EUROPEAN FOREST INSTITUTE
ATLANTIC EUROPEAN REGIONAL OFFICE – EFIATLANTIC

Species and genetic units selection process for

REINFFORCE ARBORETA

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Introduction

One of the objectives of the REINFFORCE project is to create a physical and data infrastructure for the study of the adaptation of forest trees to climate change in the European Atlantic temperate forests. One of the components of the infrastructure is the Arboreta network that will be made up of 35 “units” and planted from the South of Portugal to the South of Scotland (from latitude 37º to 55º North). The common vision of all the project members is to build a reference set of rules that can support any actor concerned by the climate change issue.

This complex process started early in May 2009 and ended in December of the same year. The following members of the Working Group 1 (WG1) on Forest Trees Selection and Arboreta Design of the REINFFORCE project have shared their information and own experiences in order to develop this selection process. Additionally, they have also played a focal point role in their organizations for detailed information in different aspects like performance of old trials, delimitation of genetic groups, contact people for Forest Reproductive Materials, key forest tree breeders, etc.

Participants of the WG 1

Maria Helena ALMEIDA , António Henrique C. G. S. Correia - ISA (Portugal)
Francisco Javier SILVA Pando -CIF Lourizan (Spain)
Julio Javier DIEZ Casero - University of Valladolid (Spain)
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1.SELECTION OF SPECIES

1.1 General overview of the process

One of the first tasks carried out for the species selection was to create a first list of species of interest for the Arboreta network based on the expert opinion. The species have been selected on the base of two main criteria:

1- Species with an economical interest (wood, non-wood products)

2- Species adaptable to actual and future climate of the Atlantic rim.

From the expert proposal we drafted a list of 174 tree species. After that an on-line voting query was designed in the intranet section of the web page of the project[1]. Each partner assigned a total of 60 points in a range of 3, 2, 1 points per species. A total number of 265 votes were received. The species were ranched according to the total score and the number of voting organizations.

Starting from the results of the votes, the species were divided into 3 different groups during Technical Committee meeting in Edinburgh on May 2009:

- Red group 74 species classified as not interesting
- Green group 12 species classified as very interesting
- White group 89 species classified as uncertain.

During the Technical Committee all the further process of the selection was assigned to the WG 1. The Technical Committee decided to draw up two documents: the ”Indicators on adaptation to climate change” and the “Tree cards with general aspects of the different species” . The aims of these documents were to balance both the current knowledge of the member organization for all the species and the potential use of a Decision Support System at last step in the selection process. Both the structure of the documents and the assignation of the species among the partners were afterwards validated. The documents are available on-line[1].

With the help of the Decision Support System a list of 35 potential species candidates was set. From this list *Populus tremula*, *Cupressus lusitanica* and *Sorbus torminalis* were eliminated for lack of information about the source of Forest Reproductive Materials.

1.2 Tree cards

The creation of the “tree cards” came soon after the selection of the species process. The tree cards are a sort of Identity Card of each single species. They list all the characteristics of the species. For each species, the following data were collected and documented:

- Scientific name (the most common and accepted scientific name)
- Local name (the name of the species in Portuguese, Spanish, French and English)

[1] http://reinfforce.iefc.net/

[1] http://reinfforce.iefc.net/

- Botanical aspects (a list of links covering different botanical aspects)
- Distribution (a short description of the natural and introduced geographic distribution of the species)
- Intra-specific variation (defined as the differences seen within species)
- Ecological characteristics (a short summary of the main ecological characteristics of the species. This point was focused especially in aspects linked with adaptation to climate change, like potential behaviour against main stress. At the same time, main productive and sort of products were listed per species)
- Pest, diseases and other perturbations (a short list of the main perturbations of the species)
- Provenances proposal (all the possible provenances of the species proposed by the partners)
- Bibliography.

In order to get a standardised structure a first draft version for some of the species was discussed at the first meeting of the WG 1. With the comments of this draft version the coordination of the project produced a final template of the document which was sent to the members of the WG. The following species cards were produced:

- *Cryptomeria japonica*, *Fraxinus angustifolia* subspecie *oxycarpa*, *Juniperus thurifera* and *Quercus suber* by ISA (Portugal)
- *Populus tremula* by Universidad de Valladolid (Spain)
- *Pinus radiata*, *Quercus rubra* and *Quercus phellos* by NEIKER-IKT (Spain)
- *Fagus sylvatica* by GAVRN (Spain)
- *Pinus elliotii* and *Pinus taeda* by INRA (France)
- *Robinia pseudoacacia* and *Tilia platyphyllos* by IDF (France)
- *Pinus peuce* and *Tilia cordata* by FR (United Kingdom)
- The other 53 species tree cards were written by the Coordination at EFIATLANTIC.

The tree cards are available on-line[1].

1.3 List of indicators on adaptation to climate change

One of the main objectives of the project is to monitor the adaptation of the species to climate change on the Atlantic area. The first priority was to identify and to use adequate indicators to measure and control the adaptation of the chosen species. In this frame the main species representative aspects were considered and 17 indicators were finally selected.

[1] http://reinfforce.iefc.net/

This list will be used also as input data for the Decision Support System (DSS) to complete the species selection process.

I. Distribution area

This category has two indicators: geographic distribution (IA) and climatic distribution (IB).

Geographic distribution (IA) covers five different values:

1. Endemic
2. Small clusters
3. Regional
4. Widely distributed
5. Unknown.

Climate distribution (IB) refers to the number of main bioclimates that the species is covering according to *Rivas Martinez et al* [2]. The values for these indicators are:

1. One bioclimate
2. Two or three bioclimates
3. More than three bioclimates
4. Unknown.

II. Climate tolerance

This category has four indicators: tolerance to frost (IIA), tolerance to high temperature and radiation levels (IIB), tolerance to drought (IIC) and yearly demand of water resources (IID).

Tolerance to frost (IIA) (according to bibliographic references and average climate values for the different species distribution). These indicators can have the following values:

1. Low
2. Sensible to early frost
3. Sensible to late frost
4. Medium
5. Adapted to frost
6. Unknown.

Tolerance to high temperatures and radiation levels (IIB) (according to bibliographic references and average climate values for the different species distribution). This indicator can have the following values:

1. Low

[2] http://ucm.es/info/cif/form/bi_med.htm

2. Medium
3. High
4. Unknown.

Tolerance to drought (IIC) (according to bibliographic references and average climate values for the different species distribution). This indicator can have the following values:

1. Low
2. Medium
3. High
4. Unknown.

Yearly demand on water resources (IID) (according to bibliographic references and average climate values for the different species distribution). This indicator can have the following values:

1. Low
2. Medium
3. High
4. Extremely high
5. Unknown.

III. Soil tolerance

This category has three indicators: nutrients regime (IIIA), soil depth (IIIB) and underground moisture range (IIIC).

Nutrients regime (IIIA): for the assessment of this indicator, key bibliographic references were checked. This indicator can have the following values:

1. Poor sites
2. Average
3. High nutrient content
4. Wide range
5. Unknown.

Soil depth (IIIB): for the assessment of this indicator, key bibliographic references were checked. This indicator can have the following values:

1. Narrow soils
2. Average soils
3. Deep soils
4. Wide range
5. Unknown.

Underground moisture range (IIIC): for the assessment of this indicator, key bibliographic references were checked. This indicator can have the following values:

1. High
2. Medium
3. Low
4. Unknown.

IV. Use in forestry with an economic value

This indicator was assessed according to references with the following values:

1. None
2. Locally used
3. Relevant but can be easily replaced by other products or species
4. Very important
5. Unknown.

V. Social interest

This indicator was assessed according to references in the following categories:

1. Low
2. Medium
3. High
4. Unknown.

VI. Growth rate annual production

This indicator was assessed according to the maximum height in meters found in key reference.

VII. Wood and products quality

This category has two indicators: wood quality (VIIA) and type of products (VIIB).

The indicator wood quality (VIIA) can have the following values:

1. Low
2. Medium
3. High
4. Extremely high
5. Unknown.

The indicator type of products (VIIB) can have the following values:

1. Disintegration wood (pulp, non structural wood boards)
2. Sawn-wood non structural use
3. Bioenergy
4. Sawn-wood structural use
5. Veneer.

VIII. Sensitivity to perturbations

This category has two indicators: biotic perturbations (VIIIA) and non biotic perturbations (VIIIB). It was assessed according to references with the following values:

1. Low
2. Medium
3. High
4. Unknown.

IX. Management references

This indicator was assessed according to the forest management knowledge of the species with the following values:

1. Seldom use in commercial forestry
2. Sometimes used in commercial forestry
3. Widely used in commercial forestry

After the creation of these documents, the results were sent to the different members of the WG for review. After that, the indicators were used as input data for the DSS.[1]

1.4 Decision Support System

To sort the tree species according to a preference rate, we used a decision support system based on PROMETHEE algorithm implemented by the software Decision lab. The PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation) technique (*Brans et al.*, 1984) is used to process multiple-criteria decision-making calculations.

To facilitate the understanding of the selection process, 5 rankings have been presented to the participants varying the weight of the decision support tool.

A previous ranking based on incomplete species list was displayed on-line in the intranet of the project web-site one week before the meeting so that the partners could get familiarised with the intermediate results.

[1] http://reinfforce.iefc.net/

The five rankings were built-up using PROMETHEE algorithm with the following parameters:

	Code for unknown	Number of Unknown	pref	Function	Q	P	objective	R1	R2	R3	R4	R5
GeoDistr	-	0	1<2<3<4	V-Shape	-	2.5	maximize	1	1	0	0	1
ClimaDistri	4 replaced by 0.9	2	1<2<3	V-Shape	-	1.5	maximize	1	1	0	2	3
FrostTol	6 replaced by 1.9	2	1<2<3<4<5	level	0.5	1.5	maximize	1	1	0	0	1
HTempTol	4 replaced by 1.9	2	1<2<3	V-Shape	-	1.5	maximize	1	1	0	2	3
DroughtTol	4 replaced by 0.9	1	1<2<3	V-Shape	-	1.5	maximize	1	1	0	2	3
WaterDemand	-	0	1>2>3	V-Shape	-	1.5	minimize	1	1	0	2	3
Nutrient	-	0	4>1>2>3	V-Shape	-	2.5	minimize	1	1	0	0	1
SoilDepth		0	0>1>2>3	V-Shape	-	2.5	minimize	1	1	0	1	2
SoilMoisture	4 replaced by 1.9	5	1<2<3	V-Shape	-	1.5	maximize	1	1	0	1	2
Econ		0	1<2<3<4	V-Shape	-	2.5	maximize	1	0	1	1	2
Social	4 replaced by 1.9	7	1<2<3	V-Shape	-	1.5	maximize	1	0	1	0	1
height		1		V-Shape	-	30	maximize	1	0	1	2	3
WQuality	5 replaced by 1.9	6	1<2<3<4	V-Shape	-	2.5	maximize	1	0	1	1	2
Wproducts		0	1<2<3<4<5	V-Shape	-	3.5	maximize	1	0	1	1	2
Biodamages	4 replaced by 0.9	5	1>2>3	V-Shape	-	1.5	minimize	1	0	1	1	2
AbioDamages	4 replaced by 0.9	6	1>2>3	V-Shape	-	1.5	minimize	1	0	1	0	1

The ranking 1 (R1) is the ranking with the same weight on all the criteria

The ranking 2 (R2) is laying emphasis on ecological indicators.

The ranking 3 (R3) is the complementary of ranking 2.

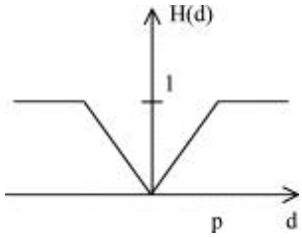
The ranking 4 (R4) is more focused on biomass production and adaptation to drought.

The ranking 5 (R5) is obtained summing 1 and 4.

There are six different shapes of preference function in the original PROMETHEE methods. The V-shape preference function (the one selected in our case) is best suited for quantitative criteria.

V-shape criterion

$$H(d) = \begin{cases} \dfrac{|d|}{p}, & |d| \le p \\ 1, & |d| > q \end{cases}$$



The preference varies linearly between **0** and **p**. If the difference is greater than **p**, the alternative is strictly preferred; if the difference is smaller than **p** the alternative is not chosen; if the difference is in the case of **0 ≤ d ≤ p** the alternative is equal to **d/p.**

The partners agreed to use the ranking number 5 as reference to select the species.

According to this ranking, the following species were selected:

1. *Betula pendula*
2. *Cedrus atlantica*

3. *Calocedrus decurrens*
4. *Cedrus libani*
5. *Cupressus lusitanica*
6. *Cupressus sempervirens*
7. *Ceratonia siliqua*
8. *Fagus orientalis*
9. *Larix decidua*
10. *Liquidambar styraciflua*
11. *Pinus brutia*
12. *Pinus elliottii*
13. *Pseudotsuga menziesii*
14. *Pinus nigra* spp*. laricio* and spp. *salzmannii*
15. *Pinus peuce*
16. *Pinus pinaster*
17. *Pinus pinea*
18. *Pinus ponderosa*
19. *Pinus sylvestris*
20. *Pinus taeda*
21. *Populus tremula*
22. *Quercus ilex* spp*. ilex* and spp*. rotundifolia*
23. *Quercus petraea*
24. *Quercus rubra* and *Q. phellos*
25. *Quercus suber*
26. *Robinia pseudoacacia*
27. *Sequoia sempervirens*
28. *Sorbus torminalis*
29. *Thuja plicata*

Quercus pyrenaica was selected during the first "Tree Selection and Arboreta

Design

" meeting of the project held in Bilbao on June 26th 2009. The rank value of this species was very low that it should be dropped. So, it was switched for:

30. *Quercus robur*

Two subspecies of *Pinus nigra: laricio* and *salzmannii;* were chosen, like as the *ilex* and *rotundifolia* subspecies of *Quercus ilex* species.

Two more genera were introduced: *Eucalyptus* and *Abies*.

31. *The Eucalyptus nitens* species will include also genetic units of others as *E. gundal* and *E. globulus.*

32. Abies cephalonica

Three species with a low ranking value were selected for having representative characteristics:

33. Acer pseudoplatanus

34. Castanea sativa

35. Cunninghamia lanceolata

Cunningamia lanceolata ensures the Asiatic genetic unit precense in the list. It was selected between two species for having a better ranking value than *Criptomeria japonica.*

1.5 Replication of species to assess site variability

The REINFFORCE project contemplates to monitor the climate change and test adaptive measures efficiency. This will be achieved by planting a common set of tree species along a latitudinal gradient that reproduces in turn a climatic gradient and by comparing different characteristics of the genetic units.

Some of these characteristics are related to (i) growth (Working Group “Design protocol growth measurement”), to (ii) the sanitary condition of the genetic units (Working group “Forest Health”) and to (iii) the phenology of the genetic units (Working group “Phenology”).

Taking into account that there are critical features or potential problems for manipulative or controlled experiments, an experiment is successful to the extent that these factors are taken into account so the results are not inconclusive (*S. H. Hurlbert*,1984).

Hulbert explains that manipulative experiments, as the arboretum is, are those that involve one or more treatments and that are based on one or more comparisons. Randomisation and replication are the most important features of experimental design to reduce confusion in an experiment like the one we have in mind with the Arboreta (*S. H. Hurlbert*, 1984).

Taking into account the roles of randomisation and replication in estimation, we can say that replication reduces the random variation (error) of the measured characteristic, increasing therefore the precision of an estimate of, e.g. the mean response of a measured characteristic to different climates or the difference between two treatments (climates). Randomisation eliminates possible bias of the experimenter, increasing the accuracy of estimates.

In this frame it was decided to include in each Arboretum 2 replications of 4 species to be planted randomly.

2 SELECTION OF PROVENANCES

2.1 Forest reproductive materials

After deciding the number of species to plant, it was considered to choose 3 mandatory provenances or genetic units per species . To ensure the site variability, it was decided to have 3 mandatory genetic units per each species and 2 replications for *Pinus pinaster*, *Betula pendula*, *Cedrus atlantica* and *Quercus robur*. In concrete terms, the 3 mandatory units of that species will be planted twice and randomly.

The choice of the 3 provenances per each species ensures a certain variability because it takes into account:

- the intra-specific variation in terms of phenology, growth and draught tolerance
- the post-glacial groups distribution
- the extend of the actual distribution. On the base of these characteristics of the species, the 3 mandatory provenances per species ensure the best grade of variability.

The provenances selection was carried out taking into account the following criteria:

- the adaptation of the species to future climate
- their climatic areas
- the various genotypic groups (genetic distance)
- the existing eco-physiological studies
- the expert knowledge on Growth, Shape, Product Value (being aware that the gene expression can vary a lot with the site quality).

The starting point for the species selection was the European Council description 105/1999/EC of 22nd of December on the marketing of the forest reproductive materials, which gives information on the forest reproductive materials of the most of European countries. Basic information about it is available at DG Health and Consumers of the European Commission[3]. The last upgrading of this record was in December 2009, with the addition of the records from Denmark. On the whole, almost 40,000 references of European Forest Reproductive Materials have been registered, what is a good starting point for searching basic information about potential provenances or genetic units for a trial network. This registry is a compilation completed by the European Commission thanks to the information sent by the national or regional authorities in charge of the services of forest plant production. For some of these countries, more information about their region of provenance and catalogue of forest reproductive materials are available. Normally these records are in the national language. Since the geographic focus of our study is the European Atlantic space, more detailed information for some countries are available as follows:

[3] http://ec.europa.eu/food/plant/propagation/forestry/index_en.htm

- Portugal:information on regions of provenances for the main forest tree species in Portugal[4]
- Spain: information on regions of provenances[5], list of forest reproductive materials[6] and maps of the most common forest tree species of Spain[7]
- France: information on regions of provenances[8], list of forest reproductive materials of the most common forest tree species in France
- United Kingdom: information on regions of provenances and list of forest reproductive materials of the most common forest tree species in United Kingdom.

2.2 Input from key forest tree breeders and scientific organizations

For some of the selected species for the Arboreta there is a wide and deep knowledge of the performance with research and development projects around the world. The partners were consulted about the following species:

- ISA: *Pinus pinea* and *Quercus suber*.
- CIF-Lourizan: *Sequoia supervisions*, *Eucalyptus globulus - E. nitens - E. gundal*, *Quercus robur*, *Pinus pinaster*, *Quercus ilex-Q. rotundifolia* and *Castanea sativa*.
- INRA: *Pinus nigra laricio, Abies cephalonica, Pseudotsuga menziesii, Quercus petrea, Pinus taeda, Pinus elliottii. Pinus brutia, Cedrus atlantica, Cedrus libani, Pinus sylvestris, Quercus rubra – Q. phellos* and *Larix decidua.*
- IDF: *Robinia pseudoacacia*
- FR: *Pinus peuce* and *Thuja plicata.*

For the other species relatively less important in the Atlantic Europe or with no identified reference breeder, the coordination looked for genetic units with a higher performance within the frame of potential changes in the European Atlantic area. These changes will be mainly characterised by a reduction in the annual precipitation, increasing of the mean temperatures, changes in the annual rainfall pattern and increments of extreme events. For this purpose, the project coordination compared information from published references and researchers for the following species:

- *Betula pendula, Calocedrus decurrens, Ceratonia siliqua, Fagus orientalis, Liquidambar styraciflua, Pinus nigra salzmannii, Pinus ponderosa, Acer pseudoplatanus* and *Cunninghamia lanceolata*.

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4 http://www.afn.min-agricultura.pt/portal/producao/mfr/listagem-dos-fornecedores-de-materiais-florestais
http://www.afn.min-agricultura.pt/portal/producao/regioes-de-proveniencia

5 http://www.mma.es/secciones/biodiversidad/montes_politica_forestal/recursos_geneticos_forestal/publicaciones/descarga_publicaciones/index.htm

6 http://www.mma.es/secciones/biodiversidad/montes_politica_forestal/recursos_geneticos_forestal/programas_mejora_genetica/catalogo_materiales_base/index.htm

7 http://www.inia.es/genfored

8 http://agriculture.gouv.fr/sections/thematiques/foret-bois/graines-et-plants-forestiers
http://www.onf.fr/collec-cli-part/sommaire/besoins_reponses/anticiper/foret/reponses/20080519-151335-121890/@@index.html

2.3 Final decision on Forest Reproductive Material

As a result of these tasks, two lists of provenances per species were drawn up: one with a short list of three provenances compulsory for the members' network and a second one with a variable number from three to five extra provenances. The second list was made out both in order to increase potential materials for members organizations with interest in some species, and to supply with substitute materials in case of seed shortage from those compulsory sources. For some species the provenances are defined by a wide geographic window, while others are defined according to the level of a provenance or a concreted Forest Reproductive Material as can be a seed tree orchard or a seed stand. The full list of provenances can be checked on-line[1].

At this last step of selection we put together all the information about the species. We confirmed the forest reproductive materials according to the two biggest international registries at European Commission and OCDE. We also used ecology, potential adaptability to climate change, different genetic pool for provenances in order to choose three compulsory and fully consensus provenances for the whole network. In addition a second group of provenances that could be used by the members was set up for each of the species. The aim of this process was to use group of provenances that are covering a big part of the distribution of the species and that are fitting in the current and future climate conditions of the geographic frame of the REINFFORCE network, namely the European Atlantic area.

Some minor changes due to commercial non-availability for some species have been made. The list of provenance for each region and Arboreta are available on-line[1].

2.4 Final selection of Forest Reproductive Material

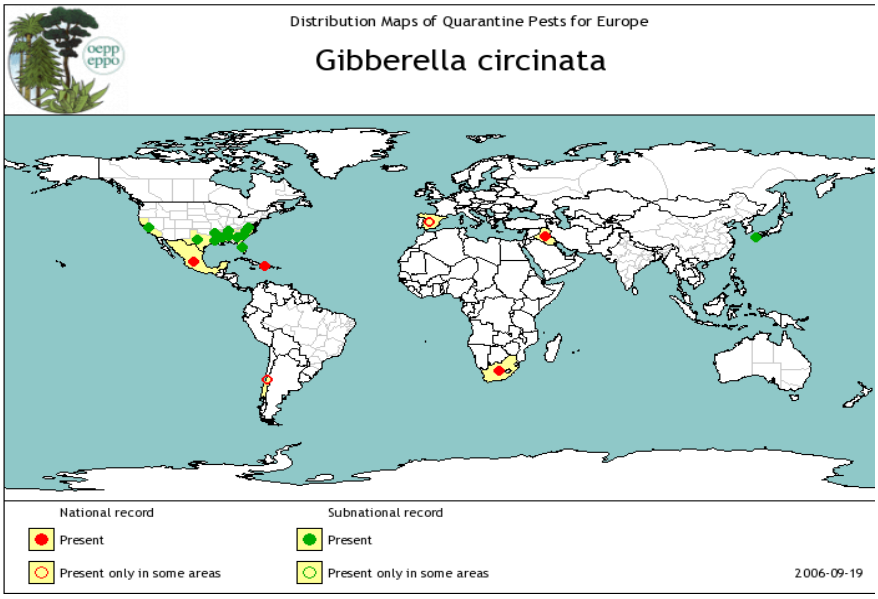
No decision taken up to this point was “compulsory”. In fact, the practice hardly matches the theory due to practical problems that induced to change the final decisions. The main changes were made at provenance level since it is difficult to find the exact ones previously chosen. The reasons for the changes are related to either the seeds availability or the more practical difficulty of finding the providers.

- ***Gibberella circinata* and *Pinus canker***

They cause serious shoot die-back, reduced growth and mortality in pines found in the southern and western USA but also in other countries as showed in the map produced by the European and Mediterranean Plant Protection Organization.

[1] http://reinfforce.iefc.net/

[1] http://reinfforce.iefc.net/



22 genetic units both of *Pinus* and *Pseudotsuga* gen. have been selected in the United States in the areas affected by the pathogen underestimating the consequences of this choice. A European Commission Decision on provisional emergency measures to prevent the introduction into Europe and the spread within the Community of *Gibberella circinata*[9] has been drafted to face the pathogen spreading in Europe, which existence has been detected in some areas of Spain.

To import this kind of seeds is necessary that the providers certify, through laboratory analysis, the free pest condition of the seeds.

PROCEDURES followed for the seeds of *Pinus* and *Pseudotsuga gen.* importation

Also the genetic units from Turkey and Spain were affected by this problem. The seeds from both countries were analysed and imported with certificates. In the case of Turkey provenances, it took 5 months to obtain the certificates as the seeds were blocked at the customs of Bordeaux, in France.

The case of the United States is different because of the difficulties in finding laboratories available for the test. An alternative has found. Through the French agency for food, environmental and occupational health safety (Anses) an analysis laboratory in France has been contacted. The seeds were sent to the laboratory for analyse.

- **Lack of harvesting**

The acorn harvesting of most of the Spanish *Quercus* gen. in particular *Q.suber* sp. was poor in 2010. For this reason some genetic units were changed, others were cut from the list.

- **Bureaucracy and countries of origin laws**

Most of the Lebanese genetic units were switched for others, like French and Italian ones. A long procedure was followed to get the Lebanese units which started from the American University of Beirut and stopped at the Ministry of Agriculture with the Lebanese answer: "*As you know Lebanon is signatory of the CBD and as such we cannot send any material without ensuring that access and*

[9] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:161:0066:01:en:HTML

benefit sharing (in this case in the form of a material transfer agreement) between the institution and the government of Lebanon has been drafted".

- **Missing of providers and/or contacts**

Most of the Greek provenances were switched for others. Both the Ministry of Rural Development and the Food University (Faculty of Biology) of Athens, Greece were contacted. Unfortunately, nobody was able to get the seeds of the requested local species.

3. GAPS FOR IMPROVEMENT

During this selection process for the Arboreta network, all the members and collaborators have been sharing ideas indicating potential gaps of knowledge, where more research or transfer of information is needed. Below some of these points are summarised:

- Necessity of improvement of the international registers of Forest Reproductive Materials, including data about real availability of seeds.
- Necessity of upgrading current provenance regions including data from past climate and also from some of the most accepted climate change scenario.
- Possibility of merging the national registers on Forest Reproductive Materials into a common and fully accessible European register.
- Development or improvement of the current indicators.

4. USEFUL LINKS AND REFERENCES

The specific references for each of the species can be found in its cards. At this point of the document we have listed a group of links providing information about ecology, taxonomy, genetics and forest reproductive materials.

4.1 Taxonomy and botanical aspects

- Gymnosperm Database

http://www.conifers.org/

- Kew Herbarium Catalogue

http://apps.kew.org/herbcat/navigator.do

- Electronic Flora from Chile, China, North America maintaining by Missouri Botanical Garden, St. Louis, MO & Harvard University Herbaria, Cambridge, MA.

http://www.efloras.org/

- Atlas Florae Europaeae

http://www.fmnh.helsinki.fi/english/botany/afe/index.htm

- Flora Europaea from Royal Botanical Garden of Edinburgh

http://rbg-web2.rbge.org.uk/FE/fe.html

- Electronic plant information centre by Kew Botanical Garden

http://epic.kew.org/index.htm

- New South Wales Eucalyptus from Royal Botanical Garden of Sydney

http://plantnet.rbgsyd.nsw.gov.au/PlantNet/Euc/

- PlanNet from Royal Botanical Garden of Sydney

http://plantnet.rbgsyd.nsw.gov.au/other2.htm

4.2 Genetics and intra specific variation

- European Forest Genetic Resources Programme (EUFORGEN)

http://www.euforgen.org/

- Establishment of an European Information System on Forest Genetics Resources

http://www.eufgis.org/

- Forest tree genome database (USA)

http://dendrome.ucdavis.edu/

- Biodiversity international publications

http://www.bioversityinternational.org/publications

4.3 Ecology and distribution of species

- Climate change and seed transfer research at British Columbia (Canada)

http://www.for.gov.bc.ca/hre/forgen/seedtransfer/seedtransfer.htm

- WorldClim global climate data

http://www.worldclim.org/

- Atlas of relations between climatic parameters and distributions of important trees and shrubs in

North America by US Geological Service (USA)

http://pubs.usgs.gov/pp/p1650-a/

- General Directorate of Forestry (Turkey)

http://www.ogm.gov.tr/

- GIS data from California by Californian Department of Forestry and Fire Protection (USA)

http://frap.cdf.ca.gov/data/frapgisdata/select.asp

- National system for environmental and natural resources information from General Directorate of Environmental and Natural Resources (Mexico)

http://www.semarnat.gob.mx/informacionambiental/Pages/index-sniarn.aspx

- National geographic information for forest resources information by CONAFOR (Mexico)

http://148.223.105.188:2222/gif/snif_portal/

- Australian Natural Resources Atlas from Australian government

http://www.anra.gov.au/topics/publications/index.html

- Eucalyptus information centre by University of Huelva (Spain)

http://www.uhu.es/cideu/DefaultInicio.htm

- National environmental geographic system from Chile

http://www.sinia.cl/1292/channel.html

- National Forest Institute of Chile

http://www.infor.cl

- Ecological subregions of California by the US Forest Service (USA)

http://www.fs.fed.us/r5/projects/ecoregions/ca_sections.htm

- National forest of California by US Forest Service (USA)

http://www.fs.fed.us/r5/forests.shtml

4.4 Forest Reproductive Materials

- Spanish register of identified, selected and qualified Forest Reproductive Materials

http://www.mma.es/portal/secciones/biodiversidad/montes_politica_forestal/recursos_geneticos_forestal/programas_mejora_genetica/catalogo_materiales_base/

- Publications for Spain and main forest tree species provenances

http://www.mma.es/secciones/biodiversidad/montes_politica_forestal/recursos_geneticos_forestal/publicaciones/descarga_publicaciones/index.htm

- National Register of Forest Reproductive Materials for United Kingdom

http://www.forestry.gov.uk/website/forestry.nsf/byunique/infd-6judsq

- Information on forest species seed from the French Ministry of Agriculture and Fisheries

http://agriculture.gouv.fr/sections/thematiques/foret-bois/graines-et-plants-forestiers

- Forest reproductive material register at the European Commission DG Health and Consumers.

http://ec.europa.eu/food/plant/propagation/forestry/index_en.htm

- Forest tree seeds and breeding service of the government of Turkey

http://www.ortohum.gov.tr/english/index.htm

- OECD

http://www2.oecd.org/agr-coddb/index_e.asp

- Forest reproductive materials links at FAO

http://www.fao.org/forestry/5106/en/

- Spanish forest tree species provenances maps by INIA

http://www.inia.es/inia/contenidos/redestem/portada1.jsp?id=69&tema=relint

4.5 Replications

Fisher, R. A. (1945). Recent Progress in Experimental Design. Reproduced from L'application du Calcul des Probabilités, (Proceedings of the International Institute of Intellectual Cooperation, Geneva, 1939), 19-31.

Hurlbert S.H. (1984). Pseudoreplication and the Design of Ecological Field Experiments. Ecological Monographs 54 (2) 187-211.

4.6 Others

- Euforest portal

http://forestportal.efi.int/

- Northern European database of long-term forest experiments

http://noltfox.metla.fi/

- Reforestation, nurseries and genetic resources from Forest Service (USA)

http://www.rngr.net/

- Forestry Compendium by CABI

http://www.cabi.org/compendia/fc/index.asp

- Agris - International information system for agricultural sciences and technology

http://agris.fao.com

ANNEXES

ANNEX1: species selection for the Arboreta

ANNEX2: species description for decision support tool and final selection

ANNEX1

	M. Alejandro Cantero	Mme. Carmen Traver	M. Christophe Orazio	M. Ander Gonzales Arias	Mme. Maria Helena Almeida	M. Richard Jinks	M. Eric Paillassa	M. Vincente Piorno	M. Julio Diez Casero	Mme. Amélie Castro	M. Patrick Pastuszka	
	60/20	/	23/24	60/20	60/24	60/37	60/60	/	/	40/40	60/40	Results
Acer pseudoplatanus	3			3	1	2	1					10/05/11
Betula pendula						3					2	05/02/11
Castanea sativa (C. vesca)					3	1	1				1	06/04/11
Cryptomeria japonica	3			3	2	1				1	2	12/06/11
Pinus nigra ssp. laricio						1					2	03/02/11
Pinus pinaster	3		3	3	3	1	1			1	3	18/08/11
Pinus pinea			2		3		1			1	2	09/05/11
Pinus sylvestris	3		2	3	3	3	1			1	1	17/08/11
Pseudotsuga menziesii	3			3		3	1					10/04/11
Quercus pyrenaica (Q. toza)							1			1	1	03/03/11
Quercus robur (Q. pedunculata)	3			3	3	3						12/04/11
Sequoia sempervirens	3			3		1	1			1	2	11/06/11
a mexican pine?										1		01/01/11
Abies procera												/
Ailanthus altissima												/
Alnus incana												/
Alnus viridis												/
Arbutus andrachne			0									0/1
Betula tortuosa												/
Buxus sempervirens			0									0/1
Carpinus betulus												/

Carpinus orientalis												/
Crataegus monogyna						1						01/01/11
Cupressocypar is leylandii												/
Erica arborea			0									0/1
Erica manipuliflora			0									0/1
Erica scoparia			0									0/1
Eucalyptus X gundal											2	02/01/11
Fagus moesiaca												/
Fraxinus ornus												/
juglans nigra												/
Juniperus communis												/
Juniperus oxycedrus												/
Juniperus phoenicea												/
Juniperus sabina												/
Juniperus virginiana												/
Larix kaempferi (L.leptolepis)												/
Larix kaempferi												/
Laurus nobilis												/
lex aquifolium						1						01/01/11
Malus domestica							1					01/01/11
Myrtus communis												/
Olea europaea												/
Other broadleaves												/
Phillyrea latifolia			0									0/1
Phyllyrea angustifolia			0									0/1

Pinus canariensis												/
Pinus cembra												/
Pinus echinata x taeda							1			1	1	03/03/11
Pinus heldreichii												/
Pinus leucodermis												/
Pinus mugo (P. montana)												/
Pinus rigida x taeda							1				2	03/02/11
Pinus wallichiana												/
Populus alba												/
Populus canescens												/
Populus hybrides												/
Populus nigra												/
Prunus dulcis												/
Prunus padus												/
Prunus serotina			0									0/1
Pseudotsuga macrocarpa												/
Quercus cerris												/
Quercus coccifera (Q. calliprinos)												/
Quercus frainetto (Q. conferta)												/
Quercus fruticosa (Q. lusitanica)												/
Quercus macrolepis (Q. aegilops)												/
Quercus trojana												/
Rhamnus alaternus												/

Rhamnus oleoides												/
Salix alba												/
Salix caprea												/
Salix cinerea												/
Salix eleagnos												/
Salix fragilis												/
Salix sp.			3									03/01/11
Sophora spp										1		01/01/11
Sorbus domestica							1					01/01/11
Taxus baccata												/
Thuya sp.												/
Tsuga sp.												/
Ulmus glabra (U. scabra, U. scaba, U. montana)												/
Ulmus laevis (U. effusa)												/
Ulmus minor (U. campestris, U. carpinifolia)												/
Abies alba			0									0/1
Abies borisii-regis			0				1			1		02/03/11
Abies bornmulleriana							1			1	1	03/03/11
Abies cephalonica							1			1	1	03/03/11
Abies Cilicica							1			1		02/02/11
Abies concolor							1			1		02/02/11
Abies grandis						1						01/01/11
Abies nordmanniana						1	1			1		03/03/11
Abies numidica							1			1		02/02/11
Abies pinsapo							1			1		02/02/11
Acer campestre			1		1		1				1	04/04/11

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Acer macrophyllum						1						01/01/11
Acer monspessulanum			1		2		1					04/03/11
Acer opalus			1				1					02/02/11
Acer platanoides							1					01/01/11
Alnus cordata							1					01/01/11
Alnus glutinosa					3	1						04/02/11
Arbutus unedo	3		0	3	3							09/04/11
Betula pubescens	3			3		3						09/03/11
Calocedrus decurrens							1				1	02/02/11
Cedrus atlantica							1			1	3	05/03/11
Cedrus deodara							1					01/01/11
Cedrus libani							1			1		02/02/11
Celtis australis							1			1		02/02/11
Ceratonia siliqua					2							02/01/11
Cercis siliquastrum												/
Chmaecyparis lawsonia						1	1					02/02/11
Corylus avellana						1						01/01/11
Cunninghamia lanceolata											1	01/01/11
Cupressus arizonica							1			1	1	03/03/11
Cupressus lusitanica					3							03/01/11
Cupressus macrocarpa											1	01/01/11
Cupressus sempervirens					1		1			1	1	04/04/11
Eucalyptus globulus	3		3	3	3						2	14/05/11

Eucalyptus gunnii						1	1			1	1	04/04/11
Eucalyptus nitens											1	01/01/11
Fagus orientalis							1					01/01/11
Fagus sylvatica	3			3		2						08/03/11
Fraxinus angustifolia spp. oxycarpa (F. oxyphylla)					3							03/01/11
Fraxinus excelsior	3			3		3						09/03/11
Gledistchia triacanthos							1			1		02/02/11
Juglans regia							1					01/01/11
Juniperus thurifera												/
Larix decidua						2						02/01/11
Larix eurolepis						2	1			1		04/03/11
Liquidambar styraciflua							1				2	03/02/11
Liriodendron tulipifera	3			3			1					07/03/11
Meatsequoia glyptostroboid es											1	01/01/11
Nothofagus obliqua						1						01/01/11
Nothofagus procera						1						01/01/11
Ostrya carpinifolia												/
Picea abies (P. excelsa)			0			2						02/02/11
Picea omorika						1	1			1		03/03/11
Picea orientralis							1					01/01/11
Picea sichensis						3					1	04/02/11
Pinus brutia							1			1	1	03/03/11
Pinus contorta						3	1					04/02/11
Pinus elliottii											1	01/01/11

Pinus halepensis					3		1				1	05/03/11
Pinus nigra							1					01/01/11
pinus nigra salzamanni					1						1	02/02/11
Pinus peuce						1						01/01/11
Pinus ponderosa							1			1	1	03/03/11
Pinus radiata (P.insignis)	3			3		1					2	09/04/11
Pinus strobus												/
Pinus taeda	3		2	3			1			1	3	13/06/11
Pinus uncinata												/
Platanus orientalis							1			1	1	03/03/11
Populus tremula												/
Prunus avium	3		0	3	2	1						09/05/11
Pyrus coomunis							1					01/01/11
Quercus faginea	3			3	3							09/03/11
Quercus ilex	3			3	3		1			1	3	14/06/11
Quercus palustris			2							1		03/02/11
Quercus petraea	3			3		3	1			1		11/05/11
Quercus phellos											1	01/01/11
Quercus pubescens							1			1		02/02/11
Quercus rotundifolia					3							03/01/11
Quercus rubra							1				1	02/02/11
Quercus suber			3		3					1	2	09/04/11
Robinia pseudoacacia							1			1	2	04/03/11
Sequoiadendron gigateum							1			1		02/02/11
Sorbus aria							1					01/01/11
Sorbus aucuparia	3			3								06/02/11
Sorbus torminalis							1					01/01/11

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Tamarix africana					3							03/01/11
Thuja plicata						1						01/01/11
Tilia cordata						1	1			1		03/03/11
Tilia platyphyllos						1	1			1		03/03/11
Zelkova spp										1		01/01/11

ANNEX2

species_id	Species EUcode	GeoDistr	ClimaDistri	FrostTol	HTempTol	DroughtTol	WaterDemand	Nutrient	SoilDepth	SoilMoisture	Econ	Social	height	WQuality	Wproducts	Biodamages	AbioDamages	management	Sel	rank1	rank2	rank3	rank4	rank5
Abies cephalonica	Ace	2	3	3	2	2	2	4	3	2	1	1.9	30	1.9	4	1	2	1	2	-0.19	-0.08	-0.38	-0.04	-0.11
Abies nordmanniana	Abn	2	0.9	4	2	2	2	3	3	2	2	1.9	55	1.9	3	2	0.9	2	0	-0.13	-0.11	-0.16	-0.14	-0.13
Abies pinsapo	Api	1	1	1	2	3	2	3	2	1	1	3	30	2	4	2	1	1	0	-0.22	-0.21	-0.25	-0.17	-0.2
Acer campestris	Aca	3	2	5	2	2	2	2	2	2	2	3	15	4	5	1	1	1	0	0.06	0.13	-0.08	-0.05	0
Acer monspessulanum	Amo	2	2	1	3	2	2	4	1	3	2	2	10	4	5	1	1	1	0	-0.04	0.05	-0.22	0.08	0.02
Acer pseudoplatanus	Aps	3	2	5	2	1	2	4	2	2	2	2	30	4	5	2	1	2	1	-0.05	-0.05	-0.04	-0.11	-0.08
Arbutus unedo	Aun	4	2	2	2	3	2	3	3	1.9	2	3	10	3	3	0.9	1	1	0	-0.07	0.04	-0.26	-0.08	-0.07
Betula pendula	Bpe	3	3	5	2	1	2	4	0	2	4	3	15	3	5	1	1	3	1	0.15	0.13	0.17	0.03	0.09
Calocedrus decurrens	Cde	2	2	5	2	3	1	4	1	3	2	3	69	4	5	1	1	2	2	0.23	0.22	0.24	0.33	0.27
Castanea sativa	Csa	2	2	4	2	1	2	3	3	2	4	3	35	2	3	3	1	3	1	-0.07	-0.16	0.1	-0.18	-0.12
Cedrus atlantica	Cat	2	2	3	3	3	2	3	3	2	3	3	40	4	4	1	2	1	2	0.02	0.01	0.06	0.17	0.1
Cedrus libani	Cli	3	2	3	3	3	1	4	2	3	2	2	30	4	4	1	1	2	2	0.1	0.21	-0.09	0.24	0.17
Celtis australis	Cau	3	2	2	3	1	2	4	2	1	2	3	25	3	5	0.9	1	1	0	-0.09	-0.08	-0.1	-0.07	-0.08
Ceratonia siliqua	Csi	3	2	1	3	3	1	4	0	3	3	3	10	2	5	1	1	2	2	0.12	0.22	-0.08	0.22	0.16
Chamaecyparis lawsionana	Claw	2	2	2	2	2	3	4	2	3	2	3	60	4	5	3	1	1	0	-0.07	-0.18	0.13	0	-0.04
Cryptomeria japonica	Cja	2	1	1	2	1	3	2	2	2	2	3	55	3	4	2	2	3	0	-0.13	-0.3	0.18	-0.21	-0.17
Cunninghamia lanceolata	Clan	3	2	1.9	1.9	0.9	2	4	2	1.9	4	2	50	4	4	1	2	3	2	-0.03	-0.17	0.24	0.01	-0.01
Cupressus lusitanica	Clu	2	2	1.9	3	3	1	4	2	2	2	1.9	40	3	4	1	2		2	-0.02	0.02	-0.09	0.22	0.1
Cupressus macrocarpa	Cma	1	1	1	3	2	2	4	1	1.9	3	3	25	1	4	3	0.9	2	0	-0.17	-0.19	-0.13	-0.12	-0.15
Cupressus sempervirens	Cse	1	2	1	3	3	1	1	1	3	2	3	30	4	4	3	0.9	1	2	0.06	0.12	-0.06	0.19	0.12
Eucalyptus globulus	Egl	4	1	1	3	1	3	4	2	1	4	2	40	1	2	2	3	3	0	-0.25	-0.34	-0.1	-0.25	-0.25
Eucalyptus gundal	Egund	1	1	4	2	1	2	4	2	2	1	1	35	1	1	0.9	0.9	1	0	-0.3	-0.13	-0.61	-0.29	-0.29
Eucalyptus spp.	Eni	2	2	1	3	1	3	4	3	2	4	2	60	2	2	2	2	2	2	-0.21	-0.3	-0.04	-0.08	-0.14
Fagus orientalis	For	3	2	3	2	2	3	4	2	2	4	3	45	3	5	0.9	0.9	3	2	0.08	-0.05	0.31	0.01	0.05
Fagus sylvatica	Fsy	4	2	3	1	1	3	2	3	1	4	3	40	3	5	2	2	3	0	-0.06	-0.26	0.29	-0.25	-0.15
Fraxinus Angustifolia	Fanox	3	2	4	2	2	3	2	2	2	3	2	35	3	4	3	2	2	0	-0.09	-0.11	-0.06	-0.14	-0.12
Juniperus thurifera	Jth	2	1	1.9	3	3	1	1	1	3	2	3	10	1	3	0.9	0.9	1	0	0.01	0.23	-0.39	0.04	0.02
Larix decidua	Lde	2	2	2	3	2	2	1	1	2	2	1.9	46	4	5	2	1	2	2	0.05	0.06	0.03	0.13	0.09
Liquidambar styraciflua	Lst	3	3	4	3	3	3	4	0	2	2	1.9	30	3	5	1	2	3	2	0.09	0.15	-0.02	0.17	0.13
Metasequoia glyptostroboides	Mgl	1	1	5	3	1	3	1	3	1	1	3	50	1	3	1	3	3	0	-0.15	-0.2	-0.07	-0.25	-0.2
Nothofagus obliqua	Nob	3	3	4	3	2	3	3	3	1.9	2	1.9	40	3	4	1	2	3	0	0.01	0.03	-0.01	0.05	0.03
Ostrya carpinifolia	Oca	3	2	5	2	2	2	4	2	2	2	3	25	2	3	0.9	0.9	2	0	-0.02	0.07	-0.18	-0.1	-0.06
Picea abies	Pab	4	3	5	1	1	3	4	2	1	4	2	40	2	5	2	3	3	0	-0.1	-0.22	0.11	-0.17	-0.14
Picea omorika	Pom	1	2	5	2	2	2	4	0	3	2	3	30	1.9	2	1	3	3	0	-0.03	0.01	-0.11	-0.02	-0.03
Picea orientalis	Por	2	2	3	1.9	2	2	3	3	1	2	1.9	65	3	5	2	1	2	0	-0.09	-0.16	0.04	-0.01	-0.05
Picea sitchensis	Psi	3	2	4	1	1	3	1	2	1	4	2	45	3	2	2	2	3	0	-0.11	-0.19	0.06	-0.26	-0.18
Pinus brutia	Pbu	2	3	4	3	3	1	4	1	3	4	2	35	2	4	2	2	2	2	0.1	0.19	-0.06	0.32	0.21
Pinus elliottii	Pel	3	2	4	3	2	2	2	2	3	4	3	34	2	4	3	1	3	2	0.12	0.11	0.14	0.05	0.09
Pinus nigra	Pnil	3	2	4	2	2	2	4	0	3	4	3	50	2	4	2	2	3	1	0.11	0.04	0.22	0.11	0.11
Pinus nigra sub. salzmani	Pnis	3	2	5	3	1	2	4	0	3	4	3	50	2	4	2	0.9	3	0	0.17	0.14	0.22	0.11	0.14
Pinus peuce	Ppe	2	2	4	2	3	1	2	1	3	2	2	30	2	2	1	1	2	2	0.06	0.26	-0.32	0.1	0.08
Pinus pinaster	Ppina	3	2	4	3	3	1	1	1	3	4	3	35	2	4	3	3	3	1	0.17	0.18	0.15	0.21	0.19
Pinus pinea	Ppine	2	2	4	3	3	1	2	1	2	3	3	25	1	4	1	2	3	1	0.12	0.2	-0.03	0.16	0.14
Pinus ponderosa	Ppo	4	3	4	3	3	1	4	0	3	4	3	60	2	5	3	1	3	2	0.31	0.3	0.31	0.42	0.36
Pinus radiata	Pra	2	2	2	2	2	3	4	3	2	4	3	50	3	4	2	1	3	0	-0.04	-0.22	0.29	-0.05	-0.05
Pinus sylvestris	Psy	4	3	5	2	1	2	4	1	3	4	3	35	2	5	2	1	3	1	0.16	0.14	0.2	0.05	0.1
Pinus taeda	Pta	3	2	4	3	2	2	2	2	2	4	3	34	2	4	3	1	3	2	0.09	0.06	0.14	0.01	0.05
Platanus orientalis	Plori	3	0.9	4	3	2	3	1	2	1.9	2	2	35	2	4	3	1	1	0	-0.12	-0.03	-0.28	-0.2	-0.16
Populus tremula	Ptr	4	3	5	3	2		3	3	1	4	3	35	2	5	2	0.9	2	2	0.1	0.1	0.1	0.07	0.09
Prunus avium	Pav	4	3	5	1	1	3	3	3	2	3	3	25	4	5	3	3	3	0	-0.06	-0.21	0.21	-0.22	-0.14
Pseudotsuga menzienesii	Pme	4	3	1	1	1	2	4	0	2	4	3	90	3	5	1	2	3	1	0.11	-0.06	0.43	0.15	0.13
Quercus canariensis	Qca	2	1	1	3	1	2	2	3	2	1	3	30	1.9	3	1	1	1	0	-0.18	-0.11	-0.3	-0.2	-0.19
Quercus faginea	Qfa	2	2	4	1	1	3	4	2	2	3	3	20	1.9	3	1	2	1	0	-0.23	-0.22	-0.23	-0.31	-0.27
Quercus ilex	Qil	4	3	1	2	2	2	4	0	3	4	3	25	2	3	2	2	2	0	0.01	0.04	-0.05	0.07	0.04
Quercus petraea	Qpe	4	3	3	2	1	2	3	3	3	4	3	35	3	4	2	1	3	2	0.1	0.03	0.22	0.01	0.05
Quercus pubescens	Qpu	3	2	5	2	1	2	4	0	3	2	2	25	1	3	1	2	1	0	-0.11	0.07	-0.44	-0.11	-0.11
Quercus pyrenaica	Qpy	2	2	4	2	1	3	2	2	1	2	2	20	1	3	1	1	2	0	-0.19	-0.09	-0.38	-0.33	-0.26
Quercus robur	Qrob	4	3	2	2	1	2	3	2	2	4	3	45	3	4	2	2	3	1	0.04	-0.09	0.27	0.03	0.03
Quercus rotundifolia	Qrot	4	3	5	3	3	1	4	0	3	4	3	25	2	3	2	2	2	2	0.19	0.32	-0.05	0.29	0.24
Quercus rubra-phellos	Qru	4	3	5	2	2	2	4	2	2	4	2	40	2	4	2	2	3	2	0.05	0.04	0.06	0.06	0.05
Quercus suber	Qsu	4	2	2	3	3	2	2	2	3	4	3	30	1	4	1	2	3	2	0.13	0.17	0.06	0.15	0.14
Robinia pseudoacacia	Rps	4	2	4	3	3	1	1	3	2	4	3	30	4	4	1	2	3	2	0.24	0.23	0.25	0.23	0.23
Sequoia sempervirens	Sse	2	2	1	2	2	3	4	0	1	2	3	112	4	5	1	1	2	1	0.01	-0.14	0.27	0.09	0.04
Sorbus aucuparia	Sau	4	3	5	2	1	3	1	2	3	2	3		3	2	2	2	1	0	-0.01	0.08	-0.19	-0.12	-0.07
Sorbus torminalis	Sto	4	2	1.9	3	1	2	4	0	2	3	3	25	4	5	1	2	2	2	0.05	0.01	0.11	0.06	0.05
Thuja plicata	Tpli	3	3	4	1	2	3	4	0	2	4	3	60	3	4	1	2	3	2	0.11	-0.01	0.33	0.1	0.11

Tilia cordata	Tco	4	3	5	2	2	2	2	2	2	2	3	25	2	2	1	1	2	0	0.06	0.22	-0.23	-0.05	0.01
Tilia platyphyllos	Tpla	3	1	5	2	2	2	3	1	3	2	3	40	2	4	1	1	2	0	0.07	0.14	-0.06	-0.04	0.02