



Green List
Protected / Conserved Areas



SCIENCE FOR FOREST MANAGEMENT,
BIODIVERSITY & BIOECONOMY
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UNIVERSITAT ROVIRA I VIRGILI

Tech4Nature

Spain



Press Factsheet | February 2026



What is Tech4Nature?

Tech4Nature is a global partnership that brings together conservation expertise and digital innovation to better protect nature. Launched by the International Union for Conservation of Nature (IUCN) and Huawei's TECH4ALL programme, the initiative supports protected areas in using technology in practical, responsible and effective ways.

Active across **Europe, Asia, Africa and Latin America**, Tech4Nature works with **protected areas** facing diverse conservation challenges, from species protection and habitat restoration to visitor management. Each site serves as a living laboratory, generating lessons that can be shared globally and scaled up across the conservation community.

The initiative is helping parks and conservation authorities apply **digital tools to improve management and decision-making**. Aligned with the IUCN Green List Standard, the global benchmark for effective and equitable protected area management, Tech4Nature ensures that technology reinforces strong governance and sound conservation planning.

Spanish Flagship

Spain sits at the crossroads of the Atlantic Ocean and the Mediterranean Sea, creating a mosaic of diverse landscapes that host **some of Europe's richest biodiversity**. This natural wealth attracts **millions of visitors each year** - locals, regional travellers and international tourists alike - drawn to the beauty and recreation opportunities offered by Spain's protected areas. In fact, visits to national parks have surged by 85% over the past two decades, reaching over 16 million annually in 2024.

This growing interest in nature should be celebrated, yet it also brings challenges. High visitor numbers and inappropriate behaviours can disturb wildlife, erode fragile habitats, and damage the very ecosystems visitors come to enjoy. Protected areas across Spain must therefore find a careful balance between making parks accessible places for all to enjoy, and safeguarding nature.

The **Tech4Nature Spanish flagship** is helping parks meet this challenge by using technology to **better understand and manage visitor impacts on biodiversity**. Between 2021 and 2026, the initiative has developed tailored digital innovations to support more informed, adaptive management that harmonises public use with conservation.

The first phase of the project (2021-2023) focused on identifying priority needs and potential digital solutions to better manage visitor pressure in four Spanish parks. **Sant Llorenç del Munt i l'Obac** was selected as the pilot site, where technology was developed to assess how visitor activity may affect the endangered Bonelli's eagle.

In its second phase (2023-2026) Tech4Nature Spain expanded the project to a new site: **Sierra Nevada**. The main objective in this new phase is to test experimental low-cost solutions, using existing tools such as motion-activated camera and acoustic recorders, to understand visitor behaviour and pressures in both parks.

Sierra Nevada National and Natural Park

is one of Spain's highest and most ecologically diverse mountain ranges, home to unique alpine habitats such as the **borreguiles: delicate high-altitude wetlands** that shelter specialised flora and fauna. These ecosystems face increasing pressure from hikers and overnight visitors.



Under Tech4Nature, Sierra Nevada is testing an experimental setup that uses **camera traps and autonomous acoustic recorders** to study when, where, and how visitors move through these sensitive areas. Artificial intelligence is being trained to distinguish people from wildlife, **track movement patterns, and even detect illegal camping**. This information can help identify disturbance, guide patrols, and support better visitor management to protect these sensitive alpine habitats.



Sant Llorenç del Munt i l'Obac

Natural Park located just outside Barcelona, is an impressive landscape of **cliffs, caves, and rocky ridges**, among the region's most popular destinations for climbing and caving. These activities, however, can disturb sensitive wildlife, including bat colonies and cliff-nesting birds.

Building on the first phase of Tech4Nature, the project is testing a suite of **light sensors, acoustic recorders, and camera-traps** that monitor when and **how caving and climbing sites are used**. This information can help assess compliance with regulations to ensure recreation does not compromise wildlife conservation.

Since these technologies may capture personal data, such as images, audio, or location information, safeguarding privacy and data protection are central to the project. Tech4Nature is conducting a dedicated **study on the legal and ethical considerations of deploying monitoring tools** within Spanish protected areas to ensure the highest standards of responsible use of technology.

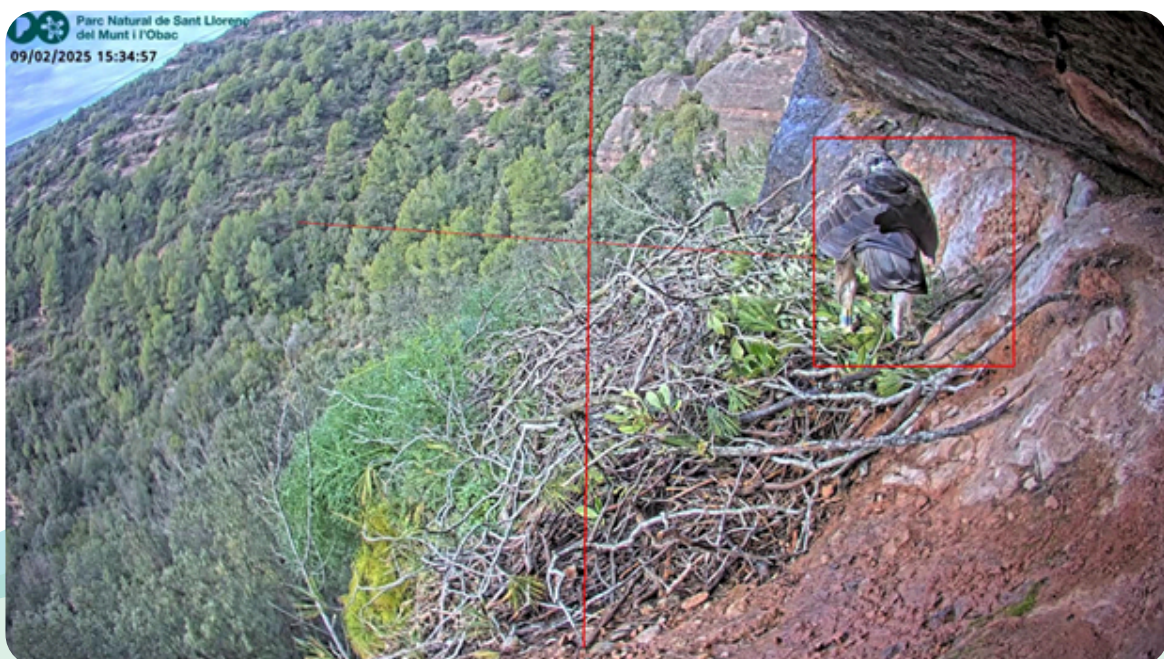
Tech4Nature in Sant Llorenç del Munt i l'Obac Natural Park

Phase I (2021-2023)

Tech4Nature in Sant Llorenç del Munt i l'Obac Natural Park began in 2021. Two key studies were carried out: a **needs assessment of the protected area** and a review of **available technological solutions**. Together, these reports helped define a tailored technological system aligned with the Park's conservation priorities and management realities.

Building on that groundwork, the technical architecture began to take shape in 2022. The focus was the conservation of the **Bonelli's eagle** (*Aquila fasciata*), a vulnerable species particularly sensitive to disturbance during breeding season. Following the surge in outdoor recreation after the Covid-19 pandemic, park managers observed increased visitor pressure in natural areas, raising concerns about potential impacts on wildlife.

By the end of 2022, the **system** was operational. A **camera** was installed near the eagle's nesting area, while additional cameras monitored visitor flows along nearby trails. **GPS transmitters** were fitted to a breeding pair to better understand their movements, hunting areas and behavioural patterns.



During the first months, the system recorded more than 25,000 GPS locations. Trail cameras also provided the first detailed characterisation of visitor use near the nesting area, recording over 1,000 user movements in just over three months, with the majority concentrated on weekends and late mornings. Importantly, no incidents of visitors entering the restricted nesting zone were detected. All information was processed through a Network Attached Storage (NAS) system, allowing continuous monitoring and faster response times.

The project went beyond data collection. An **alert system and response protocol** were developed to translate real-time information into concrete management action. Clear parameters were defined to identify potential risks—from unusual eagle behaviour to unauthorised access—**enabling park staff to react quickly and in a coordinated manner.**

The value of the system became clear in April 2023, when GPS data revealed that the male eagle had stopped moving. Rangers quickly located the bird and confirmed electrocution caused by unsafe electrical infrastructure several kilometres from the breeding site. The incident demonstrated how real-time monitoring can enable rapid response, improve traceability, and identify risks beyond the immediate nesting area.

Since then, the system has been further refined, including progress in training artificial intelligence tools to automatically detect alerts.

Key learnings from phase I

- Real-time data and automated alerts significantly improve the park's ability to react quickly to potential threats.
- Visitor behavior data provides insights on use patterns and potential infractions, helping the park better balance recreational pressure with species protection in specific sensitive zones.
- Close collaboration between technology providers, conservation scientists and park managers is essential to translate complex data streams into practical management tools.



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Phase II (2024-2026)

Building on the foundations laid in Phase I, Tech4Nature in Sant Llorenç del Munt i l'Obac has expanded its focus to better understand how recreational activities interact with sensitive habitats across the park.

While the first phase centred on a tailor-made, experimental technological solution designed specifically to monitor the Bonelli's eagle, Phase II marks a strategic shift. The project is now testing **lower-cost, replicable systems** that can be more easily scaled across different protected areas facing similar challenges. The aim is to move from a site-specific pilot to practical solutions that can be adapted and deployed more widely.

This second phase focuses on understanding how **recreational activities, particularly rock climbing and cave exploration**, interact with sensitive habitats and species, including **rock-nesting birds and bat colonies**. Working with the **Forest Science and Technology Centre of Catalonia (CTFC)**, the project is applying digital tools to generate reliable data that can inform evidence-based visitor management.

Cameras on popular climbing routes are generating detailed insights into the frequency and timing of climbing activity. The images collected are being used to develop an automated detection system that will allow park authorities to manage activity more efficiently in the future.

In parallel, acoustic sensors placed inside caves record bat activity during peak periods, while light-intensity sensors help assess patterns of human presence. Combined, this information help assess whether recreational activities overlap with sensitive periods for bat colonies, as well as verifying compliance with park regulations that restrict access to certain caves during these critical periods. This activity has been supported by the **Terrassa Mountaineering Club**, a local outdoor association assisting with device installation inside the caves. Their involvement highlights the importance of engaging local stakeholders in biodiversity managing efforts. By working collaboratively with the outdoor community, the project reinforces a shared commitment to conservation.

Key data and achievements to date

- 5 cameras active on climbing walls
- 3 LogCave light sensors installed in 3 caves
- 2 AudioMoth recorders installed in each of the 3 caves: one recording during the two hours after sunset and the other during the two hours before sunrise
- 13,000 images manually labelled from the climbing walls
- 1 climber-detection algorithm currently under development using these images
- 7,000 five-minute audio recordings collected, totalling close to 1TB
- Continuous light-intensity monitoring data from the 3 caves, which is being cross-referenced with bat activity



Ensuring responsible technology: legal and ethical guidance for protected areas

As digital tools become more common in conservation, Tech4Nature Spain is also breaking new ground on the **legal and ethical dimensions of monitoring technology in protected areas**. Alongside the deployment of technology on-the-ground, the initiative is developing a study, led by the Universitat Rovira i Virgili, to guide protected area managers, technology providers and public authorities in the responsible use of biodiversity and monitoring technology.

Early findings highlight that **no dedicated legal framework** currently regulates digital monitoring in protected natural areas at the international, EU, or Spanish national levels. Instead, parks must rely on existing frameworks such as data protection law (including the EU GDPR), environmental legislation, and rules governing the use of comparable technology in different sectors such as video surveillance and systematic monitoring in public spaces.

The study also outlines key **ethical considerations** that should shape any use of monitoring technologies. These include ensuring transparency for visitors, limiting data collection to clearly defined conservation needs, safeguarding confidentiality, avoiding algorithmic bias, and minimising the environmental footprint of the devices used. Strengthening the capacity of protected area authorities to manage data ethically is also identified as important.

To support decision-making for the equitable use of technology in protected areas, the research proposes a **step-by-step framework**: first defining the ecological or management justification for monitoring; then selecting appropriate technologies; assessing legal obligations and ethical risks; and confirming the capacity to manage data responsibly. Recommended practices include clear signage, data protection impact assessments, stakeholder consultation (including Free, Prior and Informed Consent when relevant), restricted data retention periods, and accessible mechanisms for questions or complaints.

The key results of this study will be synthesised into **practical guidelines on the responsible use of monitoring technologies in Spain's protected areas**, to be published in 2026. These guidelines will be an accessible tool that conservation practitioners can use to apply digital monitoring in ways that are lawful, ethical and fair, helping ensure that the transition to more technology-enabled conservation safeguards both nature and people.

Project partnership and contact information

For more information on the Tech4Nature Spanish Flagship please reach out to: lucia.prieto@iucn.org



The CTFC (Forest Science and Technology Centre of Catalonia) is a research centre located in Solsona (Catalunya, Spain). Tech4Nature is coordinated by the Biodiversity Management and Conservation Program, which is devoted to addressing the challenges posed by biodiversity loss and land-use changes owing to human activities. The program's main goal focuses on generating scientific knowledge to support decision-making in environmental policies and advancing innovative tools and methodologies for effective biodiversity monitoring and conservation.

The Barcelona Provincial Council is a local government institution that promotes progress and well-being across its territorial area: the province of Barcelona. In addition to its broader territorial role, the Barcelona Provincial Council is also the managing authority of the Parc Natural de Sant Llorenç del Munt i l'Obac, which forms part of the Network of Natural Parks under its administration.



**Diputació
Barcelona**

Since 2021, the Council has furthermore been a key partner in the Tech4Nature Spain flagship initiative, led by IUCN and Huawei. In Sant Llorenç del Munt i l'Obac, this collaboration supports the on-the-ground implementation of innovative monitoring pilots to better understand visitor impacts and improve the conservation of sensitive species such as Bonelli's eagle and bat colonies.



UNIVERSITAT ROVIRA I VIRGILI

The Rovira i Virgili University (URV) is the public university of southern Catalonia, internationally recognised for placing knowledge at the service of society and for its excellence in research and knowledge transfer. The legal and ethical analysis of the Tech4Nature project in Spain has been led by a multidisciplinary team from this institution.

The group brings together multidisciplinary expertise in international and EU environmental law, administrative and environmental regulation, and the legal frameworks governing protected areas and land stewardship. It includes specialists in visitor and biodiversity monitoring systems, complemented by practical experience in the management of Biosphere Reserves and public administration of natural spaces.



The International Union for Conservation of Nature (IUCN) is a membership Union uniquely composed of both government and civil society organisations. By harnessing the experience, resources and reach of its more than 1,400 Member organisations and the input of some 17,000 experts, IUCN is the global authority on the status of the natural world and the measures needed to safeguard it.

The IUCN Centre for Mediterranean Cooperation, IUCN's dedicated regional office in the Mediterranean region, is coordinating the implementation of the Spanish Flagship of the Tech4Nature project, working with national partners to apply innovative technological solutions for biodiversity conservation.

Founded in 1987, Huawei is a leading global provider of information and communications technology (ICT) infrastructure and smart devices. We have approximately 208,000 employees and we operate in over 170 countries and regions, serving more than three billion people around the world. We are committed to bringing digital to every person, home and organization for a fully connected, intelligent world.





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