✔	✔	✔	✔		✔	✔	✔				✔				✔	✔	✔						✔	✔
CASA-BART				✔	✔	✔	✔	✔	✔	✔	✔	✔												✔				✔	✔	✔		✔		✔		✔	✔
CULA-LISH	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
FASY-ESPI	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔						✔	✔	✔				✔	✔	✔			✔	✔	✔						✔	
FASY-FRAN	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔						✔	✔	✔		✔		✔	✔	✔			✔	✔	✔						✔	
FASY-PODT		✔		✔	✔	✔	✔	✔	✔	✔	✔	✔						✔	✔	✔		✔		✔	✔	✔			✔		✔						✔	

Origin of Arboretum Genetic Material

Species	Provenance	Code
Betula pendula	Nord Est et montagne - France	BEPE-NORD
	1- Kralova - Slovakia	BEPE-KRAL
	30-Wales - UK	BEPE-UNIT
	Kzarna - Poland	BEPE-CZAR
	Eastern Poland	BEPE-POLO
Cedrus atlantica	Luberon Crête - France	CEAT-LUBE
	VIS - France	CEAT-VISF
	Djurdjura - Algeria	CEAT-ALGE
	CAT-PP-03 (Saumon) Alpes de Haute Provence - France	CEAT-SAUM
	CAT-PP-01 Ménerbes - France	CEAT-MENE
Calocedrus decurrens	Northern California – USA	CADE-NOCA
	Central California – USA	CADE-CECA
	Southern California – USA	CADE-SOCA
Cedrus libani	Mersin-Aslankoy - Turkey	CELI-ADAN
	Adanan-Pozanti - Turkey	CELI-POZA
	Turkey	CELI-TURK
	Lebanon	CELI-LEBH
	C.brevifolia – Cyprus	CEBR-CYPR
Cupressus sempervirens	France	CUSE-FRAN
	Var. Pyramidalis - Italy	CUSE-ITAL
	Koprulu Kanyon - Turkey	CUSE-ANTA
	Andalucia Centro - Spain	CUSE-ANDA
Ceratonia siliqua	Italy	CESI-ITAL
	Hvar Island - Croatia	CESI-HVAR
	R.I. 37-09 - Spain	CESI-SPAI
Fagus orientalis	Vezirkopru Golkoy - Backward Black Sea Region – Turkey	FAOR-SINO
	Ordu Mesudiye - Backward Black Sea Region – Turkey	FAOR-ORDU
	Bursa M.M.Pasa, Marmara Region - Turkey	FAOR-MARM
Larix decidua	Straza - Slovenia	LADE-STRA
	Le Theil - France	LADE-THEI
	Alpes Internes Sud - France	LADE-ALPE
	5 - Juhozapadoslovenska - Slovakia	LADE-SLOV
	Hybrid European-Japanese –Lavercantière seed orchard	LAEU-LAVE
	Hybrid European-Japanese REVE-VERT	LAEU-REVE
	Hybrid European-Japanese – Truust Danish seed orchard	LAEU-TRUU
Liquidambar styraciflua	Maryland - USA	LIST-MARY
	Arkansas – USA	LIST-ARKA
	Missouri - USA	LIST-MISS
	Georgia – USA	LIST-GEOR
	Castelleone, Lombardie - Italy	LIST-ITAL
Pinus brutia	Variety Eldarica Crimea	PIBU-ELDA
	Marmaris - Turkey	PIBU-MARM
	Taurus -Turkey	PIBU-TAUO
	Eldarica – URFA Region - Turkey	PIBU-CRIM
	Cyprus	PIBU-CYPR
Pinus elliottii	Louisiana - USA	PIEL-LOUI
	Georgia – USA	PIEL-GEOR
	South Carolina – USA	PIEL-SOUT
	Pinus caribea var hondurienssis - Colombia	PICA-HOND
Pseudotsuga menziesii	Washington Cascade - USA	PSME-WASH
	Luzette - France	PSME-LUZE
	Central California – USA	PSME-CECA
	California – French seed orchard	PSME-CALI
	Siskyou Oregon - USA	PSME-ORSI
	Variety glauca Arizona – USA	PSME-ARIZ
	Oregon Cascade - USA	PSME-ORCA
	Oregon Coast - USA	PSME-ORCO
	Northern California – USA	PSME-NOCA
	Port Angeles Washington -USA	PSME-POAN
	Colorado - USA	PSME-COLO
	New Mexico -USA	PSME-NMEX
Laricio and *Salzmannii*	Laricio variety corsican - Slogne Vayrières - France	PINI-VAYR
	Laricio variety calabrian - Les Barnes-Sivens -France	PINI-SIVE
	Salzmannii - ES07b - Sistema Iberico Meridional, Sur de Cuenca - Spain	PINI-CUEN
	Laricio variety corsican - Haute Sierre seed tree orchard - France	PINI-CORS
	Salzmannii – ES10 – Soria - Spain	PINI-SORI
	Salzmannii - St Guilhem Besseges Gard -France	PINI-BESS
	Salzmannii – ES08a – Cordillera Ceticas, Cazorla Alcaraz – Spain	PINI-CAZO
Pinus peuce	Gotse Delchev -Bulgary	PIPE-GODE
	Pelister National park - Macedonia	PIPE-MACE
Pinus pinaster	Mimizan - Landes - France	PIPT-LAND
	Picard (Lande Corse) - France	PIPT-LACO
	Tamjout (Collobriere) - Morocco - French seeds orchard	PIPT-TAMJ
	Leiria - Portugal	PIPT-LEIR
	Cordal de Loba (Monfero) - Spain	PIPT-CORD
	ES12 – Serrania de Cuenca – Spain	PIPT-CUEN
	ES06 – Sierra de Gredos – Spain	PIPT-GRED
	ES16 – Levante – Spain	PIPT-LEVA
Pinus pinea	2 Valles del Tietar y del Alberche - Spain	PIPI-CAST
	Italy	PIPI-ITAL
	Région méditerranéenne - France	PIPI-FRAN
	Vendas Novas - Portugal	PIPI-VEND
	ES A – Biar – Spain	PIPI-LEVA
	Malaga - Spain	PIPI-MALA
Pinus ponderosa	Southern Rockies (New Mexico) - USA	PIPO-MEXI
	Central California – USA	PIPO-CALI
	Oregon – USA	PIPO-OREG
	Dakota – USA	PIPO-DAKO
	Colorado - USA	PIPO-COLO
	Idaho – USA	PIPO-IDAH

Species	Provenance	Code
Pinus sylvestris	ES10 – Sierra de Guadarrama – Spain	PISY-VALS
	5, Severozapadna - Slovakia	PISY-SLOV
	Turkey	PISY-TURK
	Pinhal da Pedra Bela - Portugal	PISY-SERR
	Scotland - UK (204)	PISY-SCOT
	Taborz, Polland Haute Serre - French Seeds Orchard	PISY-POLA
	ES12 – Montes Universales – Spain	PISY-UNIV
	Haguenau Vayriere - France	PISY-HAGE
Pinus taeda	Hardiness Zone Georgia Seed Orchard – USA	PITA-GEOR
	Southern California – USA	PITA-SOUT
	Virginia – USA	PITA-VIRG
	Texas - USA	PITA-TEXA
	Louisiana – USA	PITA-LOUS
	Mississippi - USA	PITA-MISS
Quercus ilex subspecie *rotundifolia*	ES11A – Region Extremaduriense – Spain	QUIL-EXTR
	Spain	QUIL-SPAN
	Ilex – Croatia	QUIL-CROA
	Rotundifolia - Barrancos (Contenda), Portugal	QUIL-BARR
	Ilex – Sud Ouest - France	QUIL-SUDO
	Italy	QUIL-ITAL
	Rotundifolia Oteiza – Alto Ebro - Spain	QUIL-OTEI
	Rotundifolia from France (North of Landes)	QUIL-DUNE
Quercus petrea	Gascogne - France	QUPE-GASC
	Charentes Poitou - France	QUPE-CHAR
	Bristol - UK	QUPE-UNIT
	Litoral Vasco-Navarro (E 05) - Spain	QUPE-ARBA
	Gresigne – Gascogne - France	QUPE-GRES
	Geronce – Gascogne - France	QUPE-GERO
	ES07 – Pirineo Navarro – Spain	QUPE-PIRI
Quercus robur	France	QURO-FRAN
	Litoral Vasco-Navarro (E 05) -Spain	QURO-PAGO
	Szlichtyngowa - Pologne	QURO-SZLI
	Italy	QURO-ITAL
	New Forest, Hampshire - UK	QURO-UNIT
	Posavina - Croatia	QURO-POSA
	Sud Ouest - France	QURO-SUDO
Quercus rubra and *Q. phellos*	Rubra- EST 902 - France	QURU-FEST
	Shumardii – Texas - USA	QUSH-TEXA
	ES06 – Litoral Vasco – Spain	QURU-VANA
Quercus suber	Alcacer Do Sal - Portugal	QUSU-ALCA
	Pyrénées Orientales - France	QUSU-PYRE
	ES03 – Montes de Toledo Villuercas – Spain	QUSU-VILL
	Extremadura, Zahíno en Badajoz – Spain	QUSU-EXTR
	Teti – Sardegna - Italy	QUSU-TETT
	Pyrénées Orientales 761 - France	QUSU-LAND
	Sud Ouest - France	QUSU-CATA
Robinia pseudoacacia	Pusztavacs - Hungary	ROPS-PUZT
	Novi Pazar -Kulevcha - Bulgary	ROPS-KULE
	Carei - Romania	ROPS-ROMA
	Nyirsegi - Hungary	ROPS-NYRS
	Gorna Oryahovitsa – Kozarevec - Bulgary	ROPS-KOZA
	Slovakia	ROPS-SLOV
	Macedonia	ROPS-MACE
	Turkey	ROPS-IZMI
Sequoia sempervirens	Northern California – USA	SESE-NOCA
	Coast California – USA	SESE-COCA
	California – USA	SESE-CALI
Thuja plicata	Idaho – USA	THPL-IDAH
	Port Angeles, Washington - USA	THPL-OLYM
	Darrington, Washington - USA	THPL-DARR
	262 Lebanon, Oregon – USA	THPL-OREG
	Montana - USA	THPL-MONT
	Qualicum, British Columbia - Canada	THPL-BRIT
Eucalyptus nitens (gundal / globulus)	*E.nitens* - Rubicon (18075), Victoria – Australia	EUNI-RUBI
	E.globulus - Wielangta (18894), Tasmania – Australia	EUGO-WIEL
	E.gundal I - France	EUGU-GUN1
	Tallaganda (18164), South New Wales – Australia	EUNI-TAGA
	Macalister (20764), Victoria – Australia	EUNI-MCAL
	E.nitens – New Zealand (16301)	EUNI-NEWZ
Acer pseudoplatanus	4 Vertiente Septentrional Cantabrica - Spain	ACPS-VANA
	Alps Jura - Switzerland	ACPS-ALPS
	30 - Wales - UK	ACPS-WALE
	Aps101 Nord-France	ACPS-NORD
	Slovakia	ACPS-SLOV
	Papucka - Croatia	ACPS-PAPU
	Hungary	ACPS-HUNG
Castanea sativa	Mediterranée 741 - France	CASA-MEDI
	Bassin Parisien - France	CASA-PARI
	ES19 – Sierra de Gredos – Spain	CASA-CORD
	Montañas y Mesetas Interiores de Galicia – Spain	CASA-GALI
	Italy	CASA-ITAL
	Bartin - Turkey	CASA-BART
Cunninghamia lanceolata	Lishu - China	CULA-LISH
Fagus sylvatica	Espinal – Navarra - Spain	FASY-ESPI
	Nord - France	FASY-FRAN
	Podtatranska - Slovakia	FASY-PODT

Biogeographical Regions

- ALPINE
- ATLANTIC
- CONTINENTAL
- MACARONESIAN
- MEDITERRANEAN

- *Arboretum*
- *Demonstration site*
- *Arboretum and demonstration site at the same location*

PARTNERS RESPONSIBLE FOR SITE MANAGEMENT

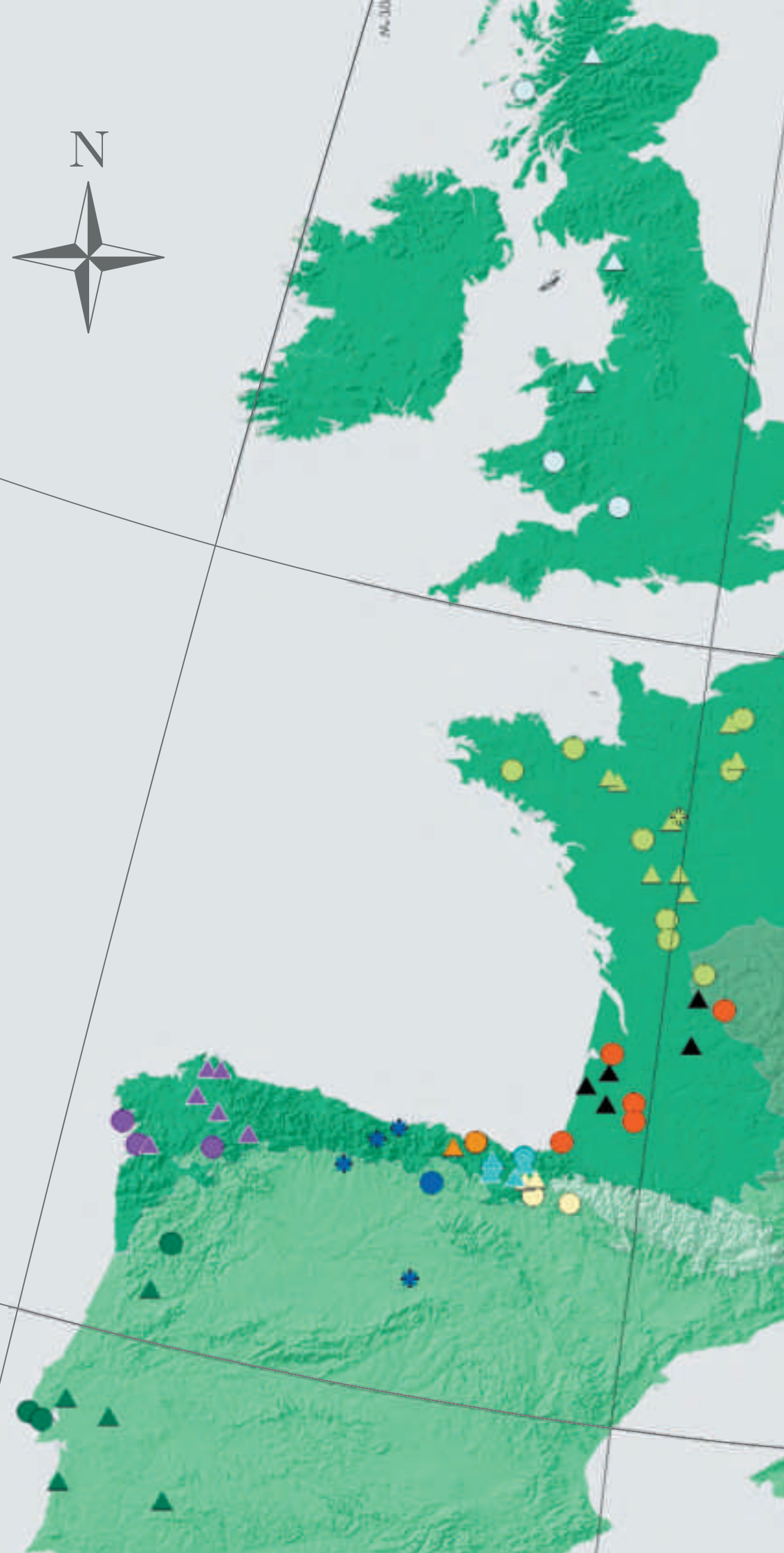
Site manager contact information can be found on the REINFFORCE website

- Centro de Investigación Forestal (CIF), Galicia, España
- Fundación General de la Universidad de Valladolid (FGUVA), España
- Forest Research (FR),United Kingdom
- Gestión Ambiental de Navarra (GAN), España
- HAZI Konsultoria, España
- Institut pour le Développement Forestier (IDF), France
- Instituto Superior de Agronomia (ISA), Portugal
- Neiker Tecnalia, Euskadi, España
- Centre Régional de la Propriété Forestière d'Aquitaine (CRPF), France
- Institut National de la Recherche Agronomique (INRA), France
- Furnas Monitoring and Research Centre, Azorina S.A., Portugal*
- Direçao Regional dos Recursos Florestais (DRRF), Portugal*

*Not financed by INTERREG

Lambert Azimuthal Equal Area

scale : 1:5,500,000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REINFFORCE Management Council meeting. Azores, Portugal. 2012

ACKNOWLEDGMENTS:

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The REINFFORCE Network

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