



Silvopastoral Management to preserve biodiversity and prevent major forest fires



Life Montserrat Project

LAYMAN report



Introduction

Landscape and biodiversity, a successful dual approach in the Mediterranean

The mountain areas in the Mediterranean have a long history of human settlement and activity. Their ecosystems and landscapes have evolved over centuries in conjunction with the presence of humans. Via a combination of agriculture, extensive livestock farming and forestry, this has led to the development of a characteristic landscape: a mosaic of agricultural land, forestry and pasture, comprised of scattered areas of woodland, fields and pasture, varying greatly in size. These provide a succession of transitional areas that contribute such great diversity to the system that today we associate the agriculture-forestry-pasture mosaic with the highest levels of biodiversity in the Mediterranean. Beyond its environmental value, this combination of landscape and nature also has significant social and economic importance. Over the years people have come to identify culturally and aesthetically with these actively managed and well-tended landscapes, seeing them as desirable and strengthening the links between the land and its occupants. A good balance between human activity and natural values and the landscape is essential for the future of any region, and the agriculture-forestry-pasture mosaic is a good example of this.



Situation at the start of the project

Thirty years on from the serious fires that damaged Montserrat and environs in the late twentieth century, the area that was burnt has now been occupied by a **continuous swathe of regenerated Aleppo pine forest**. The high density of this regenerated woodland, with over 50,000 pines per hectare in many cases, imposes serious limits on biodiversity and, because of excessive competition, leads to stunted growth and delays in reproduction. In the event of another fire, such delays could inhibit the natural regeneration of the trees and endanger the survival of these woods.

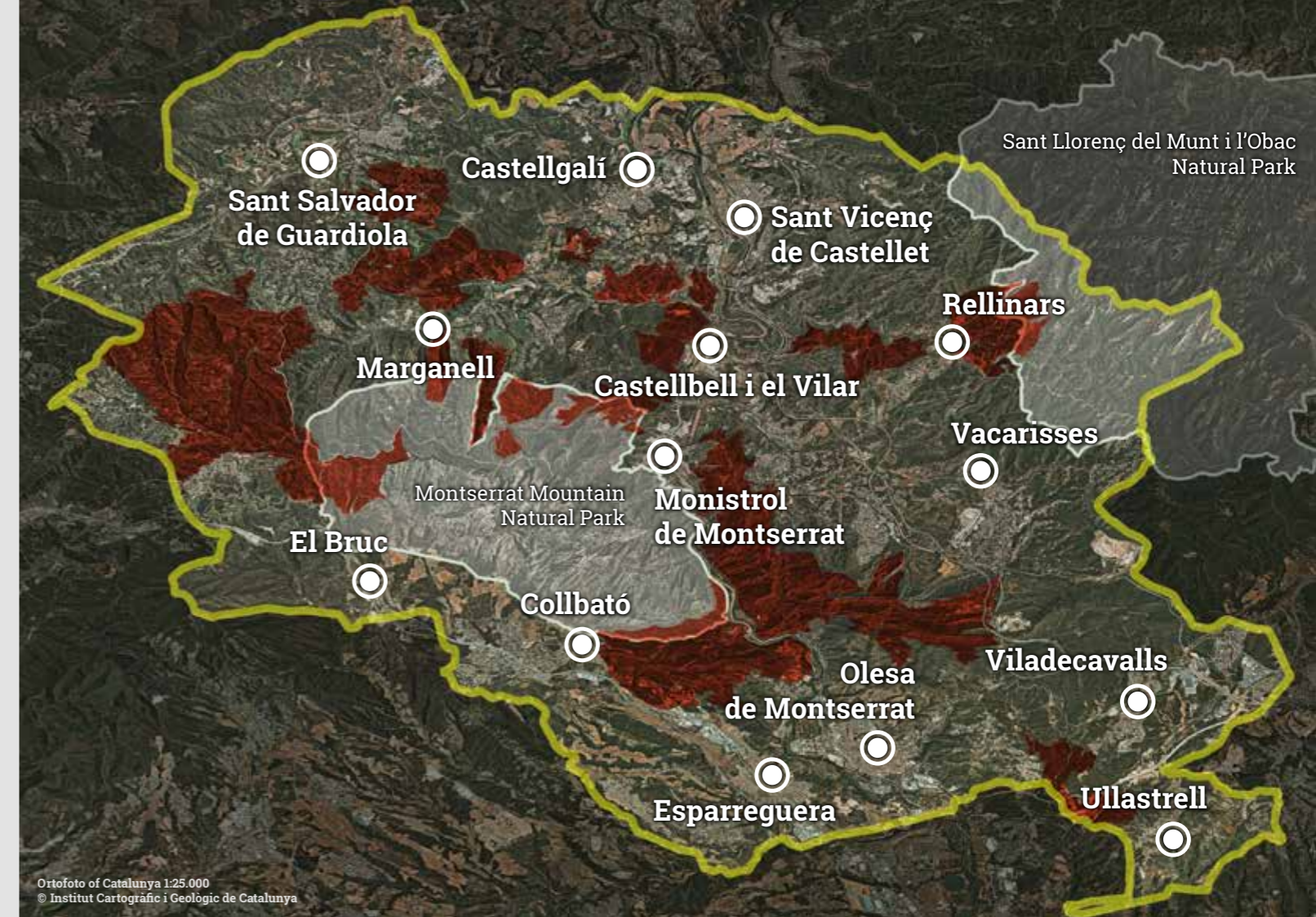
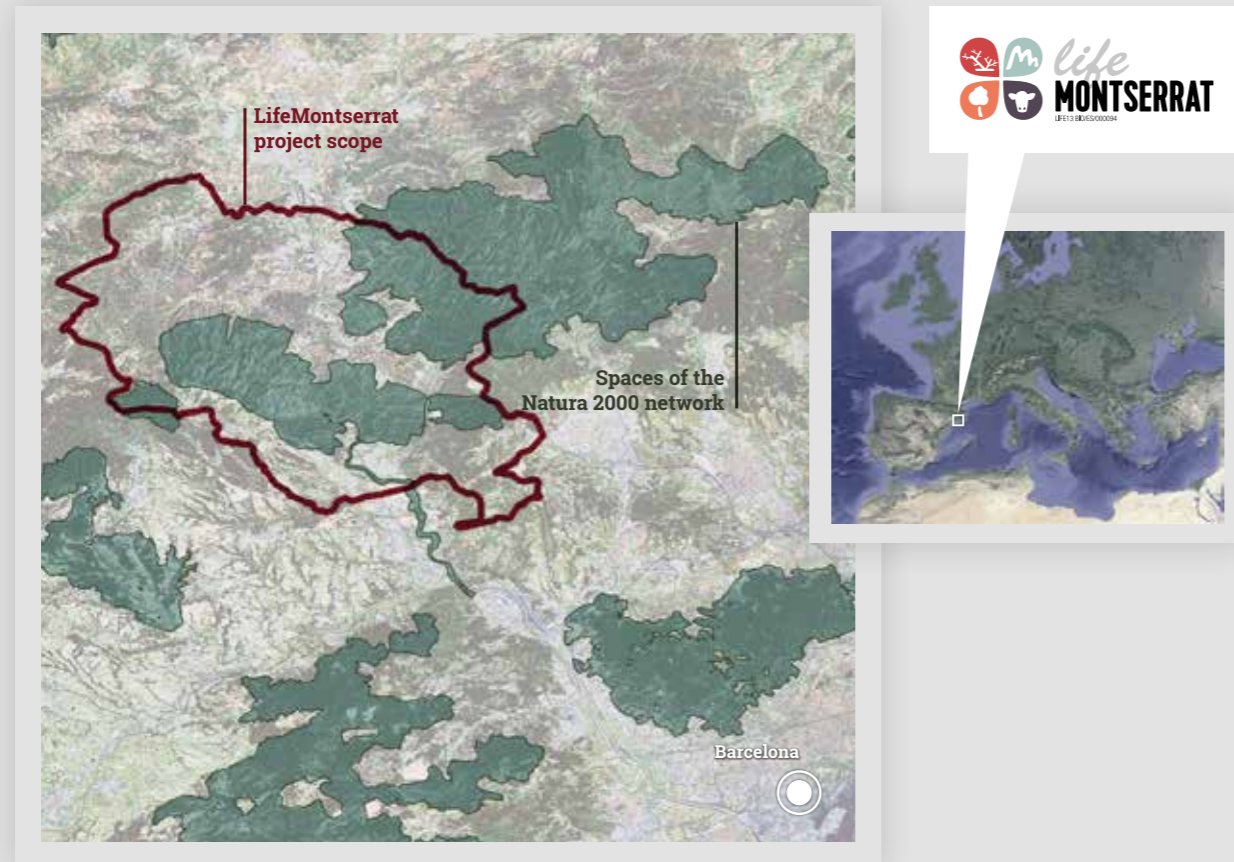
Land management has been seriously neglected due to the **decline of traditional agriculture and livestock farming** (which is in danger of disappearing not only in the area covered by the project but also throughout





the Mediterranean), leading in turn to the continuing spread of woodland at the expense of fields and pasture. We therefore need to seek new formulas to recover the mosaic which traditional land management provided. The alternative is an increasingly uniform region, with no breaks in woodland cover and the progressive accumulation of fuel in the form of biomass. **This scenario is poor in terms of biodiversity and very vulnerable to major forest fires**, especially in the current context of climate change, with heat waves and prolonged, intense droughts anticipated. Overall, it constitutes an unacceptable risk and calls for a management model based on preventive action, like that proposed by LIFE Montserrat.



The Life Montserrat project

LIFE Montserrat has created a green infrastructure to protect against major forest fires and help to conserve our natural heritage in 14 municipalities around Montserrat. The project has concentrated on areas which are strategically placed for fire prevention, as determined by the Government of Catalonia fire service. In these areas the density of trees has been reduced, there is less combustible material and **the structure of the forest has been improved**. New **open areas** have also been created and work done to recover agricultural land with a view to restoring a mosaic landscape that is highly resilient to fire with a greater variety of habitats and species. The balance of this new landscape is maintained by the **use of livestock**, with the progressive introduction of herds of cattle, goats and donkeys which will graze extensively.



-  14 municipalities involved in the project
-  3.000 ha of strategic areas in which project actions will lower forest vulnerability to wildfires
-  Over 32.000 ha of land that will benefit from the project's actions
-  2 Natural Parks within the project area

Main project measures

Restoration of woodland

One of the project's main conservation measures has been the management of densely growing regenerated Aleppo pines. Basically, woodland has been cleared to **reduce the density of these trees** to 1,000 per hectare. As a result, the trees mature earlier and the structure of the wooded area is similar to that of an adult pine wood, substantially **improving the habitat** for various types of flora at shrub and grassland level and increasing the diversity of fauna. The **increased production of pine cones** after clearing facilitates the regeneration of forest mass in case of new disruptive events, such as a fire, which is essential for ensuring the long-term survival of woodland.

Results

During the project, work on woodland restoration was carried out in an area exceeding 1,300 hectares. This amounts to some 350 hectares per year, three times the area restored annually before the LIFE Montserrat project.



Recovering open areas

Open areas play a key role in the project. They are decisive for **biodiversity** in Mediterranean locations like Montserrat, as they are the main habitats of many species. They also contribute to **fire prevention** as they provide a break in wooded areas and hinder the spread of fire. And they are indispensable for **feeding livestock**, as they allow grass to grow, thus contributing to the viability of the livestock farming linked to the project.

Open areas have been recovered by a combination of prescribed burning and mechanical clearing.

Prescribed burning as a management tool

Prescribed burning is planned and carried out according to technical guidelines that involve knowledge of fire management and the effects of fire, always subject to strict safety standards, and conducted by professional specialists.

Burning allows the volume of combustible material to be reduced, protecting woodland and surrounding agricultural and urban areas from uncontrolled forest fires. It is also a valuable tool for the recovery of open areas and pasture as it helps to replace woody vegetation, especially shrubs, by herbaceous plants which can be eaten by livestock. In the case of LIFE Montserrat, it also brings benefits in terms of biodiversity, helping to create habitats and encourage the presence of species of great interest for conservation.

This type of burning is carried out with low intensity flames, so that, unlike forest fires, the effects on organic soil covering and fauna are minimal and it does not lead to significant problems of soil loss, degradation or erosion.



Results

As part of the LIFE Montserrat project 65 hectares of open areas have been recovered via prescribed burning and 20 hectares with mechanical methods.

During the first semester of 2019 the Associació de Propietaris Forestals dels Entorns de Montserrat carried out further action to recover 70 hectares of open land as part of the project. Although from the administrative and financial points of view this action was not part of the LIFE Montserrat project, it is in line with its aims and will make a direct contribution to fire prevention and improving biodiversity.

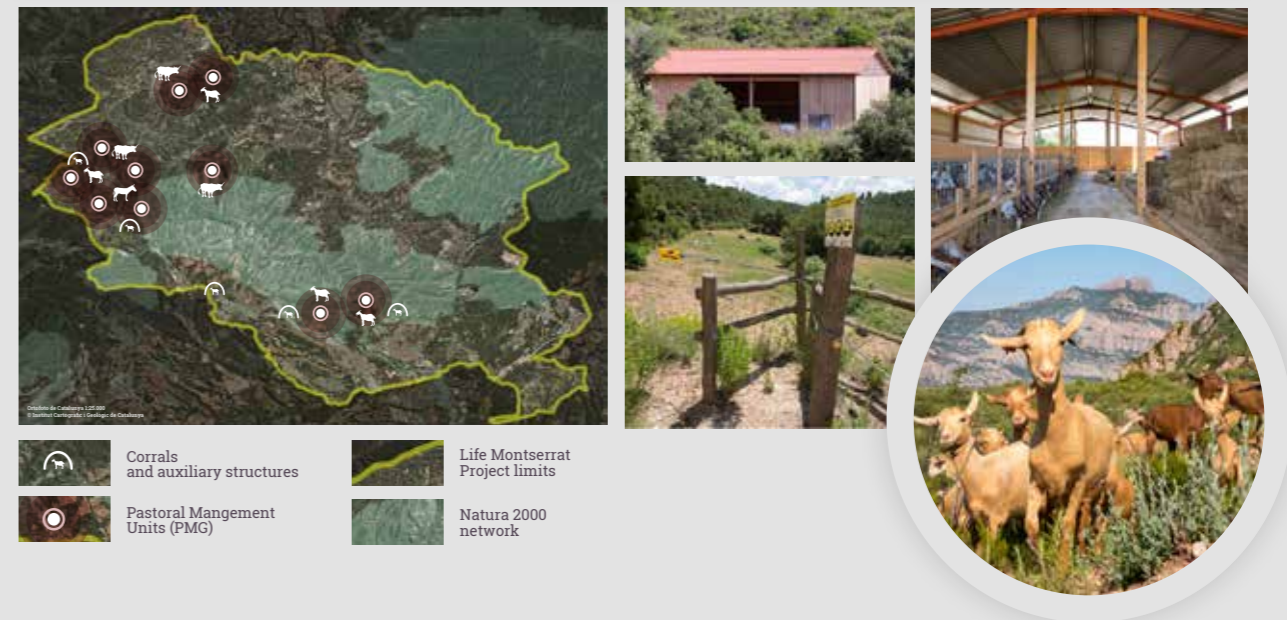


Implementation of silvopasture

LIFE Montserrat has launched ten structured livestock management units around strategic fire prevention areas and has promoted agreements between livestock and forestry owners to ensure that livestock can access areas of pasture. Eight livestock farming operations directly linked to the project, five of which are newly created, are working in these ten units. LIFE Montserrat's support for these operations has focused on **investment in infrastructure** (pens, fences and water supplies), the **purchase of livestock** and drawing up specific plans to reconcile the economic viability of each operation with the project's management aims.

Results

- Eight livestock operations linked to the project. Five with goats, two with cattle and one with donkeys.
- Livestock infrastructures: Four new pens; fences and water supply points for animals in the ten livestock units developed by the project.
- Livestock: 499 goats and 32 cows purchased directly by the project. Commitment by the recipients to double the number of animals, using their own resources.
- Agreements between woodland owners and livestock farmers to allow extensive grazing over 1,400 hectares of private land.



Participation

LIFE Montserrat is a predominantly technical project but it also has an important social dimension, on which the success of the measures taken depends. First, the owners of woodland and livestock are indispensable for the implementation of the management model proposed by the project. And, along with the parties directly involved, the support and acceptance of the local residents is necessary for the long-term continuity of the management scheme agreed with land owners and livestock farmers.

Interactive work with the parties involved has thus been a priority and various activities have been organised to familiarise local residents with the project, with a view to gathering their impressions and suggestions. The most ambitious activity has undoubtedly been work with local schools, which has involved the staff of 20 primary and secondary schools in the area and **field trips with 1,300 students**.

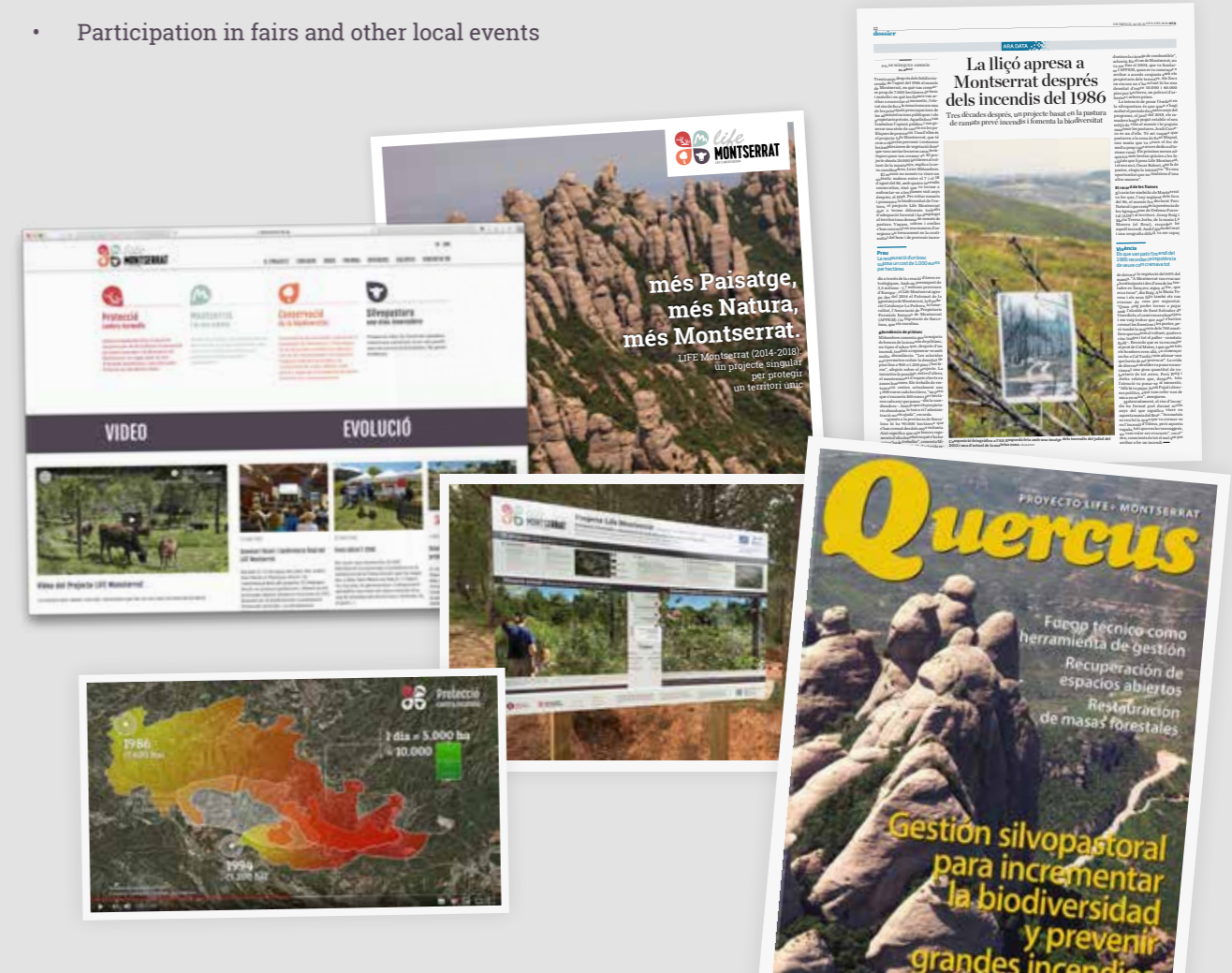
The ultimate aim has been to encourage local residents to take responsibility for their natural environment and involve them in its conservation.



Dissemination activities

The main tools used to publicise the project have been:

- Website, newsletters and the presence of the project in social media
- Information panels
- Explanatory leaflets
- Videos explaining the project
- Articles in popular publications and specialist journals.
- Presence in the media
- Participation in fairs and other local events



Effects on biodiversity

Heterogeneity is the basis of biodiversity. The area around Montserrat has been increasingly given over to forestry in recent decades, leading to more uniform habitats and fewer options for many species that rely on open areas. The measures implemented by LIFE Montserrat are designed to interrupt this trend, favouring a mosaic of environments that allow for a much wider range of habitats and species.

Within the scope of this project, many existing valuable natural spaces, within and outside the Natura 2000 network, remain in a good state in terms of biodiversity and landscape values, with low-intensity management models: thinned forest and extensive livestock farming.

Forest management and the recovery of open spaces directly drive biodiversity in the areas covered by the project. At the same time, indirectly and away from these areas, these techniques help the conservation of species and habitats that could be affected by a major forest fire.

Extensive livestock grazing has not been found to reduce biodiversity in the area covered by the project. On the contrary, in this region, grazing is the only viable way to maintain Mediterranean meadows and open spaces in general and to prevent forestation.



Monitoring results

LIFE Montserrat has developed a range of indicators to measure the effect of its actions on biodiversity. In general, more time will be needed to accurately measure the real effects and scope of the measures implemented, but **early indicators suggest a positive effect on butterflies and plant species.**

Butterflies have been used as bioindicators due to their key role in ecosystems as primary consumers (herbivores) and as a source of food for many secondary consumers (predators). Anything affecting butterflies, therefore, has a knock-on effect for many other organisms. Butterflies are also highly sensitive to the composition and structure of vegetation, which is directly affected by the project's actions, and they react quickly to changes in the environment. Butterfly monitoring was carried out at representative points in the main areas of project activity, where forestry management measures, prescribed burning and extensive grazing systems have been implemented.



Results concerning butterflies

Figures obtained from the Quatre Vents and Puigventós sites (El Bruc and between Olesa de Montserrat and Vacarisses, respectively), show that the greatest numbers of butterflies are found in grazed meadows, confirming the importance of these open spaces for biodiversity in these environments. In general, there was an increase in both the number of individuals and of species between 2015 and 2018.

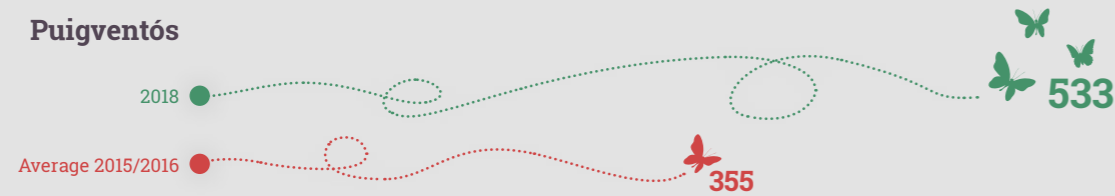
Butterfly abundance

(total number of individuals)

Quatre Vents



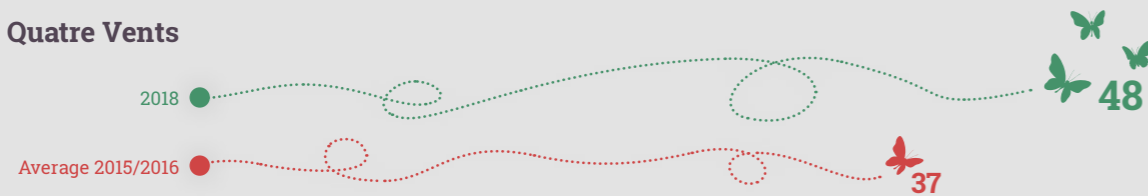
Puigventós



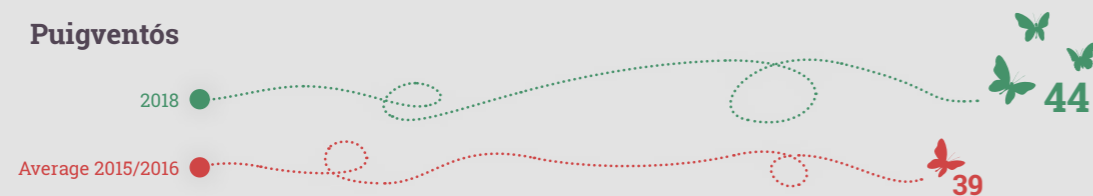
Butterfly abundance

(number of individuals)

Quatre Vents



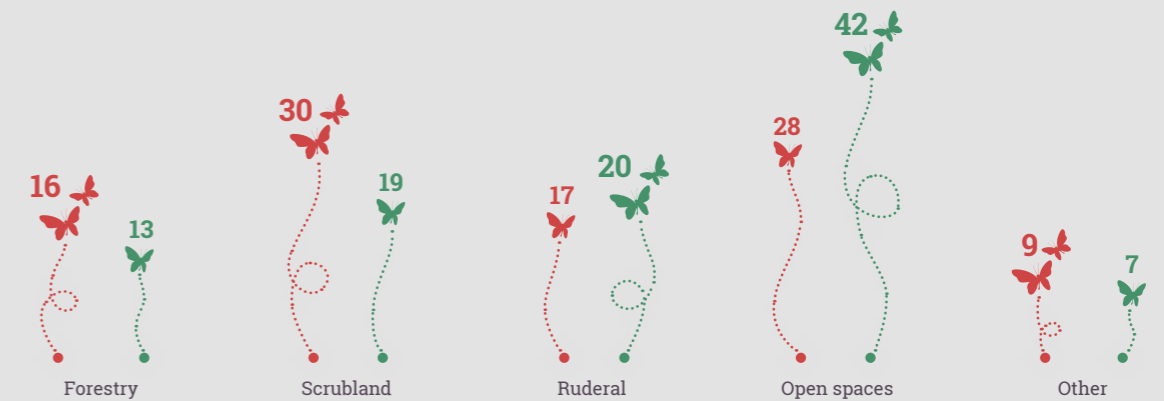
Puigventós



Significant ecological changes have also been observed with regard to available habitats. The samples taken in 2015 and 2016 showed a predominance of butterflies typical of scrubland and ruderal environments. In 2018, however, species linked to meadows and pastures were more abundant, representing 40% of the total.

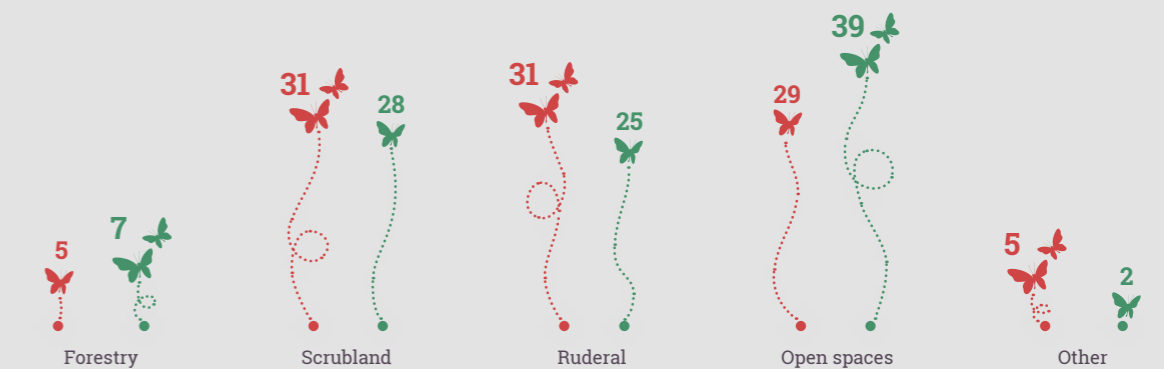
Butterfly distribution in Puigventós by habitat

Average % of total by autecological preference



Butterfly distribution in Quatre Vents by habitat

Average % of total by autecological preference



Results concerning flora species

A review of flora species using transects was carried out in the most representative habitats in the area covered by the project. A comparison of the results from 2015 (prior to the project) and 2018 (with most measures implemented or in progress) showed the wealth of plant species increasing in all habitats except maquis scrub. This was particularly notable in fenassars (dry meadows dominated by *Brachypodium* grasses) and stands of Aleppo pine, which have been subject to intense management measures.

Flora richness (number of taxa)

Habitat	2015	2018	Canvi
Rosemary scrub	25	26	+1
Fenassar (dry meadows of <i>Brachypodium</i> grasses)	32	41	+9
Jonquil meadows	33	36	+3
Dry field of false brome	21	21	0
Aleppo pine stand	18	28	+10
Maquis	22	19	-3



Results concerning other species

For threatened species such as Bonelli's eagle, the eagle-owl and the Egyptian vulture, which are of great interest from a conservation standpoint, the time period between the implementation of the measures and the end of the project is not sufficient for the results to be conclusive or significant. These species, at the top of the food web, are not efficient indicators of change in the short term.

Studies of rabbits and partridges, the main prey of eagles and the eagle-owl, **show populations increasing in areas where measures to recover open spaces have been implemented**, although the overall effect within the scope of the project is not significant yet.

The Bonelli's eagle has spread from one territory in the project area in 2014 to two in 2019, although this improvement is clearly linked to the extensive open area cleared by the summer 2015 wildfire, rather than to the project itself. This clearly demonstrates what we already knew: fire forms part of the natural dynamic of Mediterranean forest ecosystems and is fundamental for maintaining biodiversity. The LIFE Montserrat project is not, therefore, intended to prevent all forest fires, but rather minimise the risk of large, uncontrolled fires, which cause truly severe economic, social and environmental damage.



Future scenarios

Adaptation to Climate Change

LIFE Montserrat has developed a management model which is in line with the need to adapt to current and foreseeable climate scenarios in Catalonia and the Mediterranean as a whole. As established by the LIFE MEDACC project, centred on adapting to climate change in three Catalan water basins, land use management is a key tool for mitigating the observed and projected impacts of climate change.

In this context, the **active management of forests, the creation of open spaces and extensive grazing are priorities for adaptation strategies in areas such as Montserrat**. They are also vital for meeting the challenges of climate change in Catalonia, such as reduced river flows and water availability, the vulnerability of forests to stress, pests and diseases when the climate is not the same as when the vegetation became established, and the increased risk of forest fire associated with a greater number of days in the year affected by extreme weather conditions.

The clearest example is found in measures to clear regenerated Aleppo pine woods. This species of pine is the best adapted to tolerate the demands of the Mediterranean climate, able to resist severe summer droughts, grow in poor soil and reproduce at high rates. Taking into account climate forecasts, restored low density Aleppo pine forests, such as those left by the project, could be the only viable tree formations in the mid-term in extensive areas around Montserrat, and thus the only real option for maintaining the environmental and social functions of forest landscapes and their associated biodiversity.

Future challenges

The abandonment of agricultural practices where they were traditionally present, the increase in forested areas and the neglect of forests, as they are economically unprofitable, are issues affecting the entire northern Mediterranean region to a greater or lesser extent. These issues, in addition to the changes in temperatures and rainfall expected due to climate change, **mean urgent measures need to be developed to mitigate the constantly increasing risk of forest fires and biodiversity loss in this region.**

A model such as that proposed by LIFE Montserrat could be, in this context, an excellent opportunity to address three aims:

- Ensuring the region is better adapted and can be defended against fire
- Improving biodiversity management in Mediterranean mountains, favouring habitats and species of special interest, many of them protected under current legislation
- Increasing socio-economic opportunities in predominantly rural areas, with new jobs in traditionally neglected sectors and investments to boost the local economy



The desired outcome

The desired outcome is to establish a management model that recovers key ecological functions for the health of agroforestry ecosystems, such as herbivorous feeding, and leads to a return to the fire patterns typical of Mediterranean regions in previous centuries, with regular small and medium fires every ten or so years, which are accepted by society, and which create irregular spots in different stages of growth, helping to make the landscape more varied, habitats more diverse and interrupting the accumulation and distribution of fuel.

It is neither possible nor desirable to prevent all fires, but it is possible to minimise the risk of those that are likely to spread out of control. The goal is to **maintain the land properly** so that, when fire does occur, we have the capacity to control its impact on ecosystems, property and people.



Herdsmen and livestock: the key to success

The aims of the LIFE Montserrat project cannot be achieved without establishing viable farms that maintain extensive grazing over the long-term. This requires people who are committed to a livestock management model that prioritises the natural environment, the landscape and the quality of the foods produced over increasing income and profits in the short term. This is not easy, and even less so in an area such as Montserrat, where livestock herding was little more than a distant memory prior to the start of the LIFE Montserrat project. The men and women managing the livestock farms linked to the LIFE Montserrat project, who now form the Montserrat Livestock Farmers Association, are, therefore, the most valuable asset left behind after the end of the project (and also probably the most vulnerable).

New initiatives underway, such as the Parc Rural del Montserrat, can take over and ensure its continuity and viability, for the benefit of the territory and its people.





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