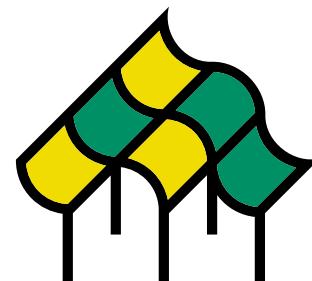




Layman Report LIFE RedBosques_Clima

Nature-based solutions to adapt
forests to climate change





LIFE RedBosques_Clima (LIFE20 CCA/ES/001624)

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Produced by Fundación Fernando González Bernáldez
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www.redbosquesclima.eu

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Climate change is already here

Massive mortality of trees on entire hillsides, forests in which all trees of the same species dry out simultaneously, or devastating fires of unprecedented extent and intensity are realities that already surround us, resulting from changes in land use, but to which climate change is now added.

Based on the best available scientific knowledge, **RedBosques_Clima provides tools to increase resilience in forests by identifying the elements that make them most vulnerable to climate change.**

These tools can be applied to any type of forest and are of interest to managers, owners and decision-makers in the forestry and biodiversity conservation sectors.

Why are our forests vulnerable to climate change?

Spanish forests are the result of a long history of human use. For centuries, they have been intensively exploited for their timber, firewood, pastures, etc. However, since the mid-20th century, society has changed, and many of the uses of the forest have been abandoned. As a result, much of the current forested area consists of young forests, or the expansion of trees over declining land uses such as agriculture or extensive livestock farming, or extensive reforestation carried out in the 20th century.

All of these are continuous, very homogeneous forests, consisting of a single species, with all trees of the same age, and with a very limited capacity to react to disturbances.



Project objectives

And what makes forests more resilient?

La ecología forestal nos enseña que algunas de las características del bosque aumentan su capacidad de resistir o de recuperarse de los efectos del cambio climático, en concreto de las sequías.

Mosaic landscapes, formed by forests of varying degrees of maturity alongside open areas of pasture or crops, and forests composed of several species of different ages, with clearings and discontinuities, are the perfect combination for reducing the impacts of drought.



Promote the adaptation of forests to climate change through forest management based on imitating nature.

To achieve this objective, the project has been organised around three specific objectives:

- **Design tools to assess the vulnerability of forests to climate change** and to ensure the **quality and effectiveness** of adaptation measures.
- **Apply these tools in the field**, in three cases representative of the most common state of conservation in Spanish forests.
- **Encourage the transfer of project results** and promote their replication throughout the territory, involving public managers, private owners and decision-makers.

Tools for adaptation

Assessing climate risks: drought vulnerability index

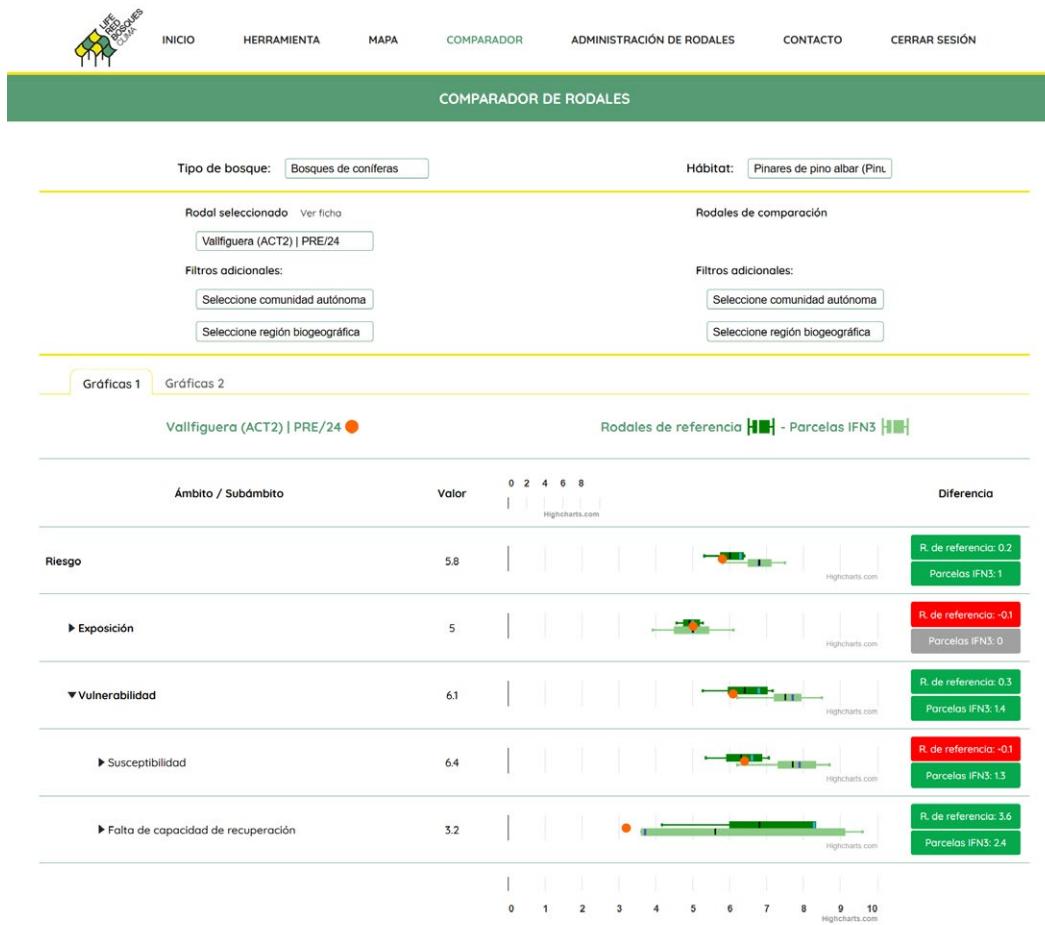
We have selected drought as the main climate risk facing Spanish forests. Based on an exhaustive review of the available scientific evidence, we have identified the characteristics of forests that provide greater resilience to drought:

Conceptual framework of areas, criteria, and indicators used for drought risk assessment

Scope	Sub-scope	Criteria	Indicator
Exposure	Exposure to drought	Climate exposure	Climate aridity index Climate suitability of species
		Geographical exposure	Topographic moisture index Solar radiation Soil thickness/rockiness
Vulnerability	Susceptibility	Average functional susceptibility	Average susceptibility to embolism Average root depth
		Functional susceptibility diversity	Diversity of susceptibility to embolism Diversity of root depth
	Structural and compositional susceptibility	Basimetric area Average normal diameter Number of tree species Number of diameter classes	
	Lack of resilience	Lack of resilience	Average regrowth capacity Diversity of regrowth capacity Regeneration index

Tool for assessing drought risk and vulnerability

With this information, we have developed an index and an online tool that allows us to **quantitatively calculate the drought risk and vulnerability of a given forest**. Furthermore, this result can be compared with the average situation of Spanish forests based on data from the National Forest Inventory. The index also allows us to identify aspects of forest structure and composition where adaptation capacity can be improved through appropriate management.



Tipo de bosque:

Hábitat:

Rodal seleccionado

Rodales de comparación

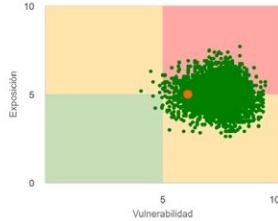
Filtros adicionales:

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Gráficas 1 Gráficas 2

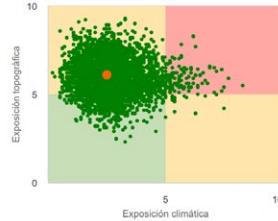
Rodales de referencia Parcelas IFN3

Riesgo



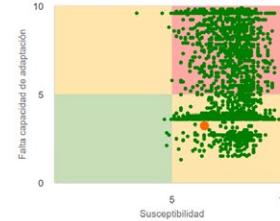
• Media de parcelas IFN3 • Rodal seleccionado
highcharts.com

Exposición

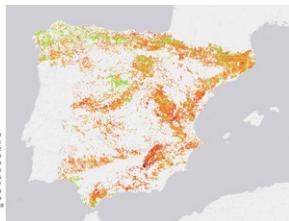
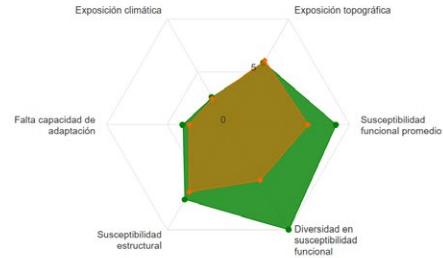
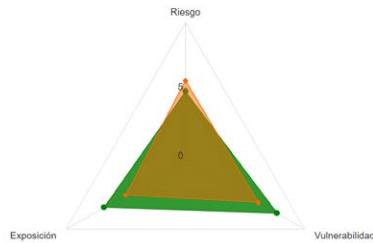


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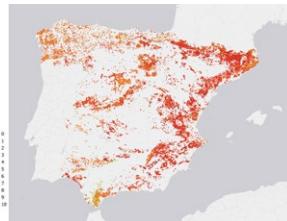
Vulnerabilidad



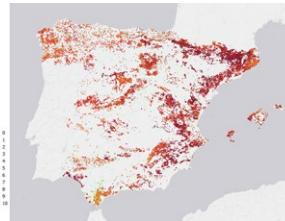
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highcharts.com



Exposure map



Risk map



Vulnerability map



You can access the tool at the following link:

<https://redbosquesclima.eu/herramienta-online/>

If you need an informative version, the “**Adaptometer**” offers the same index in a simplified form, easily applicable by people without specialised knowledge.

Measuring the risk of drought in forests

		HIGHER RISK	1	2	3	4	LOWER RISK
Exposure	Headwaters or hillside areas						Located in a valley bottom or alluvial zone
	Poorly developed soil						Deep, well-developed soil
	The dominant species is at the limit of its distribution						The dominant species is not at its distribution limit
Susceptibility	The canopy is formed by a single dominant species						The canopy is composed of two or more species
	All canopy trees are of similar diameter or age						There are trees of varying diameters and ages
	High tree density						Low tree density
	There are no trees with very thick trunks						Some of the trees are very thick
	The dominant species are not very resistant to drought*						Las especies dominantes son muy resistentes a la sequía
Resilience	There is no seed regeneration						The dominant species are very resistant to drought
	The dominant species in the stand do not have the capacity to regrow						Recent and advanced seed regeneration can be seen

*Drought resistance: classification of species according to their vulnerability to embolism

source: trait plant database; <https://www.try-db.org/tryweb/home.php>

Very low *Betula sp / Alnus glutinosa / Salix sp / Populus tremula / Populus alba / Populus nigra / Sambucus nigra*

Low *Pinus nigra / Pinus sylvestris / Fagus sylvatica / Populus nigra / Tilia sp / Fraxinus excelsior / Quercus robur*

Average *Castanea sativa / Sorbus aria / Pinus pinea / Acer campestre / Quercus faginea / Pinus pinaster /*

Pinus uncinata / Abies alba / Quercus ilex / Quercus petraea

High *Pinus halepensis / Juniperus thurifera / Taxus baccata / Juniperus communis / Ilex aquifolium / Arbutus unedo / Quercus suber*

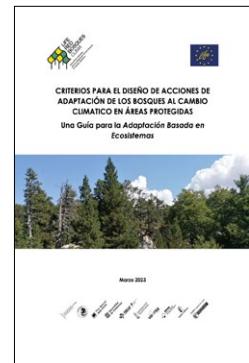
Designing actions to adapt forests to climate change

Another outcome of the project has been the **Guide for adapting forests to climate change in protected areas**, which sets out the minimum criteria that any intervention in the forest should meet in order to be considered genuinely adaptive.

This requires adequate consideration of future climate scenarios, the incorporation of protocols for monitoring and evaluating results, and a precise assessment of climate risks.

Basic criteria defining good practices in forest adaptation to climate change:

1. It fits appropriately into planning and institutional support
2. It considers the social dimension of the project
3. A climate risk and vulnerability analysis is carried out
4. The adaptation objectives are explicit
5. There are positive synergies with biodiversity conservation objectives
6. The economic viability of the project is taken into account
7. A system for monitoring and evaluating results is planned



You can download the manuals and guides at:

<https://redbosquesclima.eu/manuales-tecnicos/>



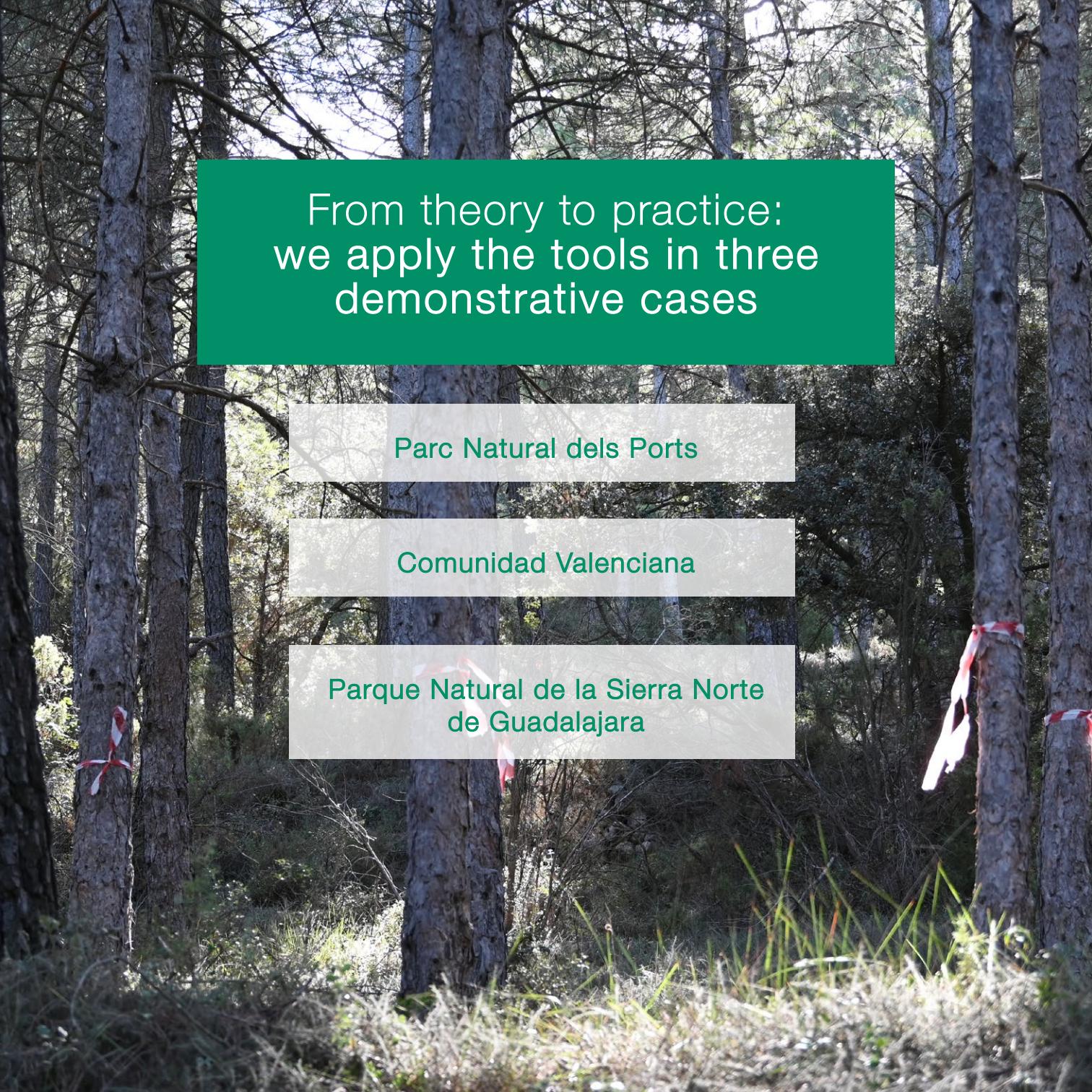
Drought vulnerability index



Index application manual and online tool



Standardised field forms



From theory to practice:
we apply the tools in three
demonstrative cases

Parc Natural dels Ports

Comunidad Valenciana

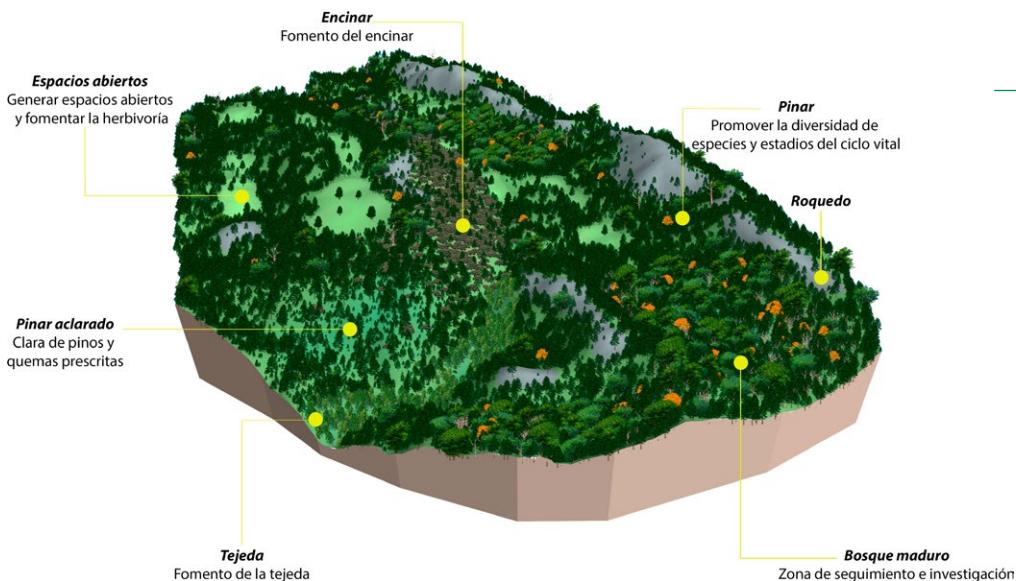
Parque Natural de la Sierra Norte
de Guadalajara

Following the guidelines developed in the project, the drought risk index has been applied in each of the demonstration areas. This has made it possible to identify the characteristics of the forest that make it most vulnerable and to design measures to reduce that vulnerability.



In the **Parc Natural dels Ports** (Tarragona), we intervened on natural pine forests of *Pinus nigra*, *Pinus sylvestris* and *Pinus halepensis*, where timber extraction ceased to be profitable decades ago.

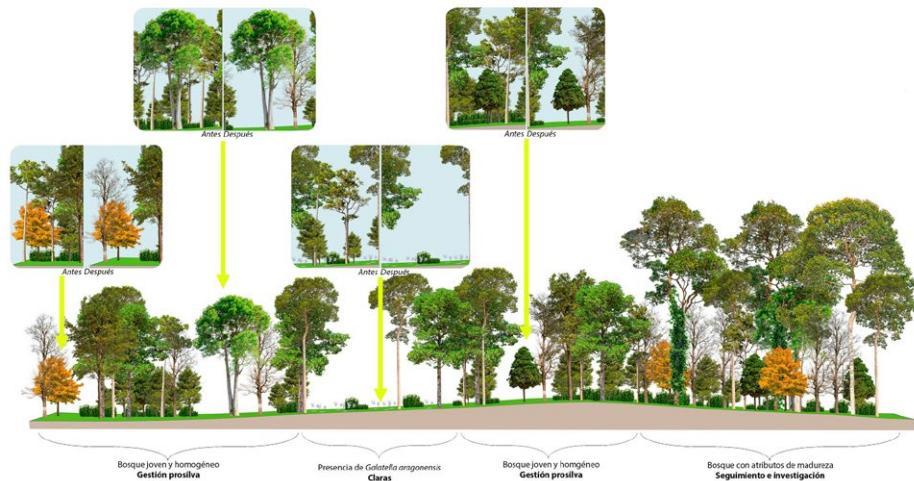
Eight public and private landowners have joined the project, contributing more than 4,000 hectares to create a resilient landscape. To this end, we have drawn up plans that regulate forest management and also incorporate the use of livestock and prescribed burning as land management tools. We have carried out demonstration projects on two farms, showcasing low-impact, low-cost forestry as a means of increasing the maturity (and thus the resilience) of forests.



Model of a resilient landscape in the Parc Natural dels Ports, showing the mosaic of ecosystems and the possible tools to be used.

Outline of the different actions planned according to the degree of maturity of the forest.

Source: Parc Natural dels Ports



In the **Parque Natural de la Sierra Norte de Guadalajara**, we carried out extensive reforestation on terraces planted with *Pinus sylvestris*, which had not been treated since they were planted in the 1970s. The clearings carried out have made it possible to reduce the enormous density of trees, open up discontinuities and favour Euro-Siberian species that are making their way into the canopy (as rowans, beeches and oaks).

In addition, we have restored mountain pastures and oromediterranean heathlands, habitats considered to be of community interest, which were occupied by a very dense plantation of *Pinus uncinata*.



In the **Comunidad Valenciana** (Valencian Community), we have selected a demonstration plot in each province, all of them in reforested *Pinus pinaster* forests that have never received intermediate treatments.

In agreement with the owners, we have cleared small areas of forest with the aim of breaking up the homogeneity of the forest mass, opening up clearings and promoting greater species diversity by freeing up competition for the deciduous trees in the undergrowth.

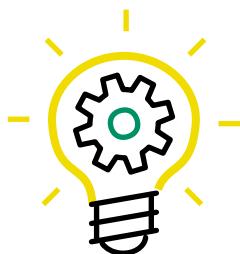
Beyond the pilot areas

Key project results



4.824 hectares with forest management plans aimed at adapting to climate change, in private and public forests.

140 hectares where we have carried out demonstration areas aimed at adaptation.

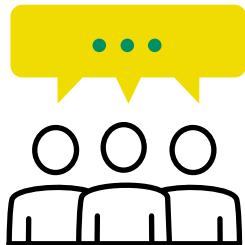


An **index** that allows for the quantitative assessment of drought risk. The index is accessible on an online platform, along with the manual and field protocols for its application.

A **guide with the criteria** to be followed for the design, implementation and evaluation of adaptation actions in forests.

A **manual for technicians and professionals**, with the scientific justification of the project and its application in the three pilot sites.





A directory with more than

1,800 contacts

related to forest management and the Natura 2000 Network, landowners and landowner associations, universities and research centres, NGOs and companies in the environmental and forestry sector.

32 technicians

from government agencies and associated public companies have participated in the **mobility programme**.

More than 100 professionals

from state, regional and local administrations, public companies and universities participated in the **four technical seminars**.

The course **'Forest maturity for adaptation to climate change'** was in high demand,

with 81 applications

for 25 places.



Transferability and exchange of information

From the outset, the project has been developed with the ambition that the tools generated will be applicable in other territories and serve as support for managers and professionals. To this end, the exchange of information and technical debate have been a constant feature through:

Four technical seminars were held with the participation of public administration managers and forest management and conservation professionals, in which the progress of the project was discussed as it unfolded.



An exchange programme, in which foresters and protected area management technicians from public administrations were able to learn about the results of the project by visiting the actions carried out in the demonstration cases.

A course in which the project's tools were applied and demonstrated in different forest areas of the Carrascal de la Font Roja and de Aitana Nature Park, in the province of Alicante.

But the project also has unexpected results such as...

- The application of the vulnerability index in the forests of Chile's Mediterranean region.
- The use of the vulnerability index to identify climate refuges in the Valencian Community.
- The use of the vulnerability index to assess the conservation status of forest habitats in the Natura 2000 Network in the Basque Country.
- The assessment of the potential of mature forest stands as climate refuges in Aragon.

Six webinars open to the general public, covering various topics such as the creation of resilient mosaics, the role of fire, silviculture for adaptation, the vision of forest ownership, and the adaptation of forests in Mediterranean Europe. The format has allowed these ideas to be disseminated to a wide audience, with an average of 200 participants in each webinar.

In addition to **attending conferences and numerous national and international events**, visits to other projects, etc.

The reality of forests in southern Europe is very different from that in the north. That is why **progress and results have also been shared at European level**, with the European Commission and the EUROPARC Federation.



webinarios RedBosques_Clima

14 febrero 2024
10.00 - 12.30

¿Es el fuego una herramienta para generar paisajes resilientes al cambio climático?

10.00 Presentación de proyecto RedBosques_Clima. José Alturi, Fundación Fernando González Benito.

10.15 Dinámica del fuego y gestión a escala de paisaje. Daniel García Nieto, Junta de Comunidades de Castilla-La Mancha.

10.45 - 11.15 Quemas prescritas como herramienta de gestión en áreas protegidas. Aitor Larrinaga, Unidad Técnica del Graf del Bosc Generalitat de Catalunya.

11.15 - 11.45 Fuego y conservación de la biodiversidad. El caso de la lantana canina. Angel Fernandez, Parque Nacional de Garrotxa.

11.45 - 12.30 Debate con los asistentes.

inscripción: webinarofuego.gr8.com

You can access recordings of all webinars in 'Knowledge Transfer':
<https://redbosquesclima.eu/>



Understanding what we do

The project has made constant use of communication to publicise its activities and results to a general audience.

The regular dissemination of the project's milestones, events and results has been achieved through:

- The website: www.redbosquesclima.eu
- The RedBosques_Clima newsletter, published twice a year
- And the dissemination of news through the social media channels of the participating entities.

The development of informative materials has enabled the production and distribution of:

- An information sheet summarising the project's actions.
- Interpretive panels installed at key points in the three demonstration cases, aimed at visitors.
- A brochure and poster illustrating the differences between a landscape that is poorly adapted to drought and one that is well adapted. In Spanish, Catalan, Basque and English.
- Two informative videos, freely accessible on the Internet, on the vulnerability of forests and possible adaptation measures
- An informative document: The adaptation of forests to climate change. Frequently asked questions.
- Articles in magazines with wide circulation in the forestry and conservation sectors, such as Quercus and Foresta





Adaptation to climate change starts now!

The end of the project is only the beginning of the work. From now on, it is time to disseminate the results, transfer the tools to professionals and promote their use.

In this regard, there are already some good prospects:

- In the Ports Natural Park, a working group has been set up with landowners to facilitate the implementation of all the measures planned on more than 4,000 hectares
- In the Valencian Community, LIFE Teixeres has used the drought vulnerability index to assess 13 stands, and action has been taken on more than 105 hectares, with coppicing to reduce their vulnerability.
- In the Sierra Norte de Guadalajara Natural Park, our adaptive forest management model and the promotion of species diversity is being extended to other public forests.
- In the Aigüestortes National Park, 300 hectares of forest are being managed with adaptation objectives in line with the criteria of the RedBosques_Clima project.





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