LAYMAN'S REPORT

LIFE ADAPTAMED PROJECT

ACTION E13. LIFE14 CCA/ES/000612

Junta de Andalucía
Consejería de Agricultura, Ganadería,
Pesca y Desarrollo Sostenible

CONTENTS

LIFE ADAPTAMED PROJECT ACTION E13. LIFE14 CCA/ES/000612. Protection of key ecosystem services by adaptive management of Climate Change endangered Mediterranean socioecosystems.

Coordinating beneficiary:

- Andalusian Ministry of Agriculture, Livestock, Fisheries and Sustainable Development (Junta de Andalucía).

Associated beneficiaries:

- Andalusian Environment and Water Agency
- University of Almeria
- University of Granada
- Doñana Biological Station (Spanish National Research Council)
- International Union for the Conservation of Nature (Centre for the Co-operation in the Mediterranean)
- Andalusian Science Park

Co-funder:

- Aguas de Font Vella y Lanjarón S.A.

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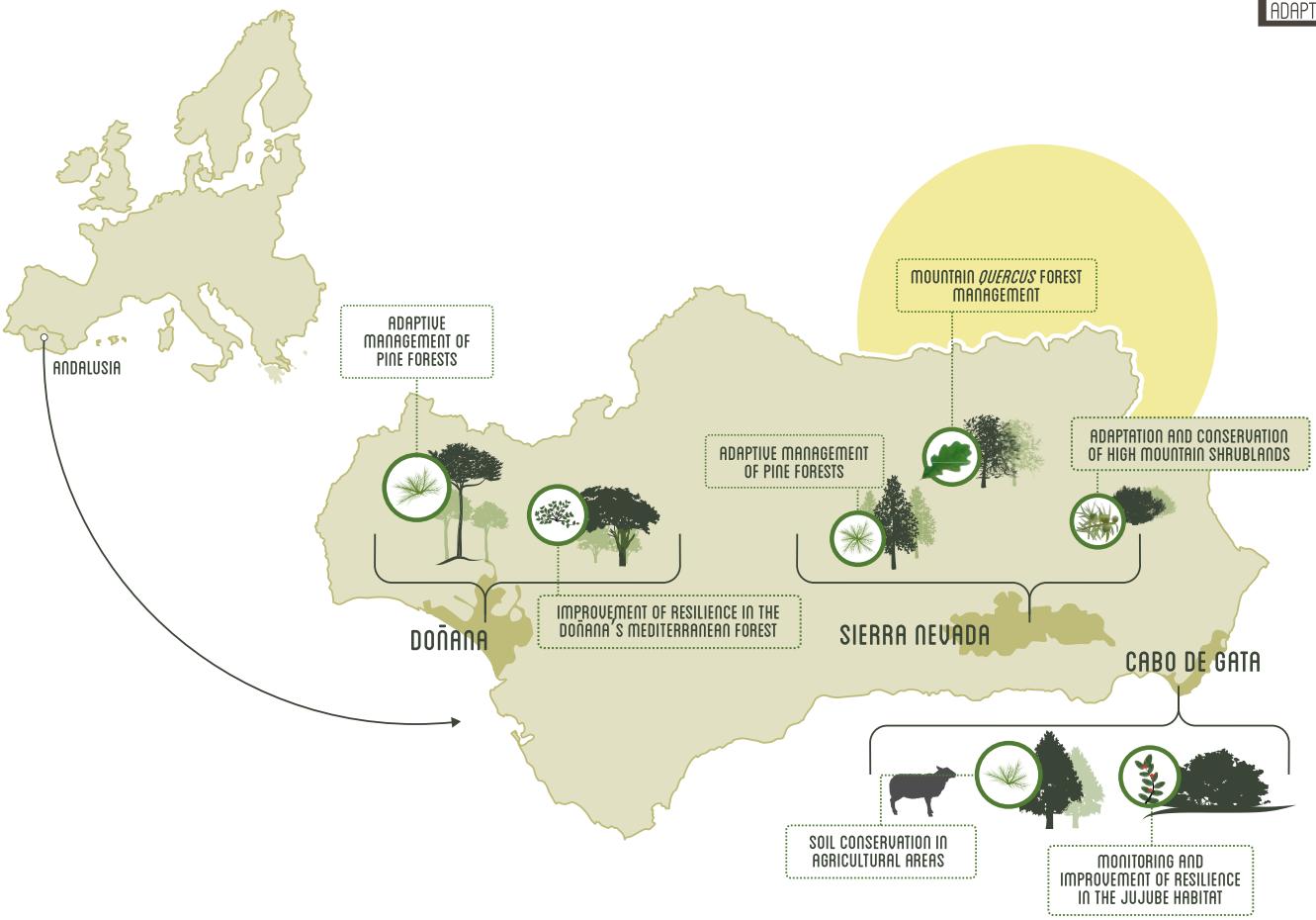


INTRODUCTION

LIFE ADAPTAMED: BUILD THE FOUNDATIONS FOR CLIMATE CHANGE ADAPTATION IN PROTECTED AREAS

The Life Adaptamed project has sought to support adaptation to climate change in three Mediterranean protected areas in Andalusia that encompass a wealth of ecosystems: Sierra Nevada, Cabo de Gata and Doñana. This project focused on developing, implementing, monitoring, evaluating and disseminating adaptive management measures to ensure delivery of key services such as soil retention, production of pastures, enhancement of habitats for the conservation of biodiversity, water regulation, prevention of forest fires and reduction of desertification. To this end, the project's actions sought to enhance ecosystem resilience to climate change and other human-induced pressures, fostering the system's natural self-organisation mechanisms.

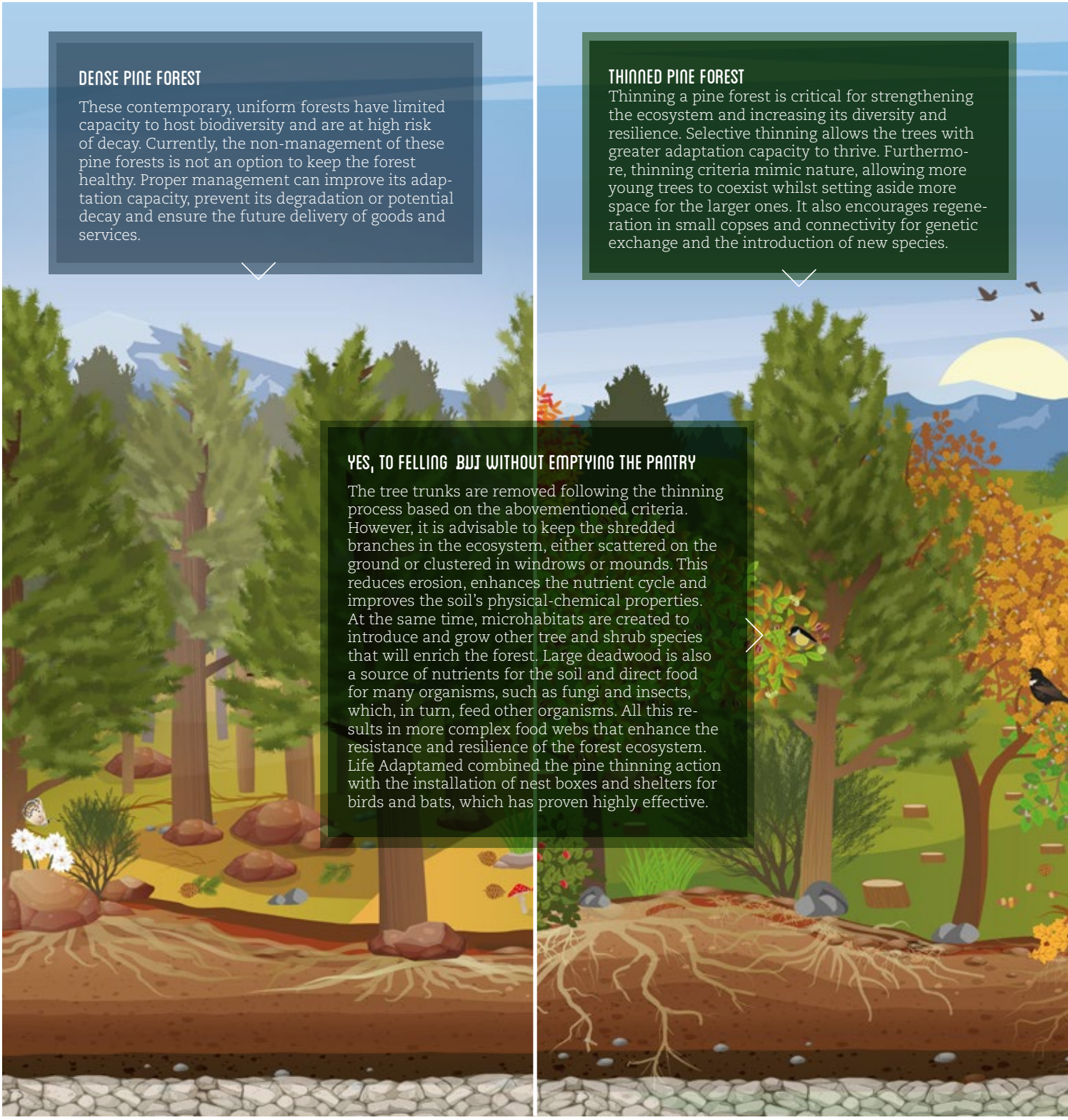
Over the last six and a half years, the actions focused on an adaptive co-management approach. This involved the naturalisation of pine forests, sowing and planting of high mountain, semi-arid and Mediterranean woodland plant species, selective thinning of mountain holm oak and Pyrenean oak forests, restoration of traditional irrigation channels, installation of a network of piezometer-equipped wells, installation of nest boxes and shelters for birds and bats, assessment of measures to prevent livestock from entering areas with high grazing pressure and restoration of dry-stone containment walls (balates), among others. A great effort was also made in communication and dissemination of outcomes, environmental education and volunteering, organising numerous meetings and publishing abundant material of different kinds. Much of this effort focused on governance, co-management and citizen engagement, acknowledging the paramount importance of the participatory bodies of the protected areas and the intrinsic value of nature-based solutions in a scenario highly influenced by climate change. Significant efforts have also been invested in monitoring management actions both in the field and through remote sensing (combining both approaches) and other activities.

Some effects are not immediate, but in the long run, given the slow dynamics of natural systems. However, there are many tangible outcomes, resulting in an inexorable shift of focus on managing protected areas, where adaptive co-management is the approach to be implemented moving forward. Additionally, a full-scale post-Life strategy has been designed to define the path forward and articulate the mechanisms enabling the drawing of conclusions based on the ecological monitoring of ecosystems targeted by Life Adaptamed's management actions. This strategy clearly illustrates the many lessons that emerge from this pioneering project, which have trickled down to the administrations, research centres and other institutions involved in the project. Life Adaptamed has created a large extension of knowledge and learning. However, global change has strongly affected the natural systems and there is still a long way to go in terms of adaptation. There is no time to waste!

Throughout this Layman's Report, the reader will find practical information on the main actions and results of Life Adaptamed. An outline of the project findings is provided at the end of the report to help enhance the existing management arrangements in protected areas, which may be transferred to other areas and geographical scales.

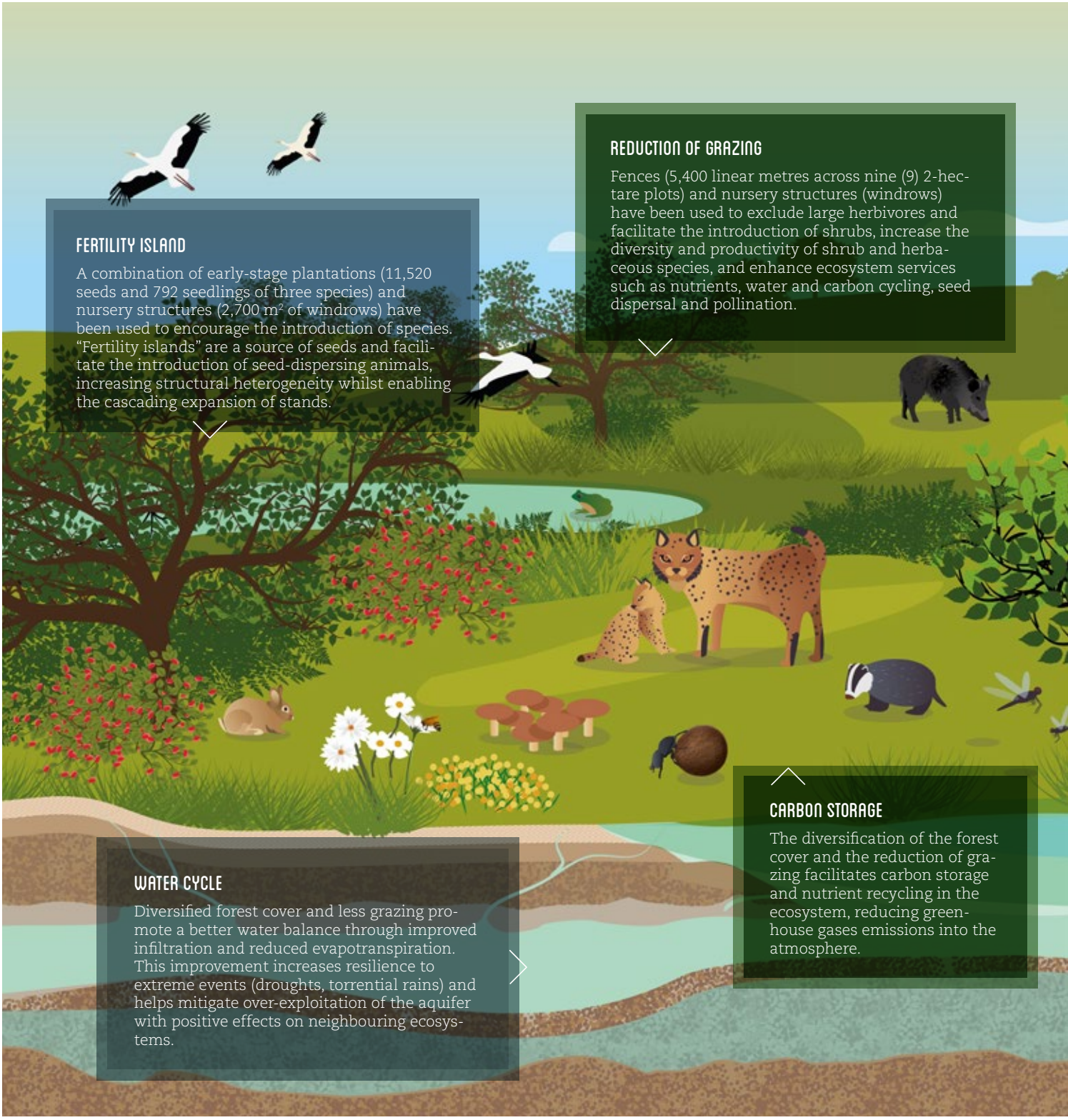
ACTION C1.
PINE FORESTS WITH HIGHER RESISTANCE AND RESILIENCE TO CHANGES

Life Adaptamed has developed demonstrative management actions for reforested pine forests with high uniformity and low biological diversity, which makes them highly vulnerable to global change processes. Overall, 240 ha have been treated in Doñana, Sierra Nevada and Cabo de Gata. Management focused on promoting its adaptation capacity using adaptive forestry. The actions focused on increasing spatial diversity and forest thinning to create more open woodlands with fewer trees to compete for water. This reduces stress, improves physiological status, makes the pine forest more resilient against disturbances, such as pests, droughts or temperature increases, and allows the introduction of seeds from other plant species. Different strategies have also been tested for managing forest residue (windrows) generated by thinning, studying its effect on the ecosystem.



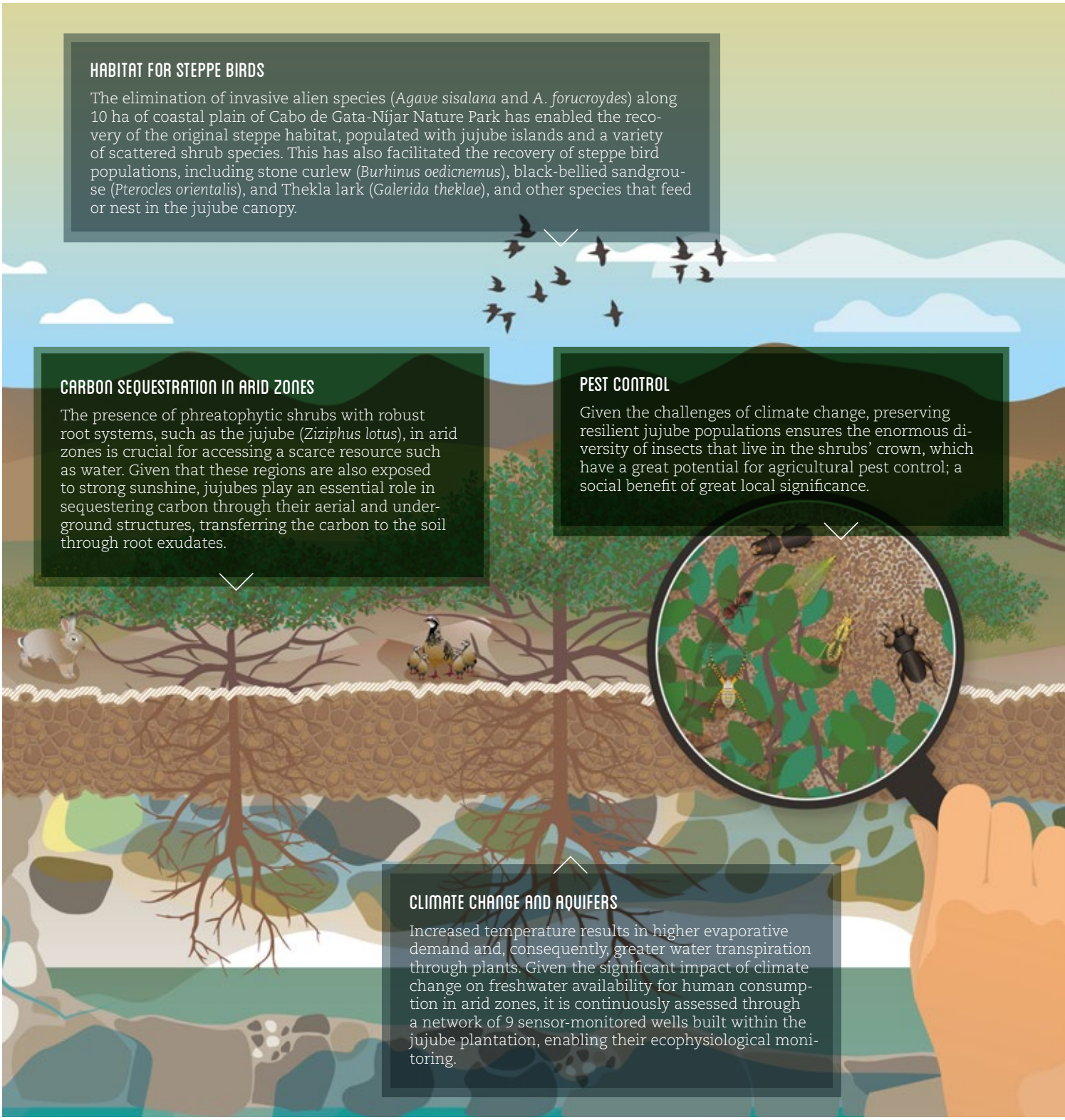
ACTION C2.
BUILD ADAPTIVE RESILIENCE AND DIVERSITY IN DOÑANA'S MEDITERRANEAN WOODLAND

Doñana's Mediterranean forests and shrubland has lost their water and soil retention capacity due to drastic alterations (reforestation, excessive grazing, fires and changes in land use). The actions proposed for Doñana focus on regenerating this critical ecosystem and increasing its biological and functional diversity to improve its resilience to climate change. To that end, various actions have been undertaken (reduction of grazing, assisted introduction on "fertility islands") to attract several key species, such as cork oak, mastic and wild olive. Additional measures have been implemented to control infection of a key species, the cork oak, caused by the invasive pathogenic oomycete *Phytophthora cinnamomi*. These actions seek to trigger a trickle-down effect on the entire ecosystem (fauna, flora and microbiota) to facilitate the delivery of services and enhance its resilience to disturbances and climate change.



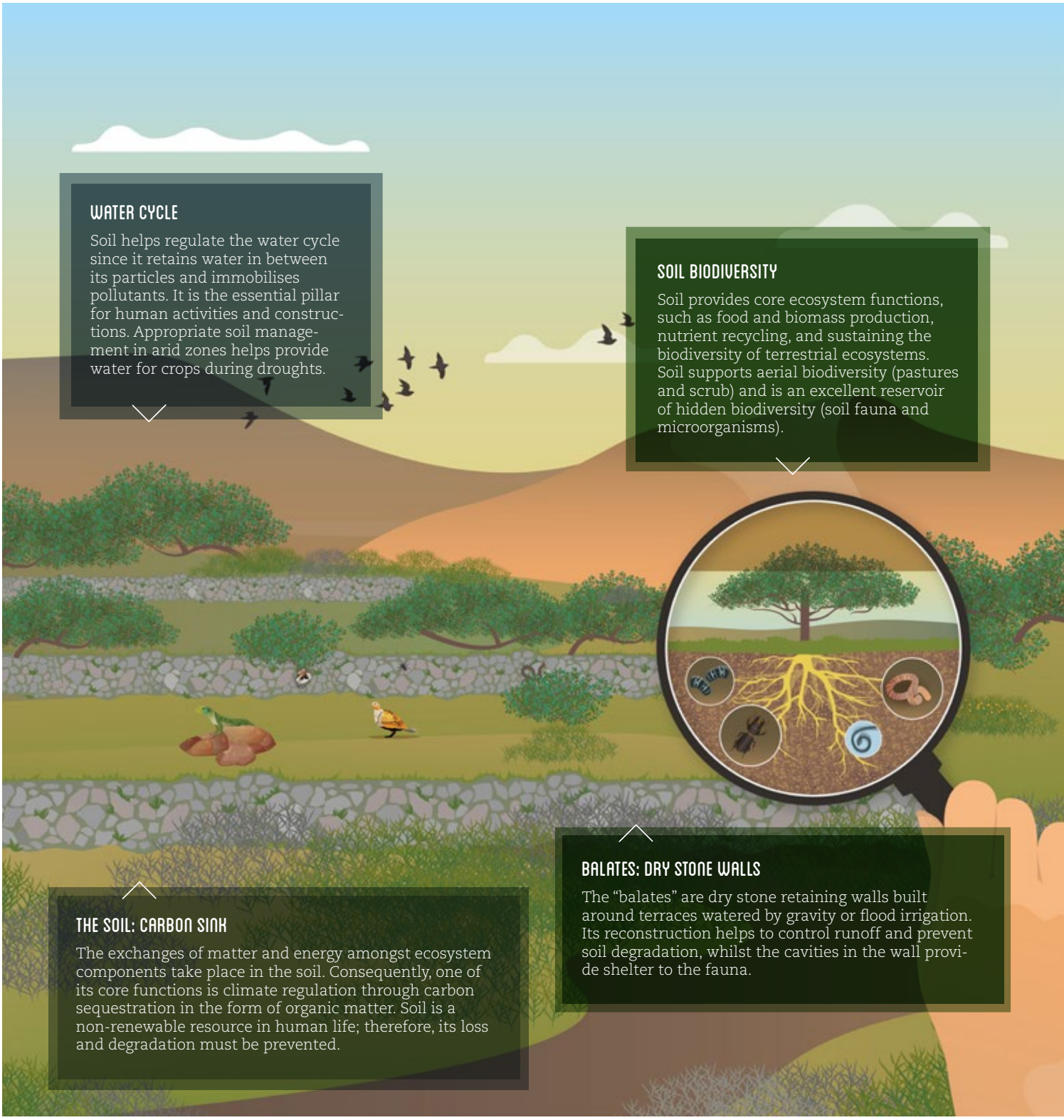
ACTION C3.
MONITOR AND IMPROVE RESILIENCE OF JUJUBE PLANTATIONS

This action took place on the coastal plain of Cabo de Gata-Níjar Nature Park. It sought to ensure the delivery of ecosystem services by jujube (*Ziziphus lotus*) stands and improve our ability to monitor the ecological processes threatened by climate change that underlie such services. Given that jujube stands are highly dependent on groundwater, 9 sensor-monitored wells have been drilled to assess the impact of climate change on the aquifer. Ten (10) ha of alien cultivars (*Agave sisalana* and *A. fourcroydes*) have been also removed to improve the habitat of steppe fauna, recover the role of soil entomofauna in nutrient cycling in the fertility islands formed under *Ziziphus lotus* canopies, and enhance the habitat of canopy insects that feed on agricultural pests.



ACTION C4.
THE SOIL: PROVIDER OF ENVIRONMENTAL BENEFITS

A key part of understanding the soil's role in providing ecosystem services is to comprehend the effect of the processes involved, including the cryptic processes in the rhizosphere, land tilling and fallow cycles, and the role of the length and structure of the roots of different types of plants. The presence of natural vegetation in places with soil and water conservation structures, such as terraces with dry stone walls (balates), has a significant impact on the spatial variability of properties related to organic matter. Meanwhile, fallow land in Mediterranean areas provides habitats with a high conservation value. The action carried out at Los Escullos public estate sought to restore the "balates" and to conduct traditional tillage practices. This highlighted the importance of appropriate soil conservation and management to maintain its role as a carbon sink, water reservoir in arid zones, and provider of suitable habitats for habitats 5330 and 6220.



ACTION C5.
JUNIPER FORESTS IN SIERRA NEVADA'S HIGH MOUNTAIN AREAS CONSERVATION AND RESTORATION

This action took place entirely in Sierra Nevada. It contributed to advancing knowledge about the best management strategies and procedures for the Natura 2000 habitat type 5120 (mountain formations of *Cytisus purgans*), particularly juniper groves (*Juniperus communis*). This is the most unique habitat managed in Life Adaptamed in terms of biodiversity in terms of biodiversity. However, current climate conditions greatly limit the natural regeneration of junipers. The restoration of fire-affected areas used for livestock grazing in the 20th century and the areas affected by skiing activity represent an opportunity for restoration. Action C5 seeks to provide scientific and technical proposals and criteria to undertake this ecological restoration.

ACTION C6.
BASIS FOR THE ADAPTIVE MANAGEMENT OF HOLM OAK AND PYRENEAN OAK FORESTS IN SIERRA NEVADA

The active management of mountain Pyrenean oak and holm oak forests involves adapting to new climate conditions. Life Adaptamed has taken action in 50 ha of holm oak (*Quercus ilex*) and Pyrenean oak (*Quercus pyrenaica*) forests in the Sierra Nevada Natural Area. The forest has been rejuvenated through pruning and selective thinning to improve the stand structure. The trees were highly degraded (stagnated growth, low fructification, etc.) mainly due to the abandonment of human practices. This type of forestry encourages forest diversity and heterogeneity and reduces the risk of fires generated by large amounts of accumulated biomass and shrub encroachment. These treatments also favour more open stand structures with greater structural diversity, increasing their resilience to climate change and improving the delivery of ecosystem services.

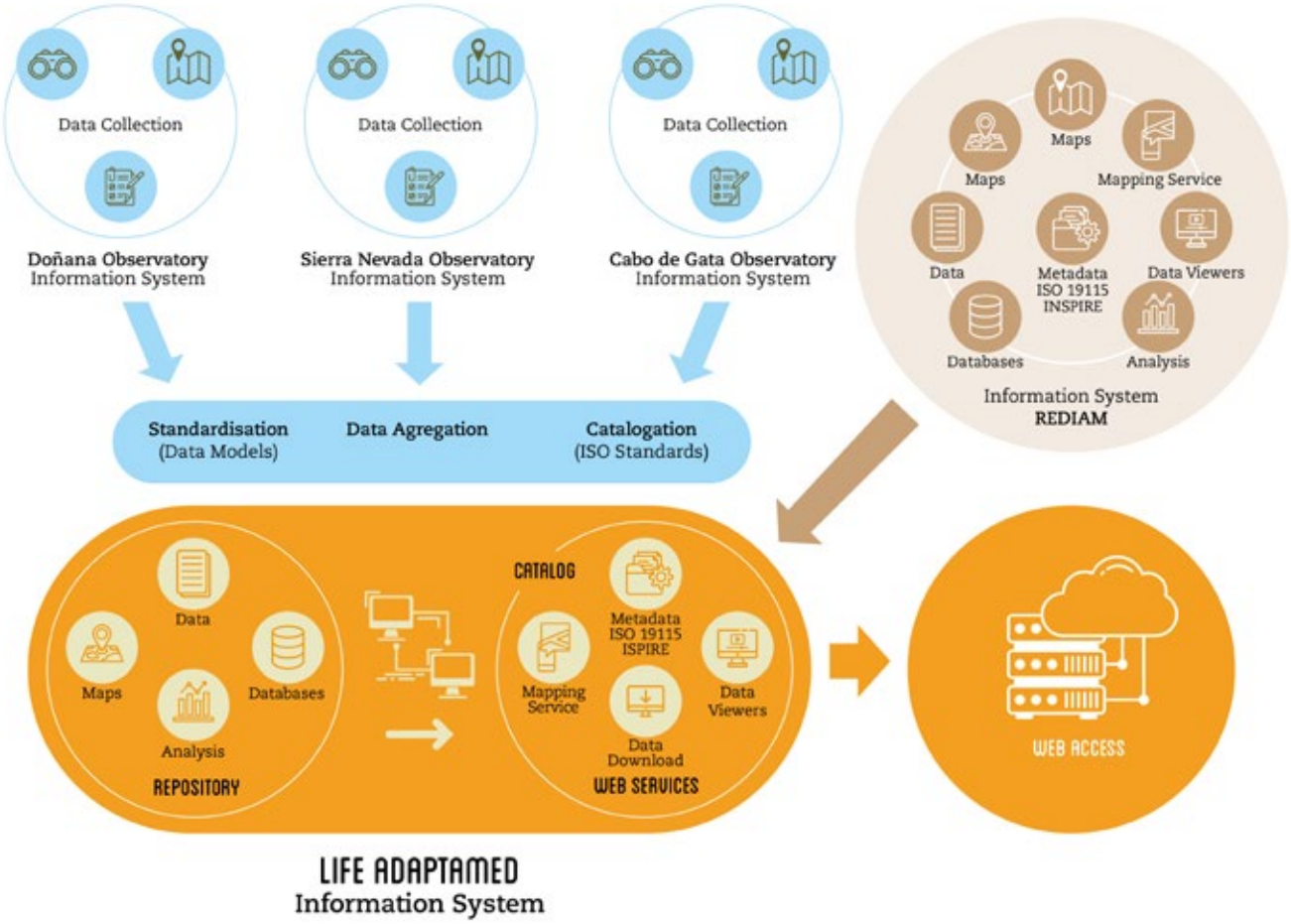
ACTION C7.
LIFE ADAPTAMED INFORMATION SYSTEM

Life Adaptamed's information system seeks to safeguard the storage of information generated by the project, its access to potential users and facilitate its analysis to build useful knowledge. The system is spread across the three nodes of the project and the central services of the Andalusian Ministry of Agriculture, Livestock, Fisheries and Sustainable Development of the Andalusian Government.

This tool includes all the data sets generated by the project and other regional or local information sources created by the Andalusian Environmental Information Network (REDIAM, in its Spanish acronym). Noteworthy among the latter are various information networks related to global change monitoring (land use, meteorology, landscape, biodiversity, habitats, etc.). The main features of the Information System include:

- A data model interfaced with the rest of the REDIAM data models (biodiversity subsystem, water, protected natural spaces, etc.).
- The analysis and integration of data from regional networks for global change monitoring and identification of data sets.
- The development of an interoperable service module to leverage and interface the system with the outside world (web platform, applications and models).
- A metadata and dataset management system to facilitate their integration into international information management platforms based on internationally accepted metadata standards such as INSPIRE or EML (*Ecological Metadata Language*).
- The preselected indicators and data sets will be integrated into European information systems to facilitate the transferability of information processes created by LIFE Adaptamed.

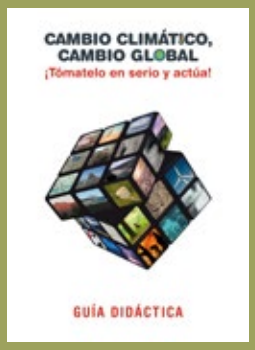
The system is available to the project stakeholders (technicians, scientists and society) to foster the adaptation of target ecosystems to the impacts of climate change.



WINDOW ON SCIENCE, TRAVELLING EXHIBITION, ENVIRONMENTAL EDUCATION AND ENVIRONMENTAL VOLUNTEERING

LIFE ADAPTAMED WINDOW TO SCIENCE

Two LIFE Adaptamed Windows to Science have been set up at the Andalusian Science Park (Granada) during the project. Several exhibits and interactive elements have been used to engage visitors in various LIFE Adaptamed actions and studies. They sought to bring scientific activity closer to the public, to familiarise them with the studies on adaptation and protection of ecosystem services in the natural environment. This activity raises social awareness about the importance of a science innovation system in a modern and democratic Europe.



TRAVELLING MICRO-EXHIBITION

The LIFE Adaptamed travelling micro-exhibition is a groundbreaking and inspirational environmental education resource. It consists of 21 panels and many other experimental activities. The entire exhibition, displayed and developped by students, fits into a couple of trunks that have toured to educational centres across Andalusia. The panels contextualise the climate change problem and the need for humans and ecosystems to adapt. It also spells out what LIFE Adaptamed is doing to encourage this adaptation. These activities allow the students to engage in small-scale experiments on the most relevant physical processes underpinning global warming. Interesting things always happen when the LIFE Adaptamed travelling exhibition arrives in schools!

ENVIRONMENTAL EDUCATION

LIFE Adaptamed has prepared two teaching units: one aimed at elementary students and the other for secondary-level students. Both are specifically designed to encourage students to reflect on climate change-related problems and what they can do to adapt their lifestyles to this new socio-ecological context. The pilot teaching units have been rolled out in six educational centres. Henceforth, they will follow their own path in coordination with the Junta de Andalucía's Aldea programme for environmental education.

VOLUNTEERING AND CITIZEN SCIENCE

Each Adaptamed Protected Space includes a citizen engagement programme with a package of activities and a body of volunteers. Lastly, a full-day joint meeting of volunteers took place. An environmental volunteering manual on climate change adaptation in natural spaces has also been published.

COMMUNICATION AND DISSEMINATION OF OUTCOMES

LIFE Adaptamed has worked intensively on communication and dissemination. It has reached specialised audiences, local interest groups (water users, livestock farmers, business people), and society through digital channels, press, social media, scientific-technical forums, etc.

WEBSITE AND SOCIAL MEDIA

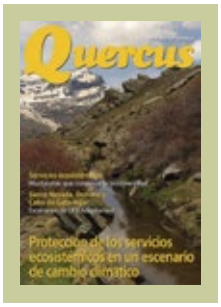
www.lifeadaptamed.eu

News on the project activities

PRESS

Media trip with 12 journalists

57 articles written by more than 20 journalists



Monograph in Quercus magazine

DISSEMINATION

- *1.500 brouchures*
- *300 posters*
- *8 enaras*
- *7 videos*
- *6 infographics*
- *2 newsletters*
- *1 media kit*
- *15 field panels*

MANAGEMENT TECHNICAL MANUALS

Pyrenean oaks in Sierra Nevada

High mountain shrublands

Jujube tree

Cork oak forests

Pine forests

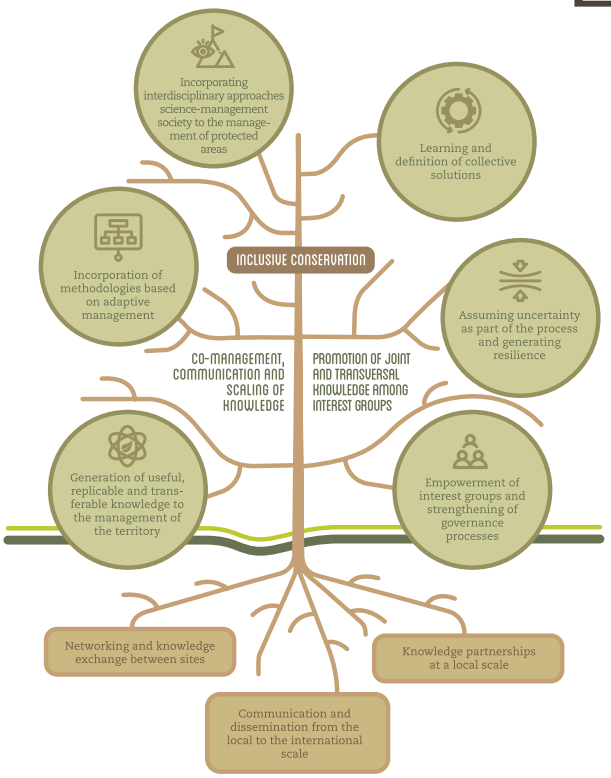
GOVERNANCE AND SOCIAL ENVOLVEMENT IN LIFE ADAPTAMED

IMPROVE DECISION-MAKING THROUGH GREATER ENGAGEMENT BETWEEN SOCIETY, SCIENTISTS, POLICY-MAKERS AND MANAGERS

Governance culture is key to promoting social revitalisation based on long-term sustainability. It also makes identifying socio-economic activities compatible with climate change adaptation processes easier.

A consultative process has been undertaken to strengthen the governance of climate change adaptation in the 3 project areas. The results have been documented in an adaptive governance manual.

Governance manual



Modified from www.inclusive-conservation.org

Evaluation surveys. Life Adaptamed

LOCAL AWARENESS AND NETWORKING

The project organised 6 participatory workshops in towns near the project's natural areas and a networking workshop with the European project "We Value Nature", which focuses on foregrounding the natural capital of protected areas in business plans. Numerous other activities have been also promoted within the networking component, including meetings and attending scientific events, participation in technical forums and exchange of knowledge with various LIFE projects. The concept of nature-based solutions and the standard supported by IUCN are validated by the broad inclusion of local actors in the activities and their active involvement, as in the case of the water users' associations to adapt the traditional irrigation channels.

San José (800 Participants)

Ugíjar and Lanjarón (290 Participants)

El Rocío and Almonte (320 Participants)

SUMMARY FOR POLICY-MAKERS AND MANAGERS

NEW PARADIGMS TO COPE WITH ADAPTATION OF NATURAL ECOSYSTEMS

The role played by ecosystems must be further promoted in these new scenarios. Identifying, mapping, foregrounding, and preserving **ecosystem services** is one of the most significant challenges the institutions responsible for managing the natural environment currently face.

Collaborative adaptive management is a management framework that embraces the complexity and uncertainty inherent to natural systems. It approaches management actions as experiences that provide the opportunity to "learn by doing". Protected natural spaces are ideal for promoting and improving these work dynamics, which are great opportunities for collaboration between administrations, the scientific community, end users and society.

Long-term ecological monitoring programs are essential to understand the functioning of ecosystems, evaluate management actions through adaptive co-management processes and develop long-term strategic planning. The Andalusian Network of Global Change Observatories is the ideal forum to develop these work dynamics.

LEARNING TO PROMOTE ADAPTATION IN MEDITERRANEAN ENVIRONMENTS TARGETED BY LIFE ADAPTAMED

- The adaptation process itself must be used as an opportunity to encourage the self-organisation of more resistant and resilient natural ecosystems. Likewise, certain severe and recurrent events in pine forests (e.g. decay or fires) should be leveraged as an opportunity to develop management strategies that reduce the future vulnerability of the forest and enhance its ability to provide ecosystem services.
- In the case of pine afforestations, an increase in thinning intensity is needed to create more open stands resilient to water deficit, thus avoiding situations of no return.
- Efforts should be made to ensure deadwood is not removed from the forest after a fire or a forestry treatment. However, account should be taken of the benefits derived versus increased combustibility of the ecosystem or greater vulnerability to forest pests.
- Regeneration actions should focus on sowing and/or planting seedlings to create biodiversity islands. These islands are a source of seeds and facilitate the introduction of seed-dispersing animals, increasing structural heterogeneity whilst enabling the cascadean expansion of stands.
- Generally, strategies that increase spatial diversity and improve connectivity are encouraged. Diversification of the forest cover is essential to promote the reduction of greenhouse gas emissions into the atmosphere.
- Holm and Pyrenean oak forests best adapted to climate change are the most heterogeneous and often have more open structures. Efforts should be made to manage low shrubs and medium forest into high forest through selective thinning.
- The preservation of traditional practices increases the ecosystems' ability to deliver services.
- The use of exclusion fences for large herbivores facilitates the recruitment of shrubs and increases the diversity and productivity of shrub and herbaceous species, thus increasing its ability to provide services.
- In the arid environments of Southeast Spain, the conservation of soils and key vegetation (such as jujube) is essential. Therefore, it is vital to control the quality and quantity of groundwater and reduce the impact of intensive farming on aquifers.
- Soil protection and restoration is critical in the adaptation process. Soil contributes to climate regulation through carbon sequestration in the form of organic matter and is a great biodiversity reservoir. The exchanges of matter and energy amongst ecosystem components take place in the soil.

It is essential to deepen the trans-disciplinary processes of co-management and adaptive governance to ensure the satisfactory delivery of **long-term results in a changing world**.

Adaptation projects must include **environmental education** actions. **Volunteering** and **citizen science** provide substantial support in achieving adaptation goals and offer an opportunity to encourage participatory processes.

The opportunities rendered by **nature-based solutions** should be seized. These solutions often encourage **traditional practices**, which are essential in the race towards adaptation.

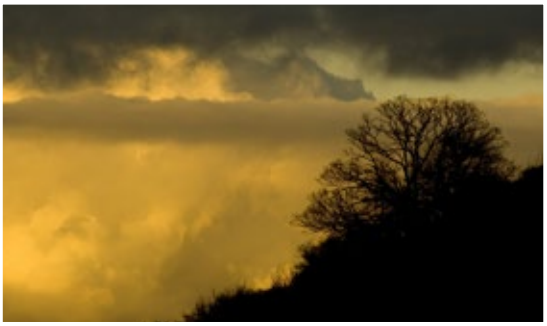
An adequate **strategy for communication and dissemination of results** must play a leading role in any adaptation project. This requires fostering multidisciplinary teams of communicators, technicians and scientists specialised in communication and knowledge transfer.

It is essential to ensure the **transferability of the knowledge** generated at different layers to European, national or regional policies and promote networking. To this end, efforts should be made to create the necessary transfer mechanisms, including professional profiles with expertise in policy development and implementation and activities that combine science, management and society.


LIFE ADAPTAMED


Espacios protegidos andaluces:
Ecosistemas
que nos protegen


Life




Life


¿Cómo diversificar los
pinares de repoblación?

WWW.LIFEADAPTAMED.EU

Coordinating beneficiary

Junta de Andalucía
Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible

Associated beneficiaries

Junta de Andalucía
Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible
Agencia de Medio Ambiente y Agua de Andalucía

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