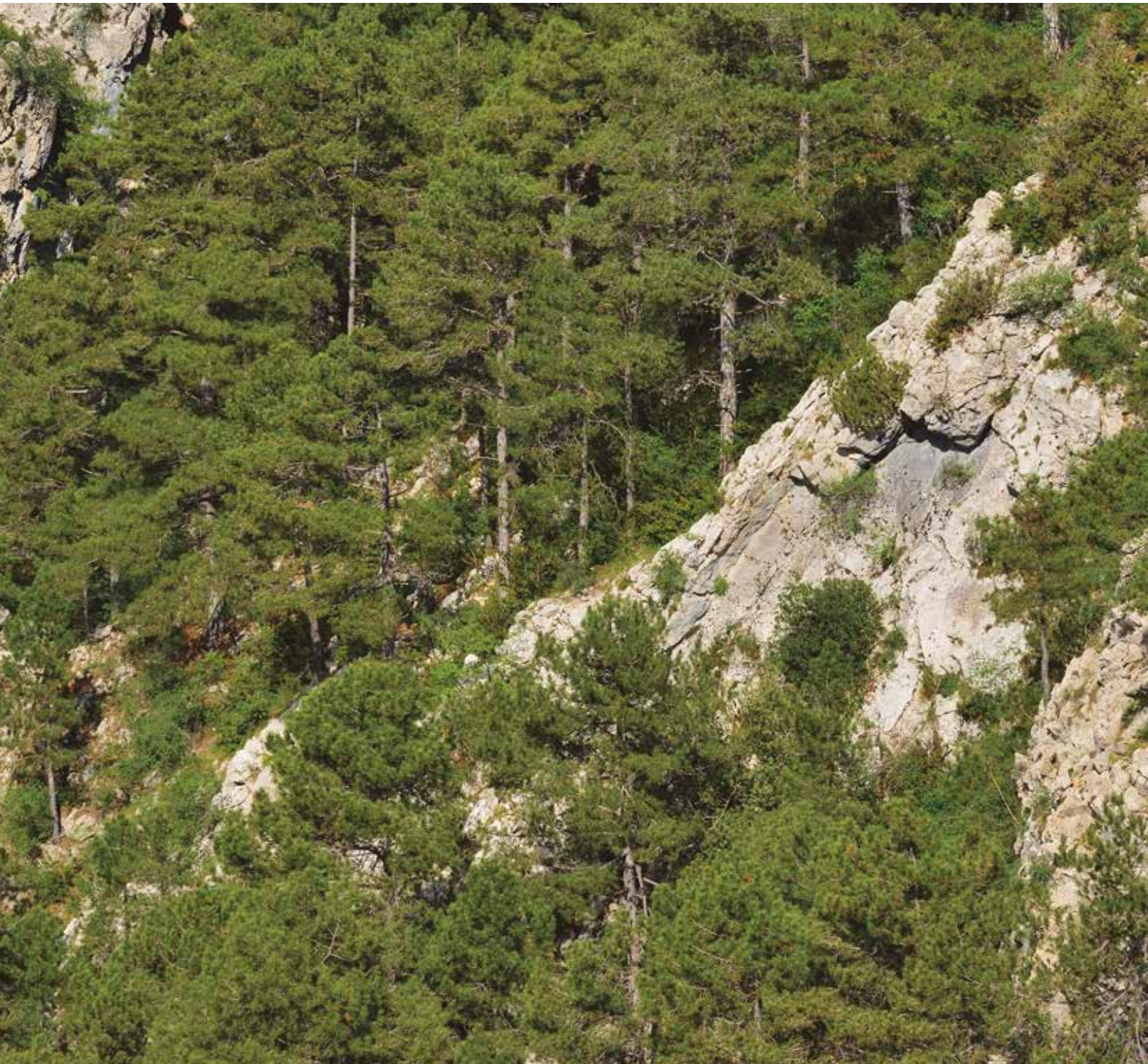
LIFE NAT13/NAT/ES/000724

Sustainable management for conservation of Black Pine forests in Catalunya

LAYMAN'S REPORT



BLACK PINE FORESTS

In the Habitats Directive, black pine forests are considered to be a priority habitat of community interest. In Catalonia, they occupy a significant surface area of 140,000 hectares (according to the 2016 forest map of Spain), 50% of which are mixed formations, with two distribution regions being distinguished: Southern biogeographical region and Pre-Pyrenean and central biogeographical region. 35% of the surface area of black pine forests in Catalonia are included in the Natura 2000 Network, as it is found in 38 Special Areas of Conservation.

Currently, black pine forests stands are in regression, particularly due to the effect of the large forest fires that have occurred in the territory in recent decades. In addition, the current structure of the forests does not promise a much better future because of the effects of climate change, with a high vulnerability to crown fires and the abundance of not very mature forests with simplified structures, which involves a biodiversity level below that which it could potentially have.

The Life+PINASSA project confronts this problem with the introduction of measures that deal with the main threats mentioned in an integrated way, while improving the state of conservation of a habitat of priority community interest. The challenge is to implement a multifunctional management that guarantees the provision of services that today's society demands.The ORGEST models for black pine forests will be applied which envisage as preferential objectives the production of wood and the prevention of forest fires, with the integration of measures to conserve and improve the biodiversity.

FOREST MANAGEMENT AND THE CONSERVATION OF THE BLACK PINE HABITAT

The forests that are structurally the most diverse offer a greater variety of features that contribute to biodiversity and favour maintaining processes that are essential for the conservation of the forest ecosystems. This kind of structure is associated with mature forests with the presence of certain features such as old trees or ones with cavities, deadwood, variety of species (arboreal and bushes), etc.

The application of certain silviculture practices enables the incorporation of some of these elements of interest into the biodiversity of forests in which they are missing or not commonly found, but that can be found in groves of a more diverse similar structure, for example in the case of deadwood or in more mature groves, such as the case of old and large trees. This enables the objectives of productive management to be compatible with the improvement of the habitat, through specifically designed measures or adapting more generic forest management measures.

In the Life+PINASSA project, groves were identified with singularities of maturity, in which the priority was conserving the natural dynamics and processes (either by leaving them to evolve naturally or by applying a management plan aimed at improving their biodiversity) and, at the same time, other groves were selected in which it was decided to make the objectives of production and/or the prevention of forest fires compatible with the improvement of the habitat.

The decision on the strategy to be applied and how to guarantee compliance with the objectives set in each case was carried out based on the information obtained from the preliminary inventories.

OBJECTIVES OF THE PROJECT

The main objective of the project is the conservation of black pine forests (*Pinus nigra*) in the face of the progressive regression of the habitat in the Natura 2000 Network in Catalonia, based on the introduction of measures that improve their current state in the mid-and long-term future.

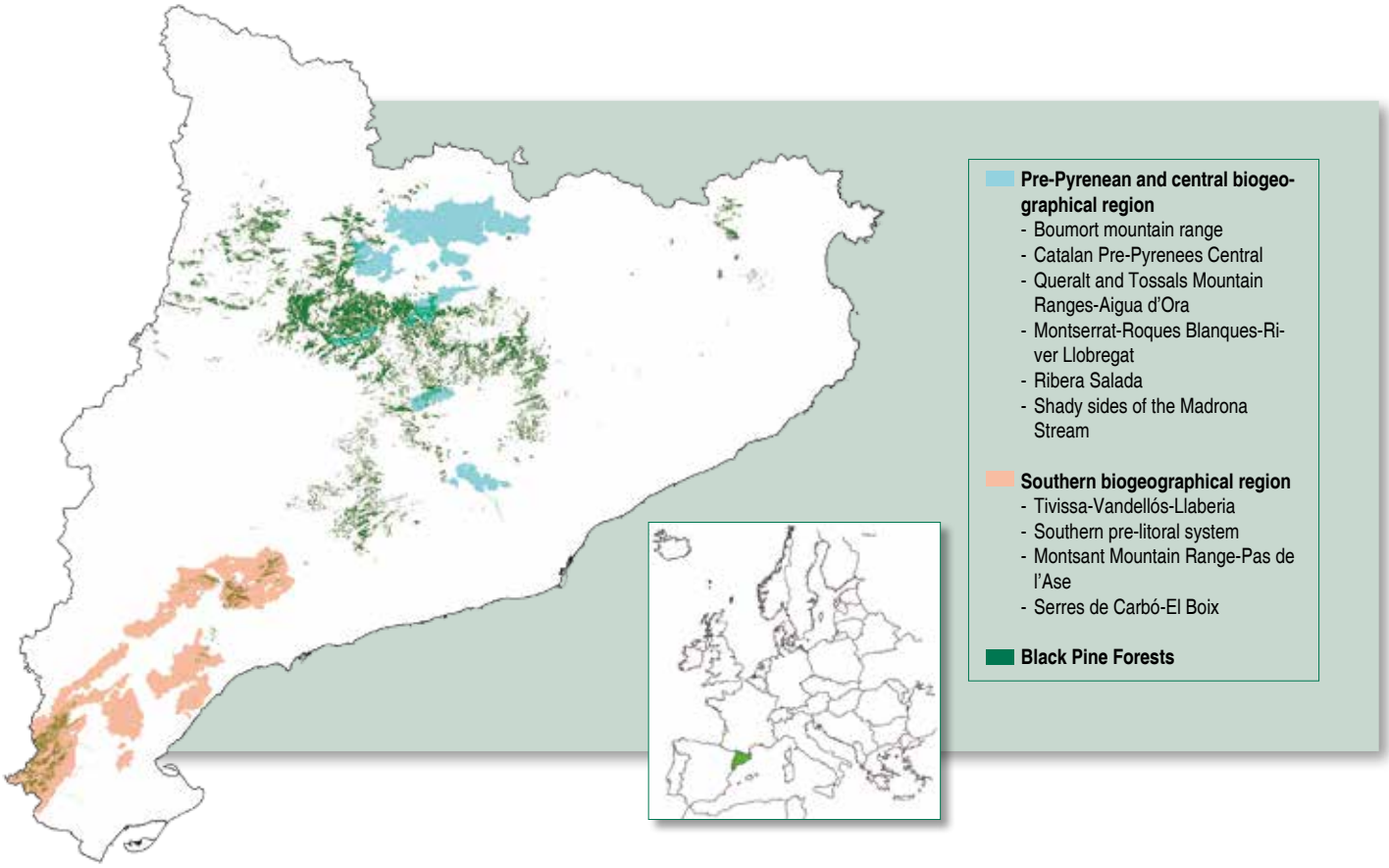
The unique nature of the conservation measures proposed involves a clear demonstrative dimension regarding sustainable and multifunctional forest management.

The specific objectives are:

- To identify masses of exceptional cultural and biological characteristics found in the black pine distribution area, to improve the stability of the habitat, the regeneration and the biodiversity, and to reduce their vulnerability to forest fires.
- To significantly improve the biodiversity of young, dense forests with a simple black pine structure, the regeneration of those that have been heavily exploited and those that have been affected by large forest fires.
- To increase the resistance and resilience (self-defence and recovery ability) of black pine forests to large forest fires and to the climate change.
- To generate and transfer plans and management tools to the forest owner and to the administrations, to make the conservation of black pine forests compatible with their productive and recreational functions.
- To contribute towards the solving of conflicts between the various functions of black pine forests: productive, environmental and social.
- To disseminate information about the Natura 2000 Network, the environmental values and the sustainable management of forests at schools and to the general public.

WORK AREA

Groves were identified with different problems distributed between 10 SACs (6 in the pre-Pyrenean and central biogeographical region and 4 in the Southern region). In all, it has had an impact on 457.03 hectares, distributed into 61 groves, in which important work to characterise the forests and their biodiversity was carried out. This initial diagnosis enabled the functions and objectives of each grove to be identified, and to define the measures to be introduced where they were necessary. In all, some kind of silviculture operation was carried out in 283 hectares (53 groves).



PROJECT CONSERVATION ACTIONS

The measures developed deal with main problems and threats to the habitat in an integrated way.

VALUE OF SINGULAR HABITATS AND CONSERVATION OF FOREST ADAPTED TO THE NATURAL REGIME OF FIRES

It includes groves with specific characteristics of maturity that require specific conservation management

1. Conservation of unique groves

174 hectares of unique groves were selected with the aim of allowing them to evolve naturally, notwithstanding the fact that in certain cases, when technical conditions so recommended (lack of heterogeneity, problems of competence or lack of regeneration) treatments to improve them were carried out. In 24%, treatments were made to improve the conservation of the habitat and the rest were left to evolve naturally according to information obtained from the preliminary inventories.

The main measure carried out consisted of the improvement of the biodiversity through the creation of standing (through the girdling of living trees) or fallen (generating trunks and high stumps) deadwood. In some specific cases, selective cutting was done and in one of the groves there was selective clearing to free up some tree bases of special interest (oaks, large black pines, etc.).

In public forests, authorisations or collaboration agreements were signed, while in the private ones three rental contracts were signed for a period of 25 years, during which the owner guarantees to preserve the forest.

A Plan of public use of unique forests was put together with the aim of regulating the affluence of visitors and permitting their scientific and technical follow-up. The proposals of this Plan are aimed at getting to know the initial situation of the grove, minimising the affluence of visits and decreasing their impact. Therefore, and based on the characterisation, the forests that could form part of the circuits of general social use, the groves which can be accessed through guided tours and those that are restricted to just technical and scientific visits were differentiated. In all the cases, this plan was agreed on with the owner.

2. Conservation of adult forests adapted to the natural forest fire regime

To favour the conservation of black pine forests adapted to the natural forest fire regime, measures were used to emulate the natural dynamics of low-intensity natural forest fires through prescribed burns. This technical operation permits a low-intensity fire to be developed even in groves in which the accumulation of bushy plant life would have favoured a more intensive fire had it occurred fortuitously.

This measure was carried out on 34.14 hectares of black pine forests in the southern area with signs of maturity, where indications of the action of natural forest fires were found and, in some cases, with a fuel load in the lower strata that could condition the survival of the species in the case of a natural or anthropic fire.

Some of the groves adapted to the natural fire regime coincide with singular groves. In these cases, prescribed burns were carried out as well as treatments to improve the biodiversity (creation of standing and fallen deadwood).

The prescribed burns allowed the preservation of the characteristics of adult structures adapted to a natural fire regime to be advanced and to improve the conditions to avoid the loss of these adult structures of high ecological value due to a forest fire. At the same time, the measures helped to deepen knowledge about the relationship of fire and black pines to be able to establish management bases that integrate the perturbation of fire by this species.

All prescribed fires were planned and executed by specialist technical staff from the Fire Brigade of the Catalan Government (GRAF).

IMPROVING THE HABITAT, STRUCTURE AND BIODIVERSITY IN AREAS WITH YOUNG, VERY DENSE, MONOSPECIFIC STANDS, IN MORE MATURE STANDS WITHOUT REGENERATION AND IN UNSTRUCTURED, UNEVEN-AGED STANDS

136 hectares of black pine forest were selected that had structural problems (young dense masses, adult masses without regeneration and unstructured, uneven-aged stands) and the measurement of trees and forests, faunistic, floristic, deadwood and cavity and other inventories were done which enabled each grove to be characterised in detail and to define the necessary measures in each case.

The measures to alleviate these problems were focused on the introduction of the ORGEST models that integrate the objectives of wood production and fire prevention. The silviculture measures applied were low and mixed thinnings (in even-aged young stands), regeneration

cuts (in even-aged adult stands) and selection cuts for young forests (in masses with some irregularity). In groves that are most vulnerable to crown fires, selective thinnings was also applied to reduce the vulnerability to fire. These interventions were complemented with measures to promote features of value for the biodiversity such as maintaining broad trees and trees with cavities for natural evolution, generating high stumps, standing deadwood and fallen deadwood, as well as the conservation of living trees with unique features or micro-habitats (cavities, nests, dead branches in the crowns, moss, tree stump fungi, etc.), to respect the vertical stratification of the plant life (e.g. ivies), to favour an distribution of oak trees and other leafy trees, taking into account the presence of threatened or protected flora and fauna populations, etc. Refuge boxes for bats, in particular for Barbastelle bats and Bechstein's bats (Annex II of the Habitats Directive) and other threatened forest species. At the same time, favouring bats may have a positive effect on the biological fight against the pine processionary caterpillars. The intensity of these measures was adapted to the characteristics of each grove.

The silviculture operations resulted in the improvement of the conditions for the growth of the forest which it is hoped can lead it towards a status of structural maturity (young stands and uneven-aged stands), promoting natural regeneration (mature stands) and the reduction of fire risk and the increase in the resistance and resilience against climate change. In the long term, it is hoped that an improvement in the structural heterogeneity and the composition of the stands, of the ecological complexity and of the biodiversity of the forest can be improved.

EVEN-AGED YOUNG STAND

MATURE EVEN-AGED STAND

UNEVEN-AGED STAND

RECOVERY OF THE HABITAT IN AREAS AFFECTED BY LARGE FOREST FIRES IN WHICH A GRADUAL REPLACEMENT OF THE MAIN SPECIES IS TAKING PLACE WITH OAKS, ALEPPO PINES AND SCRUBLAND

32 hectares affected by large forest fires during the 1990s were selected, in which black pine had previously been the dominant species. Based on the characterisation of these groves, the measure was planned on 18 hectares.

The measures proposed sought to remove competition, both in terms of bushes and trees and to increase the regeneration capacity of the black pine through facilitating the access of seeds to mineral soil, with the one-off support of sowing and planting. To do this, selective cutting was carried out, cuttings of Aleppo pines and the selection of holm oak sprouts, the planting of 3,000 black pine trees and the sowing of 4 kilos of seeds.

The final result of this measure was the regulation of the competence, over the previously existing natural generation, soil preparation to welcome new natural regeneration and the introduction of new regenerations (sowing seeds and planting saplings) to complement the existing ones.

TO IMPROVE THE VULNERABILITY AND BIODIVERSITY IN STRATEGIC MANAGEMENT POINTS (SMPs) TO REDUCE THE RISK OF LARGE FOREST FIRES

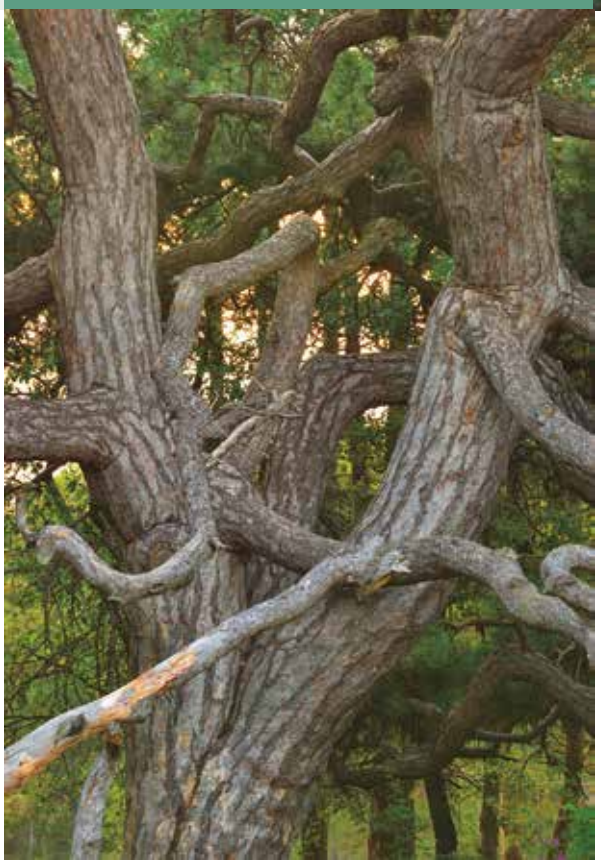
The Strategic Management Points (SMPs) are key places that condition the movement and scope of fires at a territorial level and that enable the firefighting system to concentrate resources in a safer and more efficient way. At a landscape level, the planning of the SMPs allows landscapes to be constructed with structures and patterns of spatial distribution that contribute to making it difficult for active crown forest fires to propagate and facilitating the extinction of forest fires.

Within the context of the Life+PINASSA project, the specialist technical staff of the Fire Brigade of the Catalan Government (GRAF) selected 81 hectares situated in SMPs. Managing to achieve structures with low vulnerability to crown fires in the selected SMPs allows the risk of Large Forest Fires (LFFs) to be reduced in black pine habitats in the Queralt and Tossals Mountain Ranges-Aigua d'Ora, the shady sides of the Madrona Stream, Tivissa-Vandellòs-Llaberia and the Southern Pre-Littoral System SACs.

To reduce the vulnerability to fire in the groves situated in SMPs, measures aimed at breaking the horizontal and vertical continuity of the mass were applied. Depending on the characteristics of each grove, the measures carried out consisted of clearing the lower parts, selective cutting and/or prescribed burns. Measures to promote valuable features for the biodiversity were also integrated.

In all the cases, the measures managed to reduce the initial vulnerability of the mass, to create structures that were more resistant to the passage of fire and that facilitated forest fires being extinguished.

ECOLOGICAL MONITORING OF THE CONSERVATION MEASURES



To characterise the various forest structures and carry out an ecological follow-up, a series of biodiversity indicators and components were selected. Among the indicators, the structure of the tree canopies were inventoried, along with the covering of the various plant life strata, the deadwood and the cavities in trees. As notable components of biodiversity, threatened flora, butterflies, the ground-dwelling fauna, birds and bats were selected. Therefore, the 61 stands included in the project were characterised and monitored with 119 permanent inventoried plots and 21 points of expert estimation. The permanent plots allow for the long-term follow up on the changes in the forest structure. 75 transect were carried out to follow up on the deadwood and the cavities. As far as the biodiversity indicators are concerned, 118 bird listening stations were established, 10 stations for capturing butterflies and moths (1 night per station) and 10 stations for recording the ultrasounds of bats (4 nights per station). One night was also spent catching bats. In addition, in the groves used for the prevention of fires located in the SMPs, a specific monitoring was carried out on the fuel loads to make a model of the vulnerability of the forest to forest fires. Models allow fires of diverse characteristics to be simulated to evaluate the importance of the vegetatopm characteristics in the behaviour, propagation and intensity of fire and, at the same time, to evaluate the effectiveness of the forest measures. In prescribed fires, the effect of the fire on the bird community and the

ground-dwelling macroinvertebrates was also analysed.

These measures were carried out at the beginning of the project to characterise the groves, after the intervention to evaluate the measures, in the case of forest inventories, a year after in the case of sowing and planting and two years after the measures to evaluate the response of the bioindicators. In addition, complementary inventories were taken for certain measures: follow-up on natural regeneration, follow-up on induced regeneration, follow-up on the mortality of the sowing and planting and follow-up on the prescribed burns and how they affect the woodland.

MONITORING TREE STANDS

This monitoring enabled the introduction of the silviculture measures applied to be evaluated and to measure the response of the stand to the short-term measures.

With respect to the result of the measures, in general terms, the parameters (tree density, basal area, understory coverage, etc.) adapted correctly to the design of the interventions, in such a way that the forestry measures applied meant an improvement to the structure of the stands.

The most substantial change is detected in the structural vulnerability to crown fires. Overall, before the measures, the structures were classified as high-or medium-vulnerability. After the measures, they became low-vulnerability structures, although the tree residues add some vulnerability to the structure. Two years after the measures, the low-vulnerability structures are still more abundant mainly due to the compaction and decomposition of the remains. In contrast, the control areas continue with high-or medium-vulnerability structures.

From top to bottem: Grove C3.03 before, after and two years after the measures.

It should be taken into account that the effects of the measures take place progressively, meaning that a longer-term follow up is able to detect more marked changes in growth, vitality and regeneration.

In any case, within the two-year period, increases in diameter and basal area are observed that are significantly greater in the groves that were treated than in the control areas, particularly in the case of regularised adult forests.

In the plantations in areas affected by large fires, there was a 51% survival rate of two-year-old saplings. Mortality was high due to the drought in the spring-summer of the year in which they were planted (2017), with greater survival in areas with less sunlight. The experimental seed sowing under the coverage of the black pine groups was not successful due to the depredation of seeds and the effects of the drought, showing that it is not an efficient method, and too greatly exposed to weather conditions. In contrast, it is estimated that the regulation of the competence of the understory carried out under the crowns of the adult black pines could be an effective method to facilitate their regeneration in years with good seed production.

MONITORING BIODIVERSITY FEATURES

1. Deadwood

This variable is associated to a natural dynamic and a high degree of maturity. It contains a large part of the typical biodiversity of mature forests. Therefore, the abundance, quality and associated biotic elements were estimated.

Deadwood is abundant in various forest structures, whether standing or fallen, and in various stages of decomposition. Singular groves do not stand out with respect to the number of deadwood units, but in terms of volume, which indicates that the deadwood units are larger, with a predominance of standing deadwood (Figure 1).

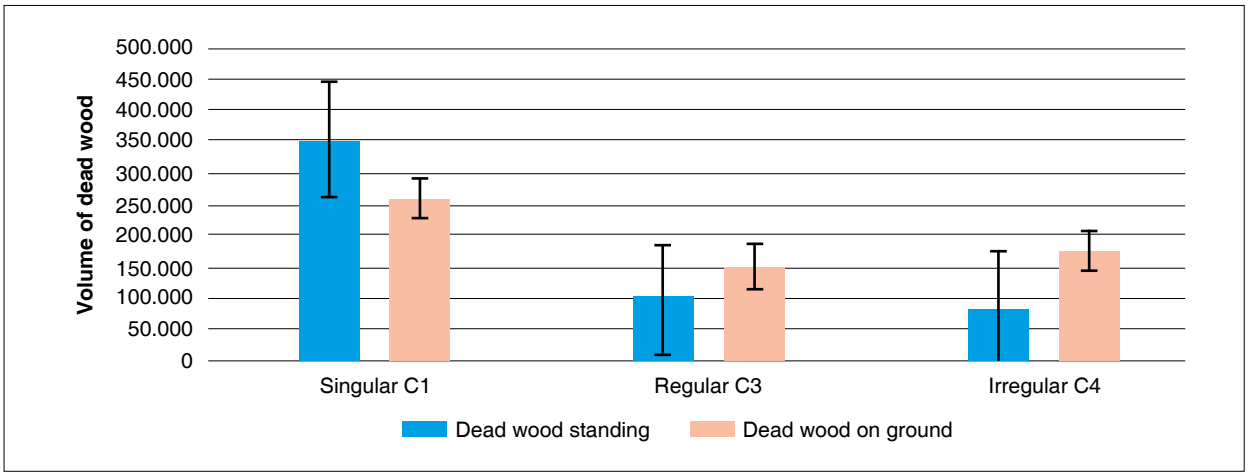


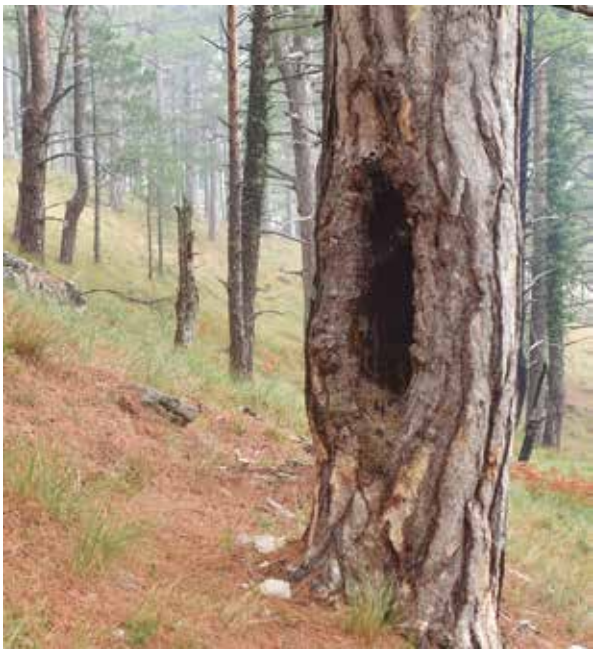
Figure 1. Kilometre index of abundance (number of units per kilometre) of deadwood in different structures (C1: singular masses, C3: regular mature masses, C4: irregular masses).

Most of the deadwood had been colonised by various organisms: 66% were fungi, lichens and/or moss and 17.8% had signs of invertebrates. The 16.2% that did not have biome were very recent deadwood or dry deadwood.

In the groves in which a shortage of deadwood was estimated in comparison with forests of a similar structure a certain amount was generated, with a minimum of 20 centimetres of diameter being normal to favour the colonisation by fauna, both standing and fallen. After a year, they showed signs of colonisation by fungi and invertebrates.

2. Tree cavities

Tree cavities are essential for forest wildlife which uses them as a microhabitat (invertebrates), a refuge (mammals) and for nesting (birds). Cavities suitable for birds and bats are significantly more abundant in singular groves and tend to be found in the thickest trees (Figure 2). All the cavities that were found during the forest work were respected. The standing deadwood generated can offer new cavities once the bark cracks and the woodpeckers excavate their nests.



3. Flora

Threatened plants and those of biological interest were identified in groves in all the measures of the project (Figure 3). Their abundance responds to conditions of plenty of light (many species are found in forest clearings and meadows) and the presence of rocky outcrops, rather than the maturity of the woodland. It was only in groves that had been fragmented by fires that there was a significantly lower abundance of threatened plants (Figure 4).

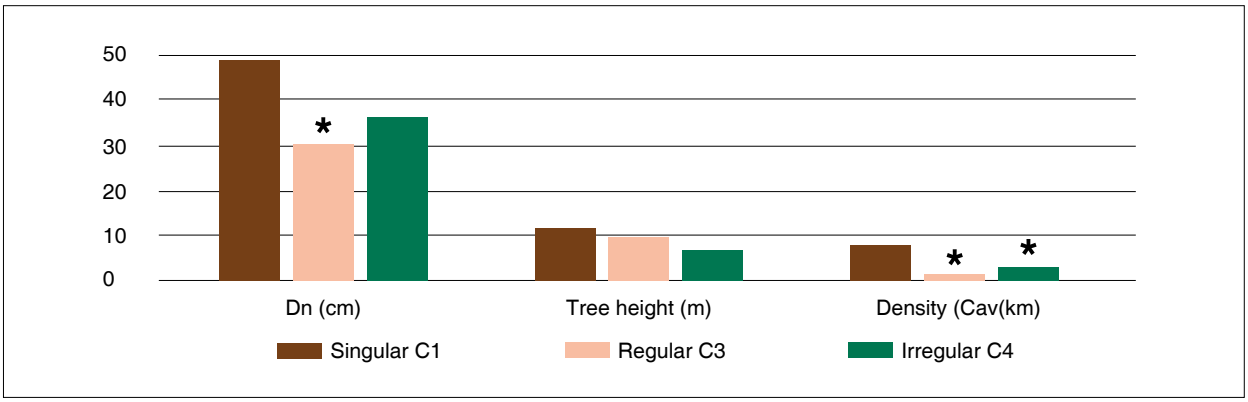


Figure 2. Estimated density of cavities per forest structure (C1: singular masses, C2: regular young masses, C3: regular mature masses, C4: irregular masses, C5: masses affected by fires C6:SMP).

Figure 3. The common or the garden peony (*Paeonia officinalis* subsp . *Microparpa*), a rather unusual flowering plant in Catalonia and typical of the clearings in sub-Mediterranean black pine forest.

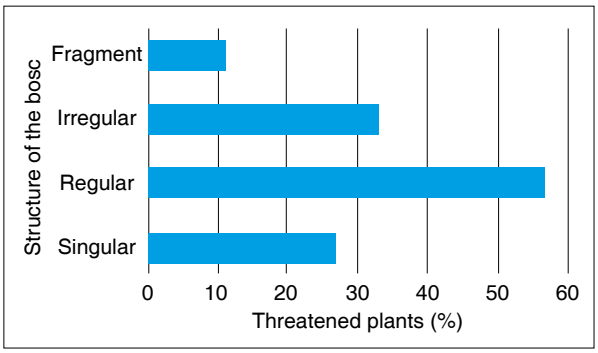


Figure 4. Average of threatened plants and those of special interest according to the structures of the massas (C1: singular masses, C3: regular young masses, C4: irregular masses, C5: masses affected by fires C6: SMP. C7: adult masses adapted to fire).

4. Fauna

Birds

Climbing birds, those that climb up tree trunks, are good indicators of the maturity of the forest. Highly significant differences were observed in their abundance between singular groves and the rest of the forest structures that were less mature (Figure 5).

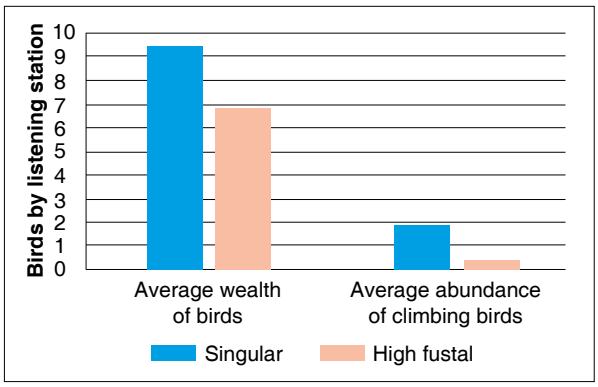


Figure 5. Average richness in species of birds and average abundance of climbers in singular groves and the other groves.

Bats

Up to 10 species of bats were detected in black pine forests, of which four are tree dwellers. The activity of the general species did not differ between structures, while tree-dwelling bats were more active in the singular forests (Figure 6). It could be deduced that general bats, that hunt in forest areas as well as in open fields, do not discriminate between structures of greater or lesser maturity. The species may take refuge in tree cavities, but they mainly frequent coves, fissures in rocks and buildings. To the contrary, the forest specialists mainly use tree cavities as a refuge. A notable piece of information is that the first case of breeding in Catalonia of Bechstein's bat (Myotis bechsteinii) was confirmed, which usually take refuge in old woodpecker nests (Figure 7).

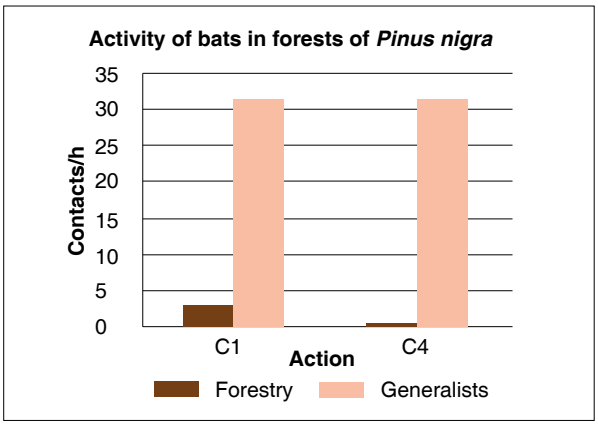


Figure 6. Richness of bat species and the activity of different black pine structures (C1: singular masses, C4: irregular masses).

Figure 7. Female Bechstein's bat caught in a grove in the Shady of the Madrona Stream.

Saproxylic Coleoptera and ground-dwelling invertebrates

Signs of Saproxylic insects (perforations and galleries) were found in 26% of decomposing wood, 84% of which was in mature groves. The community of ground-dwelling invertebrates is highly diverse, with 17 identified orders, with the greatest occurrence of Diptera (36.54%), Hymenoptera (27.12%) and Coleoptera (11.58%). Of the latter, more than 60 species were determined (distributed into 25 families), about some of which there is a shortage of information on an Iberian scale. It was verified that the entire community of ground-dwelling macroinvertebrates had recovered a year after a prescribed burn. Nitidulidae Coleoptera increased after the fire, probably favoured by the increase of decomposing plant remains, on which they feed (Figure 8).

Figure 8. Phenolia picta, *Nitidulidae Coleoptera* in a grove of Tivissa-Vandellòs-Llaberia Mountain Ranges SAC, caught after a prescribed burn. Font: www.flickr.com.

Moths

In all the black pine forests a total of 2,741 specimens of 257 species of moths or Heterocera were found (Figure 9). Two of the species were catalogued for the first time in Catalonia. A greater percentage (in terms of abundance and number of species) was detected in groves with a greater heterogeneity of plant life. The abundance and, in particular, the wealth of species is clearly higher in extensive forests than in small forest islets that survived the large forest fires.

Figure 9. *Graellsia isabellae*, a characteristic moth found in sub-Mediterranean Iberian pine forests.

COMUNICATION AND DISSEMINATION ACTIONS

Edition of a leaflet to present the project.

One of the project priorities was the transfer and dissemination of the conservation measures carried out in the context of the Life+PINASSA project and their results. Throughout the project, the following communication and dissemination measures were introduced:

- The setting up of 17 informative panels in different sizes and formats based on their function and location.

- Edition of a leaflet to present the project.

- Technical training through the organisation of 6 transfer conferences and training university students and agricultural recruitment schools doing practical work experience, as well as the presentation of a degree thesis and two master's theses.

- The publication of 31 communication and dissemination articles in digital press and 17 in written press. There was also a press conference to present the project.

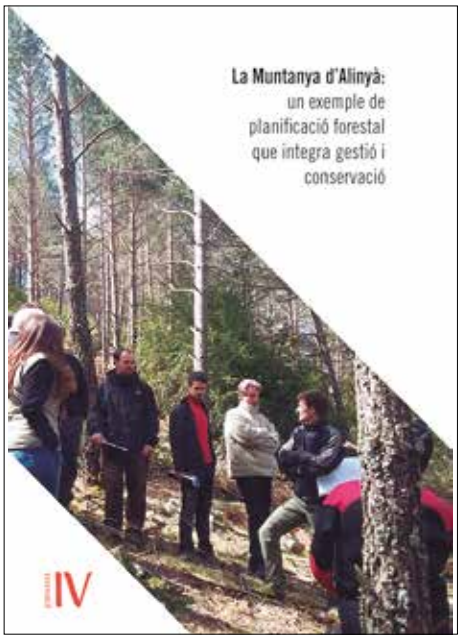
LA VANGUARDIA

Un proyecto de la UE quiere recuperar el pino negral en Catalunya

- Ongoing dissemination on the project website (http://lifepinassa.eu), on the social networks (Twitter and Facebook) and on YouTube.

- Presentation of 10 scientific and/or technical communications at seven events (3 international and 4 national).

- Publication of 6 technical articles in journals specialising in the forest sector.



- Publication of 4 handbooks and informative technical guides:

  - Manual de bones pràctiques de gestió per a la conservació dels boscos de pinassa. (Best Management Practices handbook for the Conservation of Black Pine Forests)

  - El paper del foc en la conservació de l'hàbitat dels boscos de pinassa. (The Role of Fire in the Conservation of Black Pine Forest Habitats)

  - Manual de caracterització i conservació de rodals singulars de pinassa. (Handbook for the Characterisation and Conservation of Singular Black Pine Groves)

  - Libro divulgativo de conciliación de la gestión forestal y la conservación de la biodiversidad. (Informative Book on Balancing Forest Management and the Conservation of the Biodiversity).

- Publication of an "Education al dossier" aimed at schools.

FINAL MESSAGES

- **T**hanks to the Life+PINASSA project, there has been an impact on the conservation of the black pine habitat in 457.03 hectares distributed among 10 SACs in 2 different biogeographical regions.

- The improvement of the state of conservation was carried out by establishing agreements with the owners to guarantee their conservation, the detailed characterisation of the groves and the follow-up on the evolution of the biodiversity over the long term, carrying out silviculture measures and the dissemination of the results.

- The conservation of a black pine habitat with singularities of maturity can involve the application of management aimed at improving its biodiversity or the commitment to leave it to its natural evolution.

- In black pine forests with a strict conservation vocation, the regulation of its social use requires special attention.

- The ORGEST models were a basic tool to achieve the improvement of the conservation of the black pine habitat as they are multifunctional models (that now include the integration of the objectives of wood production and fire prevention) to which one-off measures can be added to also integrate the conservation or improvement of the biodiversity.

- The conservation of the existing biodiversity in a grove can be combined with a productive management without this involving great changes in the silviculture measures or involving a significant loss of income.

- The main elements to be valued for the biodiversity that need to be conserved or boosted to favour the welcoming ability of a grove's biodiversity are the accompanying species, the large trees, the standing and fallen deadwood, and trees with singularities or microhabitat such as the presence of cavities (made by woodpeckers, rotten trunks, fallen bark or cracks in the wood acting as a refuge), deadwood in the crowns, lightning or fire damages, fresh flows of sap or fresh resin, fungi or canker diseases, ivy and other lianas, mistletoe, mosses and lichens, or nests, particularly those of birds of prey and other protected species).

- Depending on the development stage in which a grove is found (whether it is younger or more mature) it will have a structure that is better or worse for encouraging biodiversity. Thanks to silviculture, we can advance the appearance of some of the previously mentioned features, particularly in the more mature

stages, such as girdling trees to generate standing deadwood.

- In the integration of biodiversity at a stand level, the surrounding environment also needs to be considered. The valuation of the biodiversity at a stand-scale and at a landscape scale allows one to evaluate and prioritise where the conservation efforts should be focused. For example, depending on the distribution of the threatened species of flora and fauna or depending on the age of the grove.

- Taking into account the effect that Large Forest Fires (LFF) have had in the past on black pine forests, the identification of the SMPs and the application of silviculture measures aimed at reducing the vulnerability to fire of these forests is a key feature to guarantee the conservation of existing black pine habitats. These measures are compatible with the improvement of the biodiversity as long as they suitably adapt the amount of deadwood to be left, the percentage of understory to be respected, the presence of threatened edaphic flora and fauna populations or those of any other special kind of interest, etc.

- Fire of natural origin is a feature that is integrated into the development of certain black pine forests, meaning that the emulation of this kind of low-intensity fire through prescribed burns favours the regeneration and decreases the risk of Large Forest Fires.

- In degraded areas which are repeatedly affected by fires and with the black pine masses in a precarious state, help is required with regeneration (sowing, planting, cutting and/or clearing) to maintain and improve the state of this habitat. In each case, the most efficient method must be evaluated.

- The dissemination of the concept of integration of the conservation of the biodiversity and the production of wood with the forest owner is a basic feature to guarantee the conservation of the black pine habitat. It must also have an impact on the training of forest operations staff.

- Environmental education is a powerful tool to guarantee the general public's understanding, and in particular that of schools, of the problems that affect the black pine habitat and to seek their involvement/understanding in the application of the proposed solutions.

FUTURE CHALLENGES

- To guarantee the conservation of the groves that are part of the project through the follow-up on floristic and fauna features, vulnerability to fire, evolution of the regeneration and of the deadwood, etc.
- To maintain the proven value of black pine groves with greater potential.
- To boost the replicability of the solutions proposed in the project through the introduction of conservation measures in other groves and in other forest habitats.
- To promote the introduction of management models that integrate production with fire prevention and maintaining and favouring the biodiversity in private forests.
- To continue disseminating the results obtained.

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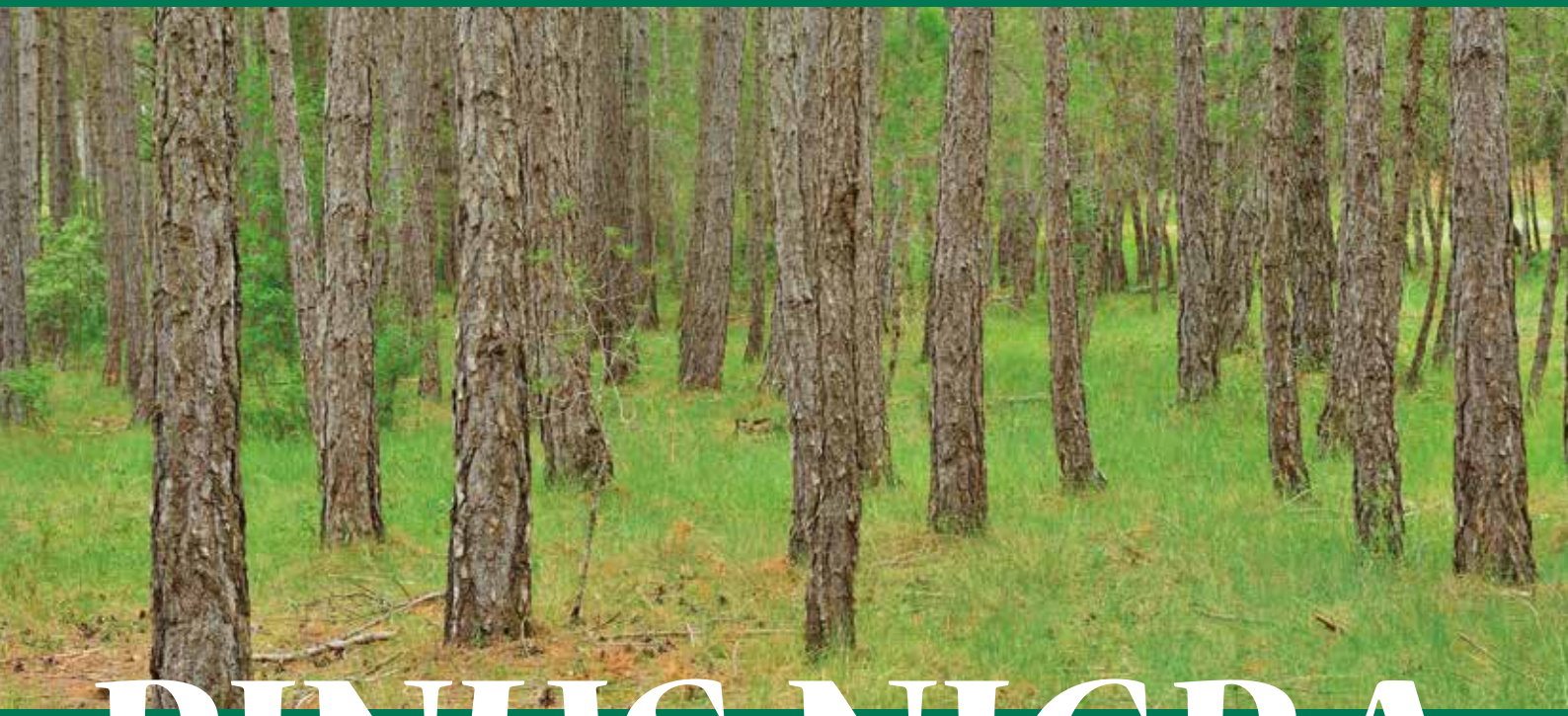

PINUS NIGRA

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