

Promoting Biodiversity Conservation with Technology Innovation in Sant Llorenç del Munt i l'Obac, Spain

Daniel Pons Juliá, Conservation Officer and Biologist
Sant Llorenç del Munt i l'Obac Natural Park
Barcelona Provincial Council



Diputació
Barcelona

Xarxa de Parcs Naturals



Parc Natural de Sant Llorenç
del Munt i l'Obac

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The **Barcelona Provincial Council** manages a network of **14 protected areas**

Management areas:

- Conserve and value the **natural and cultural heritage**
- Promote **development compatible** with ecosystem dynamics and landscape quality
- Organise and ensure **public use**
- Provide **environmental education**
- Develop **management documents** and other **resources**





Parc Natural de Sant Llorenç del Munt i l'Obac

- **Type of park:** periurban, close to large cities with more than 200,000 inhabitants and access to the metropolitan area of Barcelona (5 million people)
- **Hectares:** 13,694
- **Annual visitors:** 318,840
- **Type of visitors:** recurrent users acquainted with the area
- **Outdoor activities:** mountain biking, running
- **Areas with high visitation:** La Mola, El Montcau



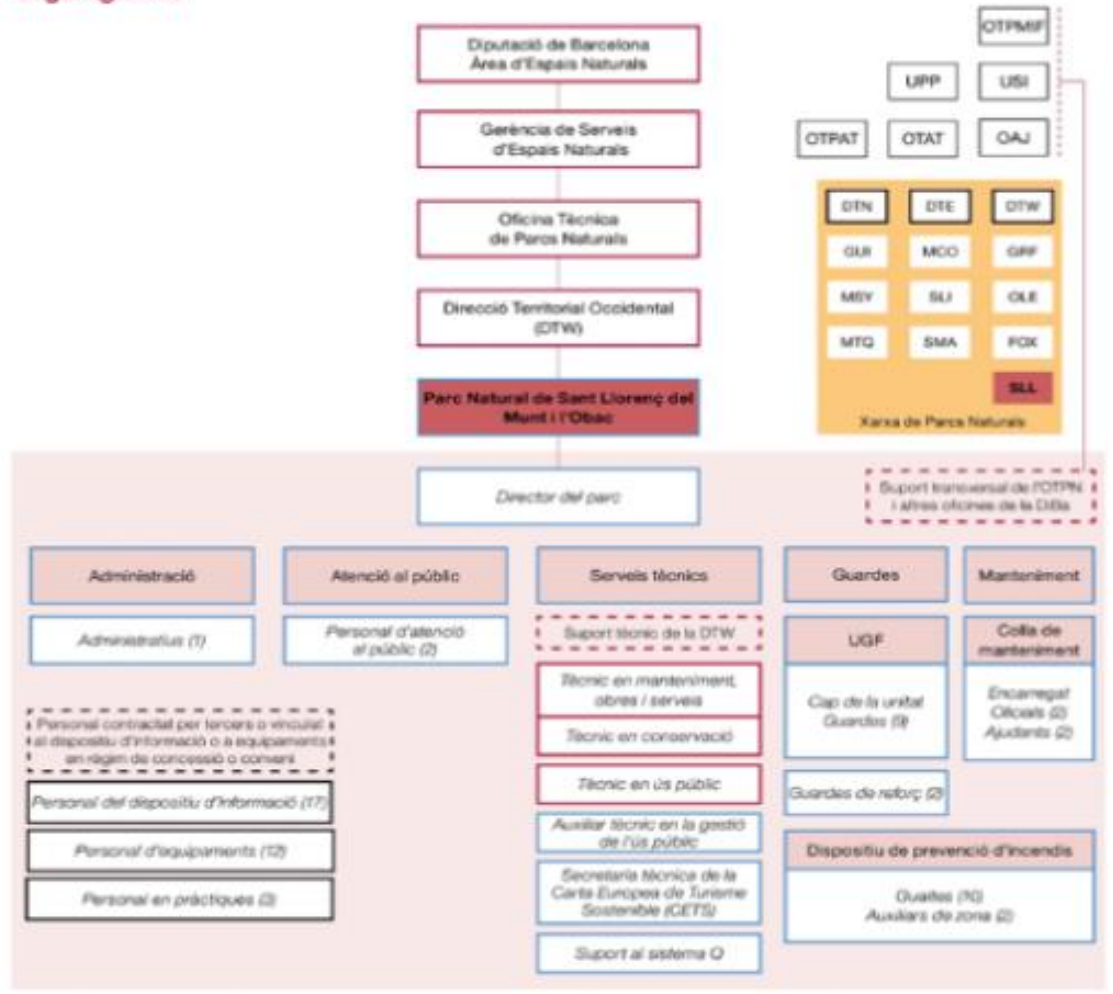
Natural and Cultural Values

- **Geology:** El Montcau and La Mola
- **Flora:** *Delphinium Bolosii*, *Saxifraga callosa* ssp. *Catalaunica*, *Polypodium vulgare*, *Arenaria fontqueri* ssp. *Cavanillesiana*, *Campanula speciosa*, *Cistus ladanifer*, *Myricaria germanica*, *Silene viridiflora*, *Spiranthes aestivalis*
- **Habitats:** 168 CORINE habitats, and 23 habitats of community interest (of which 7 priority habitats)
- **Fauna:** *Aquila fasciata*, *Circaetus gallicus*, *Neophron percnopterus*, *Bubo bubo*, *Falco peregrinus*, *Anthus campestris*, *Lullula arborea*, *Sylvia undata*, *Emberiza hortulana*, *Barbus meridionalis*, *Myotis capaccinii*, *Myotis myotis*, *Miniopterus schreibersii*, *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*
- **Cultural Heritage:** religious architecture (monastery of Sant Llorenç del Munt), military architecture, civil architecture (popular, elite)



Park Staff

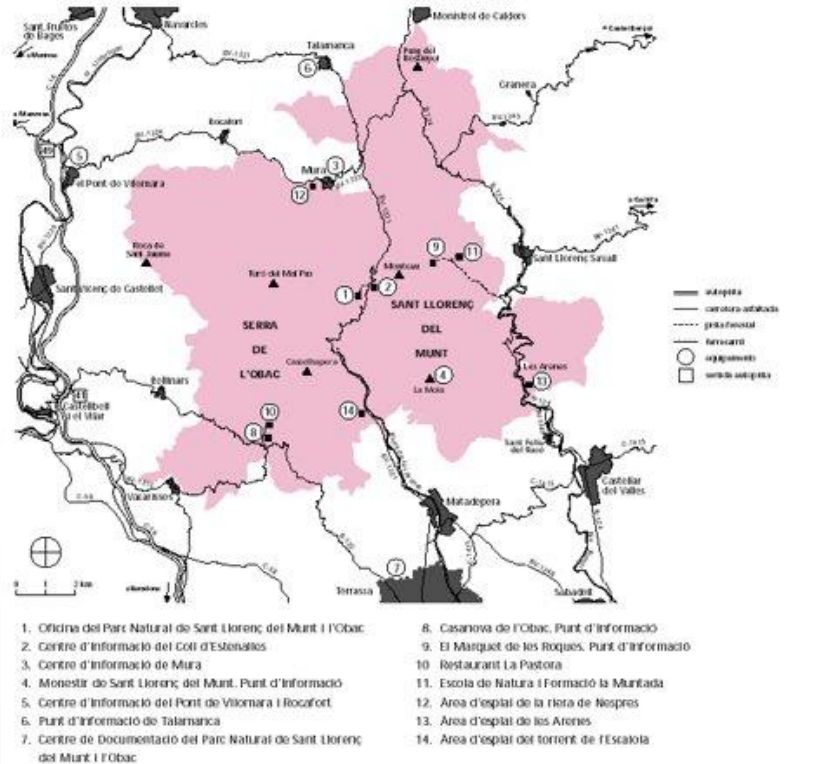
Organigrama



STAFF

- **Technicians:** 4
- **Administration:** 2
- **Maintenance:** 5
- **Rangers:** 10 (2+38 in summer)
- **Public use:** 4 (21+13 external support)
- **Central services:** planning, works and investment, admin and logistics support

Park Equipment



Nature and Training School - La Muntada



Visitors Center - Mura

Park Equipment



**Cultural Center -
Marquet de les Roques**



**Recreation area -
Escaiola stream**



**Cultural Center - Casa
Nova de l'Obac**

Wildlife Monitoring in the Park

CATÀLEG DE FLORA VASCULAR, FAUNA
INVERTEBRADA I FAUNA VERTEBRADA
DEL PARC NATURAL DE SANT
LLORENÇ DEL MUNT I L'OBAC

MEMÒRIA TÈCNICA I DIVULGATIVA

2020

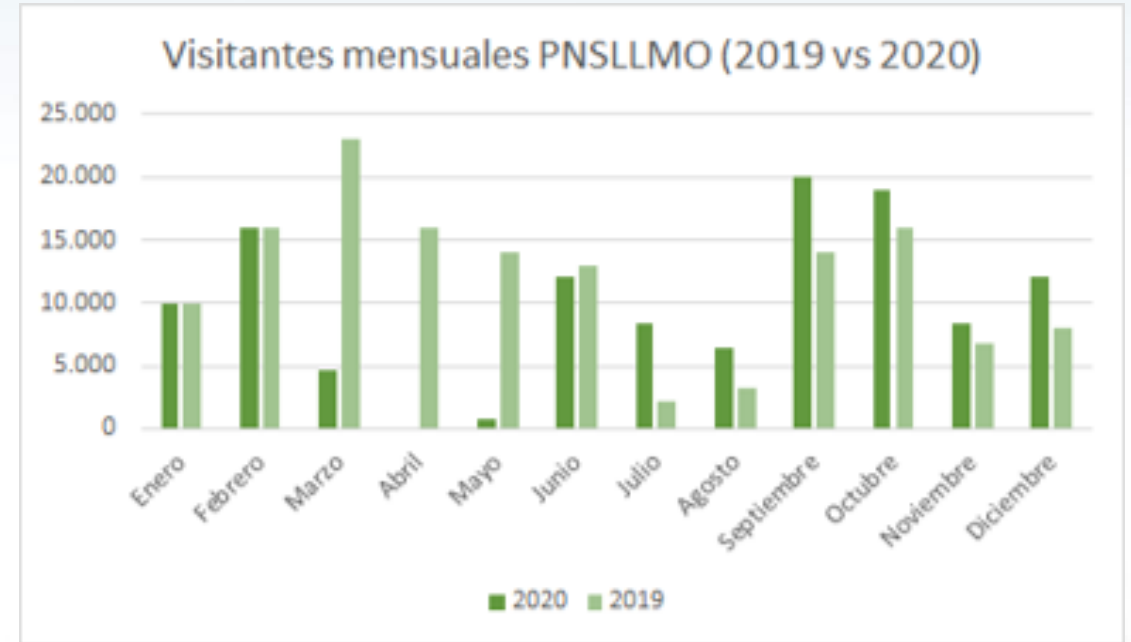
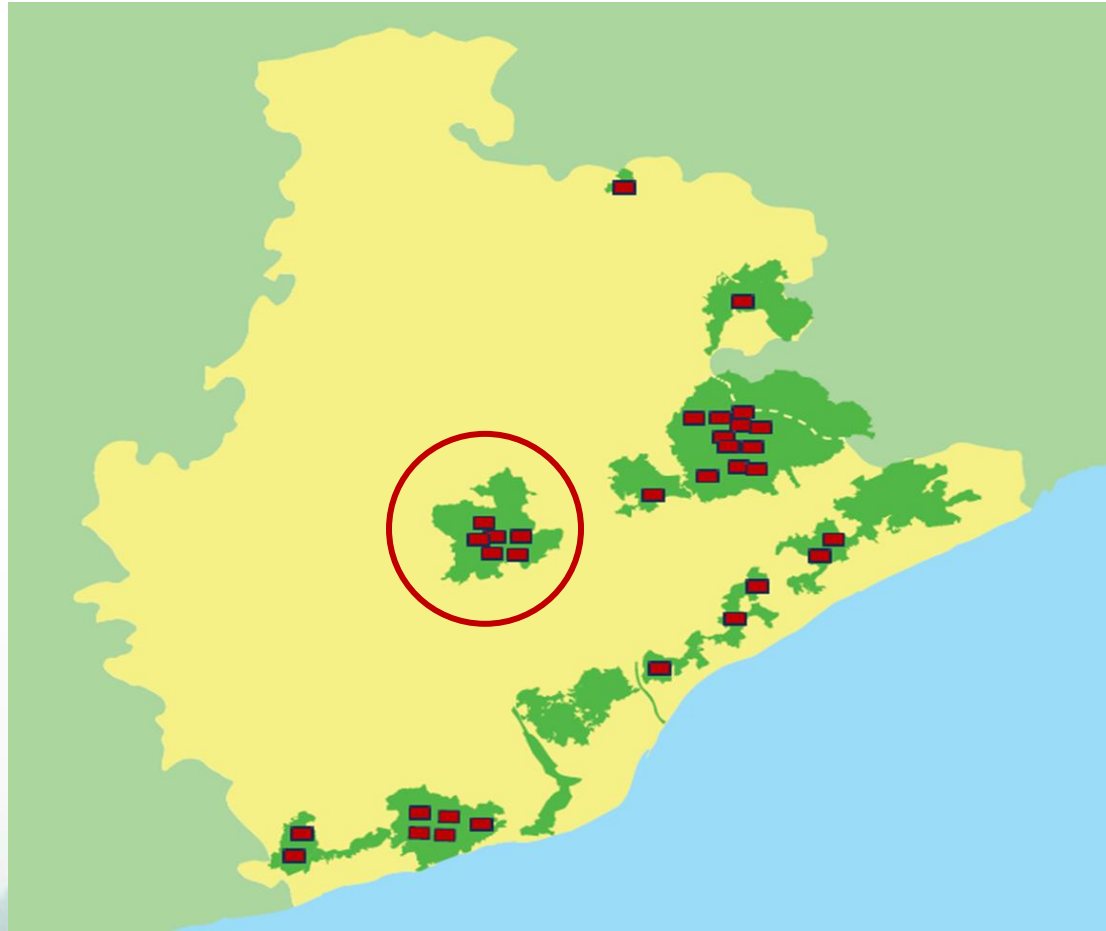
Roger Puig-Gironès



Inventory and classification of vascular plants, and invertebrate and vertebrate animals (cited, living or observed up to 2020)

Kingdom	Species	Vulnerability Status
Fauna	<i>Aquila fasciata</i>	Endangered
Fauna	<i>Xerocrassa Montserratensis</i>	Vulnerable
Flora	<i>Saxifraga callosa</i> spp <i>catalaunica</i>	Vulnerable
Flora	<i>Arenaria fontqueri</i> spp <i>cavanillesiana</i>	Vulnerable
Flora	<i>Erodium foetidum</i> ssp. <i>glandulosum</i>	Least Concern

Monitoring Technology in the Park



Key Visitor Data - 2023

- **Total estimated visits (parking lots, facilities, eco-counters): 391,337**
- **Facility users: 54,137**
- **Activities users (cultural, pedagogical): 23,348**

Tech4Nature – Current Connectivity and Technology Deployment in the Park

Visitor monitoring around park central area:

- **Automatic gaugers:** 4 to count visitors on foot, one of them with poor coverage. Two at Montcau (west and south access) and two at La Mola (north and south access). They detect direction, time and day. Data can be manually downloaded at any time, it is currently done once a month. Technology does not allow for real-time information

Eagle nesting area:

- Transmission possible via **point-to-point microwave** to the Rellinars town hall
- **Bandwidth:** 100 MB
- Before Tech4Nature, **no specific monitoring on footpaths** due to lack of resources
- No knowledge of **new trends and areas of interest** (obsolete maps)
- No data to evaluate the **impact of bicycles on unofficial trails** apart from observations

Tech4Nature – State of the Arts Assessment

Technique	Frequency/Periodicity	Application	Data	Limitations
Accountants/ Gaugers (5)	Daily	Accesses to 'La Mola' and 'Montcau'	Number of persons; manual e xtraction	Manual extraction; insufficient; periodic maintenance; only people are counted
Field counting	Weekends and holiday s	Main car parks	Counting of vehicles	No labour data; estimate of persons per vehicle
Surveys at information p oints	Daily; weekends	Visitors center	Characterisation of visitors	Limited scope

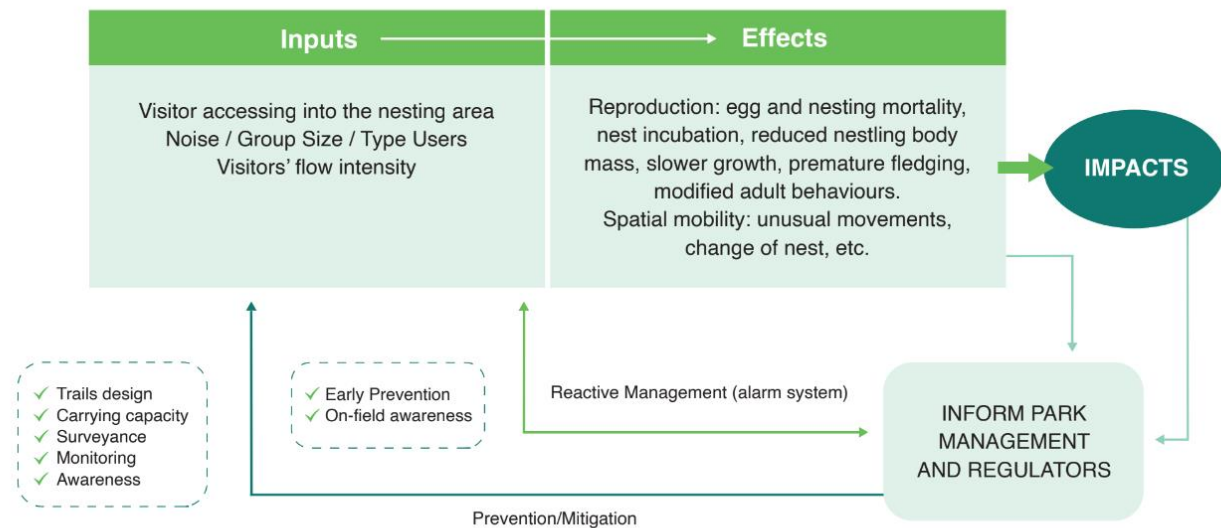
Tech4Nature – Assessment of Park Needs

Need	Associated problems	Possible solutions identified
To know the exact number of visitors	Manual counting and 4 sensors at the start of trails (of which 1 has poor coverage). Controlling the influx is especially important in parking areas and during weekends.	Automatic counting and further installation of sensors. The central area is well known but the isolated areas are not. Frequency detection system, to count the number of mobile phones in the NP.
To know the number of visitors in real time	Current technology does not allow for real-time information. Information is extracted manually from current meters. Especially problematic in parking areas.	Frequency detection system: Automatic telephone counters placed at main entrances, communicating the number in real time. Especially useful for planning ahead (closing parking areas before they fill up, this reduces the noise impact on neighbours) and improves the visitor experience.
To know the spatial temporal mobility	Visitor behaviour inside the park is not known. There is no knowledge of new trends, such as new areas of interest disseminated through Instagram or new routes (maps have become almost obsolete to know the movement of visitors).	Keep track of visitor mobility with location maps of the photographs uploaded to SM (especially at points of high visitor frequency). Also, thanks to the use of open data in apps such as Strava, Wikiloc.
Monitoring the impact of public use on wildlife behaviour	Unplanned routes and the consequent human impacts on wildlife (e.g. loss of bird nests due to families going camping) are unknown. In climbing, there are established routes, and climbers can be instructed not to go on mountains where there are young birds of prey (they obey well if they are informed of the situation - more	Acoustic sensors. Audiomoth. Determine the relationship between anthropogenic and natural sounds. Study their impact on the environment to carry out an adaptive management. Pilot project in design phase. Regulation of good practices adaptable according to the season of the year, i.e. according

Tech4Nature - Bonelli's Eagles

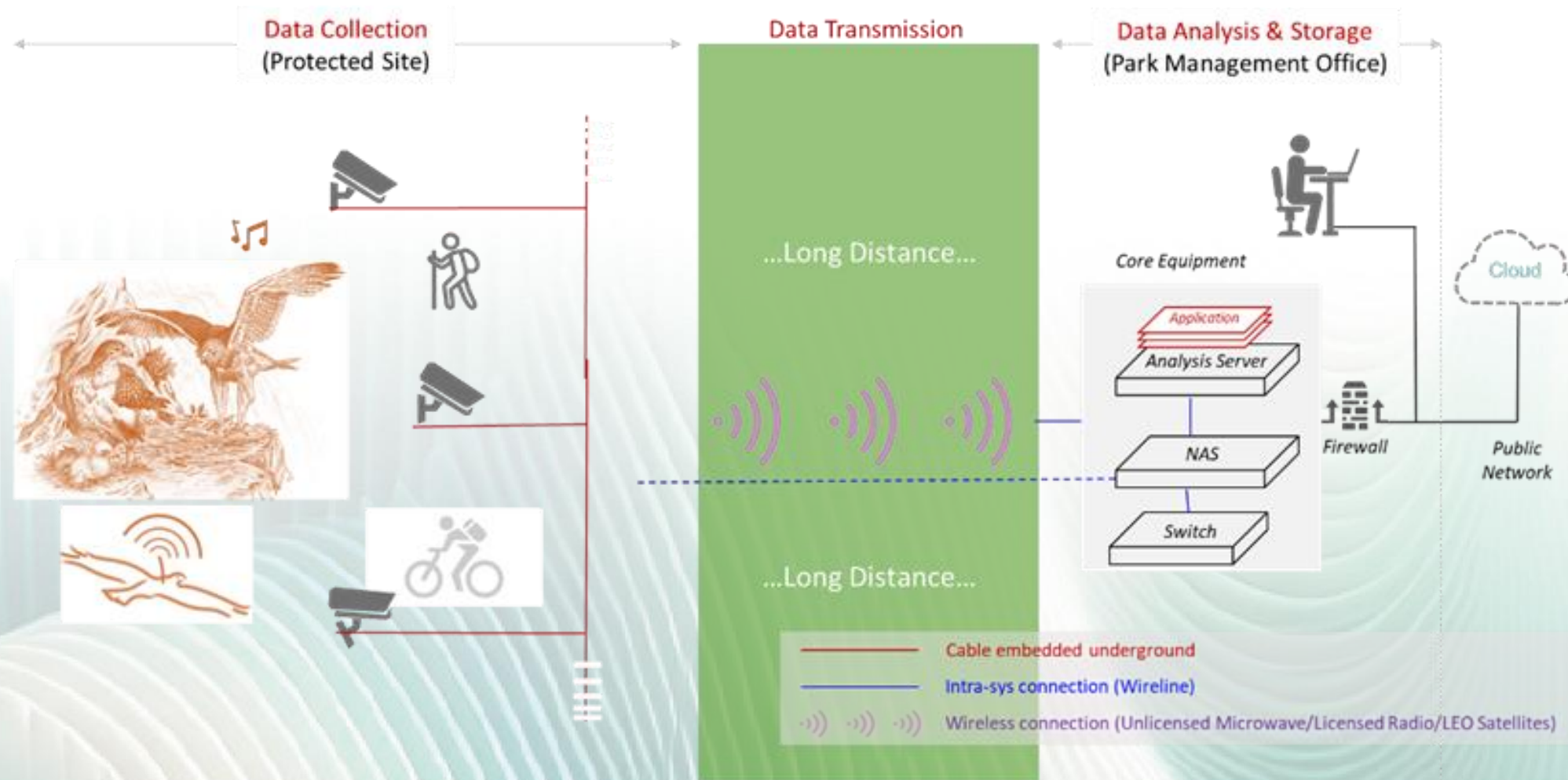
Understand the **correlation between visitor mobility and the behavioural patterns of Bonelli's Eagles**, via:

- Installation of a technological solution based on cameras and GPS trackers
- Development of a monitoring model of the interaction between visitors and wildlife



Tech4Nature - Bonelli's Eagles

Protected Site e-Fence: Data Collection -> Data Transmission -> Data Analysis & Storage



Tech4Nature - Actions



- Installation of **cameras with microphones**
- **GPS trackers** / Movebank Platform
- **Axis Station software with metrics and alerts** for potential territory expulsion, nest absences, users near the nest, and noise thresholds
- **Annual reports** on spatial mobility, interactions and critical events

[Video from camera](#)

Tech4Nature – Alert System GPS

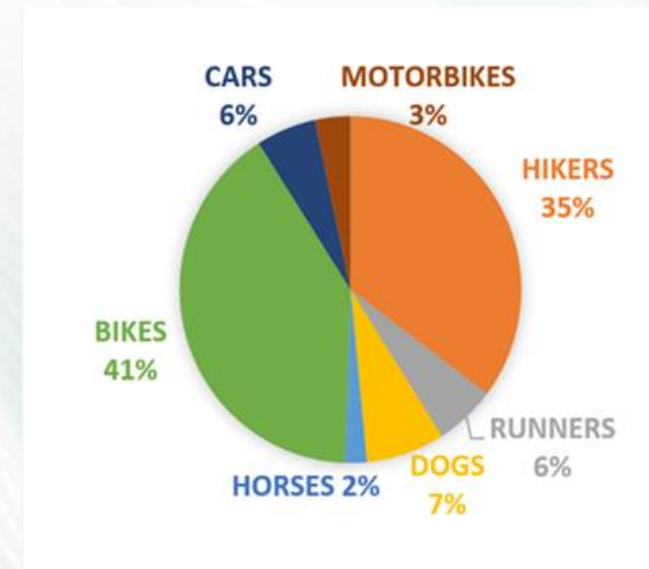
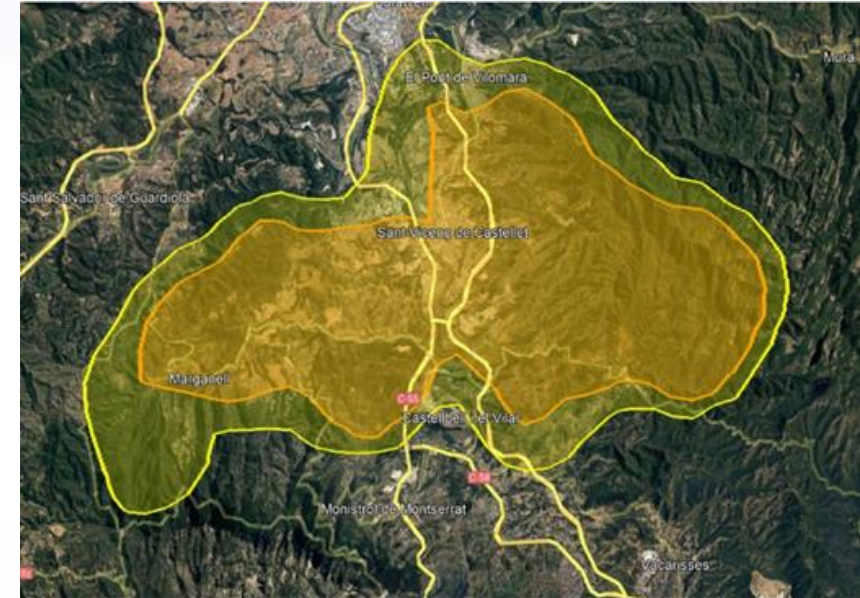
Alert	Definition	Who receives it	Protocol
Possible mortality	Movement less than 300 meters in 24 hours, or X consecutive locations without moving 300 meters	Bosch & Parés (automatic alert)	1)The degree of danger is verified on the orthophoto on-screen. 2) If it's high, you have to go to the point with AR. 3) The Park and the ranger station are also notified. 4) Possibilities: dead eagle, injured eagle, transmitter fall. 5) The result is communicated to the rest of the collaborators and to the SFF. 6) If it is during the breeding period, it may be necessary to intervene with the chicks; the SFF decides this.
Possible expulsion from the territory	Locations outside the usual territory	Bosch & Parés (not automatic, detected with location control)	Communication is made to the rest of the project collaborators and to the SFF.
Transmitter is not sending data	Possibilities: transmitter falling out of mobile coverage, transmitter malfunction.	Bosch & Parés (automatic alert)	1)Waiting is necessary. 2) Communication is made to the rest of the project collaborators and to the SFF.
Low battery and not transmitting	It could be due to low solar radiation or the solar panel being covered or dirty.	Bosch & Parés (automatic alert)	1)Waiting is necessary. 2) Communication is made to the rest of the project collaborators and to the SFF. Waiting until June 30 to deactivate the transmitter.

Tech4Nature – Alert System Cameras

Period	Alert	Definition	Who receives it	Protocol
Incubation or chicks less than 20 days old	Nest without adults for 30 minutes	No adults in the nest for 30 minutes; there is a risk of the eggs or small chicks getting cold.	Rangers	1)It's a first pre-alert. 2) Cameras are monitored for any disturbances, people in front of the nest; if there are, assistance is provided.
Incubation or chicks less than 20 days old	Nest without adults for 40 minutes	No adults in the nest for 40 minutes; there is a risk of the eggs or small chicks getting cold.	Rangers	1)It's a second pre-alert. 2) Cameras are monitored for any disturbances; if there are none, the ranger station approaches the breeding sector to locate other possible disturbances.
Incubation or chicks less than 20 days old	Nest without adults for 50 minutes	No adults in the nest for 50 minutes; there is a risk of the eggs or small chicks getting cold.	Rangers. Rangers inform biologist and director	1)It's an Alert. 2) Cameras are monitored for any disturbances; if action is required (assistance), the ranger station approaches the breeding sector to check for other disturbances. 3) Previous images are reviewed. 4) Previous audios are reviewed. 5) Previous locations are checked if possible. 6) Biologist and director make decisions.
Chicks in the nest from 20 to 40 days old	Nest without adults for 2h	No adults in the nest for 2 hours; there is a risk of predation.	Rangers	1)It's a first pre-alert. 2) Cameras are monitored for any disturbances.
Chicks in the nest from 20 to 40 days old	Nest without adults for 3h	No adults in the nest for 3 hours; there is a risk of predation.	Rangers	1)It's an alert. 2) Cameras are monitored for any disturbances; assistance is provided if needed. 3) The locations of the male and female are checked. 4) If there is an individual in the breeding sector, it's not a problem. 5) If there are no adults in the breeding sector, the biologist is notified, and the breeding sector is observed from a distance.
Chicks in the nest more than 40 days	Nest without adults for 4h	No adults in the nest for 4 hours; there is a risk of predation.	Rangers. Rangers inform biologist and director	1)It's an alert. 2) Cameras are monitored for any disturbances; assistance is provided if needed. 3) The locations of the male and female are checked. 4) If there is an individual in the breeding sector, it's not a problem. 5) If there are no adults in the breeding sector, the biologist is notified, and the breeding sector is observed from a distance.

Tech4Nature - Results

- **Recognition of territory:** nesting and feeding area
- **Territorial defense** against neighbouring pairs
- **No nesting occurs**
- **Male death** from electrocution and new colonisation
- **GPS and camera tracking data** and key assessments
- **Spatial-temporal characterisation of the trail:** movements, group typology, temporal dynamics, trail use practices
- **Compliance with regulations**



Tech4Nature – Lessons Learned

- **Remote trail monitoring with cameras:** integrate Object Analytics software and Network Attached Storage (NAS)
- **Insolation conditions of GPS solar panels:** use dual solar panel transmitter to maintain maximum battery charge
- **Threats outside the park:** better understanding of threats is essential for a more accurate estimation of its vital domain under optimal reproductive conditions
- **Noncompliance with public use regulations:** persuasive communication messages need to be deployed to avoid trail departures
- **Integration of systems for continuity over time:** integrate data collection, analysis and alert systems with the park's different management processes

Tech4Nature Spain – Award '100 Best Ideas'



The background features a light teal and white color palette. On the left side, there is a faint silhouette of a bar chart with several vertical bars of varying heights. The rest of the background is filled with a pattern of wavy, concentric lines that create a sense of depth and movement, resembling a stylized landscape or a topographical map.

Thank You