Strategic biodiversity baseline and ecosystem services, within the scope of E-REDES' biodiversity strategy (BASELINE4BSE)

Sustainability

22 April 2026

Contents

E-REDES

01

Context

Context

Integrating biodiversity into the management of grid infrastructure

Strategic commitment to reduce the impact of grid infrastructure on biodiversity and **the environment**
The EDP Group has set the commitment to a no net loss approach to biodiversity, or even a net gain, in 100% of its new projects by 2030.

Fuel management as an opportunity for biodiversity
E-REDES has a legal obligation to manage fuel management strips (FGC) beneath power lines, ensuring infrastructure safety and fire prevention, and can, in this context, promote compatible land uses (agriculture, scrubland and grasslands), as provided for in the applicable legal framework.

Need for a structured approach to biodiversity
FGC management takes place in areas with relevant ecological value, often in proximity to or overlapping with protected areas. The absence of an *baseline* of integrated biodiversity limits monitoring, impact assessment and the definition of effective management measures.

The BASELINE4BSE project
Partnership between The Equator Company (S317 Consulting) and cE3c (University of Lisbon)

- Focus on high- and medium-voltage lines managed by E-REDES in mainland Portugal
- *Baseline* of integrated biodiversity: fauna, flora, land use, ecosystem services, protected areas
- Monitoring network designed with *Spatial Conservation Planning*

The Equator Company

cE3c centre for ecology, evolution and environmental changes

BASELINE4BSE Project Structure

Completed phases

PHASE 1

Biodiversity Baseline

WP1

1 Digital mapping of Habitats and Ecosystem Services

- Habitats
- Ecosystem services
- Threats (threatened species and habitats)

2 Digital biodiversity mapping

- Species
- Conservation statuses
- Threats (threatened species and habitats)

WP2

3 Production of an integrated database and digital mapping

- Biodiversity hotspots
- Conservation areas
- Threats
- Potential impacts

PHASE 2

Monitoring network

WP3

4 Design of the monitoring network

- Scenario planning
- Constraints and risks
- Consultation with E-REDES
- Field validation

5 Digital mapping of the monitoring network

- Monitoring areas
- Factsheets on biodiversity

Results include mapping

02

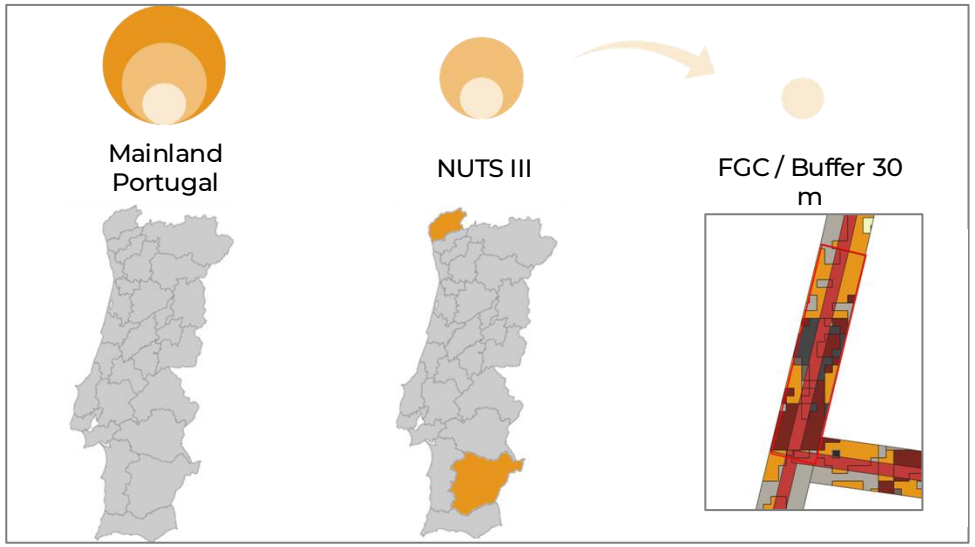
General methodological approach

Study area

AREAS UNDER THE POWER LINES MANAGED BY E-REDES IN MAINLAND PORTUGAL

- **The areas under the power lines (high and medium voltage)** managed by E-REDES
- All of **mainland Portugal**
- Structuring the analysis by **NUTS III sub-regions**, ensuring territorial coherence
- Definition of **two units of analysis:**
  - FGC (*Faixas de Gestão de Combustível* – Fuel Management Strips*)* – area directly under the power lines
  - Buffer (30 m) – surrounding area for ecological context

Multiscalar approach



FGC and Buffer as units of analysis → Detail on the next slide

Unit of analysis

Fuel Management Strips and Buffers

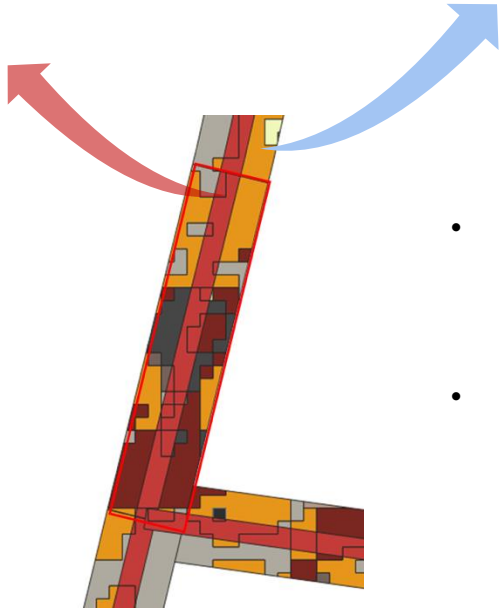
FGC – Fuel Management Strip

Strip reserved for fuel management, with the aim of reducing the risk of fire and protecting the infrastructure. For AT lines, the total width of the FGC is 25 metres (12.5 m on each side of the line). For MT lines), the total width of the FGC is 16 metres (8 m on each side of the line).

Buffer 30m

In addition to the FGC, this study incorporates a 60-metre buffer zone (30 metres on each side of the line). It is important to note that the buffer zone includes the full width of the FGC and an additional area, allowing a more accurate biodiversity survey.

- Area for implementing on-the-ground management actions
- Can be used to monitor and classify habitat within the strips



- Used to identify habitats in the area where the management strip is located, as it covers a wider area, which allows a more accurate biodiversity survey
- Basis for choosing the best areas for applying mitigation measures

02

Phase 1: Biodiversity Baseline

Objectives

Phase 1: Biodiversity Baseline

Data collection

Phase 1 began with the collection and integration of different sources of information relevant to biodiversity.
Spatial land-use data, species, habitats and protected areas were used.

Processing and analysis

The data were processed, harmonised and analysed, including land-use reclassification and the integration of relevant ecological variables.
This stage made it possible to characterise the territory and identify biodiversity patterns.

Production of the *baseline*

Based on the analysis carried out, the biodiversity baseline was produced, including mapping and indicators that reflect the current state of natural values in the areas studied.

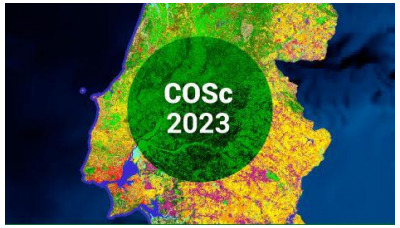
Integrated digital mapping Biodiversity Baseline

This phase resulted in the spatial characterisation of biodiversity in the areas under E-REDES power lines.
It forms the basis for defining the monitoring areas in Phase 2.

Methodology

Data sources used

LAND COVER CLASSES



COS - Land Use and Land Cover Map

- Reference mapping at national level and the most widely used for matters related to land use
- Vector product updated every 3 years

COSc - Conjunctural Land Cover Map

- Represents land cover in a specific year
- Annual *raster* product based on Sentinel-2 satellite imagery and other supporting data

***OSPOC** (Land covers with potential for compatible land uses)*

For this study, the land cover classes of **agriculture, scrub and grasslands** were assumed to have potential for compatible land uses, since these are the ones that most directly have the potential to be framed as compatible land uses, as provided for in legislation.

https://smos.dgterritorio.gov.pt/cartografia-de-uso-e-ocupacao-do-solo

SPECIES

LISTA VERMELHA DA FLORA VASCULAR DE PORTUGAL CONTINENTAL

LIVRO VERMELHO DOS MAMÍFEROS DE PORTUGAL CONTINENTAL

LISTA VERMELHA DA FLORA VASCULAR DE PORTUGAL CONTINENTAL

- Review of the **literature** and **existing studies** (identification based on COS and COSc)
- Field **validation**
- Compilation of information on **threats** and **conservation status**, in accordance with the respective Red Books and IUCN status
- The list of compiled species was prepared based on the analysis of the **Buffer zone,** and not only the Management Strips.

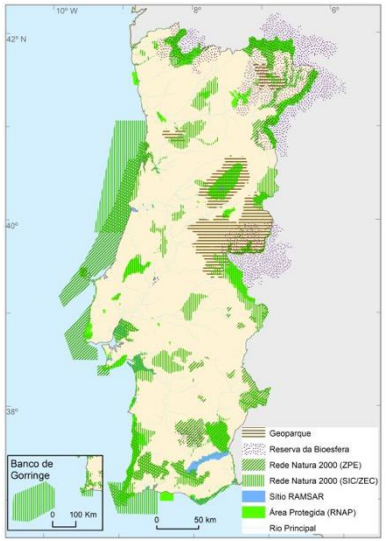
Methodology

Data sources used

ECOSYSTEM SERVICES

- The identification of ecosystem services was based on the 'Common International Classification of Ecosystem Services 5.1'
- CICES has been widely adopted by the ecosystem services community and is, for example, the framework used in the Mapping of Ecosystem Services of the European Union (MAES), which aims to map ecosystem services at European scale.
- Using a similar approach, for this work we associated the different land-use types obtained in 2.2 with the ecosystem services typology in CICES.
- For each ecosystem services typology identified for the FGCs and Buffers, the area occupied in each section defined by the SAP ID was calculated.

PROTECTED AREAS



- The overlap area between the FGCs and Buffers and the national network of protected areas and the Natura 2000 Network was also calculated.
- The digital databases available on the GeoCatálogo portal of ICNF were used, from which, in addition to the nomenclature of each protected area, information was also extracted regarding the codes (four digits) and habitat types of Annex I of the Habitats Directive.
- These results are also presented for each section defined by the SAP ID code.

https://cices.eu

https://geocatalogo.icnf.pt/catalogo.html

Results

General indicators

Results of the biodiversity baseline for the E-REDES network in mainland Portugal, reflecting the characterisation of land-cover classes, fauna and flora species, ecosystem services and classified areas.

These data provide E-REDES with a solid basis for informed decisions, with monitoring indicators that are robust and reflect biodiversity performance along the distribution network lines.

Indicator class	Indicator	Value (based on the buffer)	Value (based on the FGC)
Land-cover	**OSPOC (Agrículture+grassland+meadows)**	72%	76%
	% grassland	14%	16%
	% scrubland	13%	14%
	% agriculture	44%	45%
	Forests	19%	14%
	% eucalyptus	6%	6%
	% pine forests	3%	3%
	% native forest (oaks)	3%	3%
	% deciduous	3%	3%
	% cork oak and holm oak	5%	1%
	Other	9%	10%
	% artificial	6%	10%
	% without vegetation	3%	6%
	% water	0%	0%
	% moist areas	0%	0%
Classified areas	% protected areas	5%	4%
	% Natura 2000	12%	11%
Ecosystem services	Ecosystem services (all types)	44/44[1]	44/44
	Regulation and Support	16	16
	Provisioning (biotic/biophysical)	15	15
	Cultural	8	8
	Provisioning (abiotic/geophysical)	5	5
Fauna	N° threatened/emblematic species	80/98[2]	80/98
	N° species CR	10/13	10/13
	N° species EN	28/33	28/33
	N° species VU	42/52	42/52
Flora	N° threatened/emblematic species	348/381[2]	348/381
	N° species CR	71/84	71/84
	N° species EN	120/128	120/128
	N° species VU	157/169	157/169

1 | There is a total of 105 ecosystem services (CICES V5.2 classification), but 44 ecosystem services relevant to the analysis area – all those that could potentially occur within the E-REDES action area were considered in the analysis.

2 | Number of species in relation to the total number of species in the same threatened categories existing in Portugal.

3 | Sources
Land cover – COS and COSc
Classified areas – DGT
Ecosystem services – TEEB, MAES
Fauna and flora – Red Books, atlases, publications

Results

Land use

At mainland Portugal level, the **distribution of land-use types in the 30m buffer is almost identical to that of the FGC.**

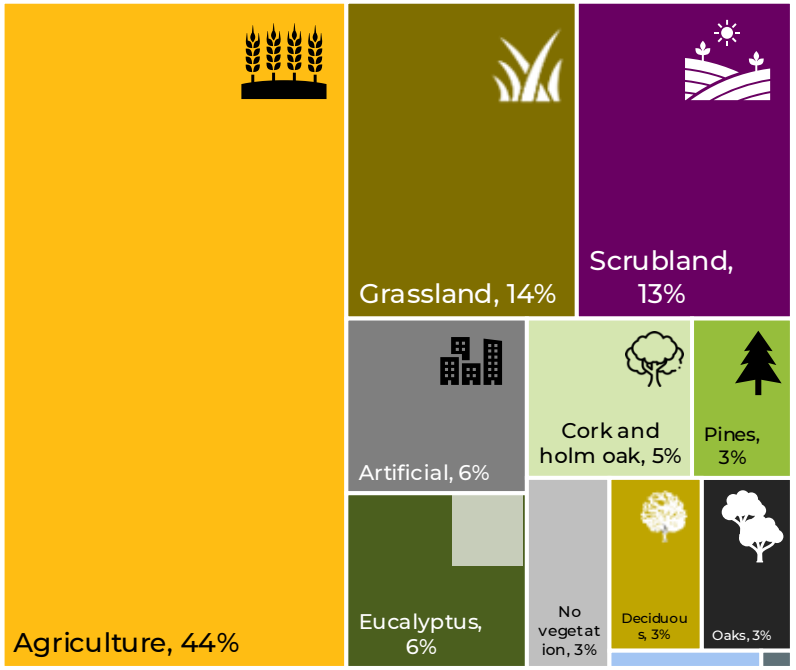
In the 30m buffer analysis, agricultural land predominates, with 44% of the area occupied.

Grasslands and scrub follow as the most relevant land-use classes with 14% and 13% of the area, respectively.

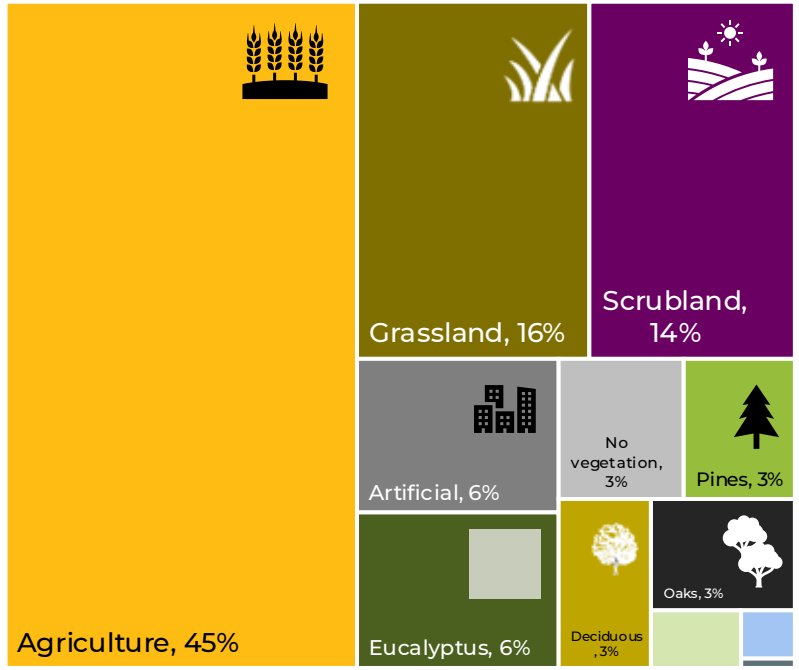
Despite being more prominent in some analysed regions, eucalyptus plantations represent 6% of the area analysed. Pine forest **represents** only 3%.

Oaks, indicators of Native Forest, represent only 3% of the area.

30m BUFFER

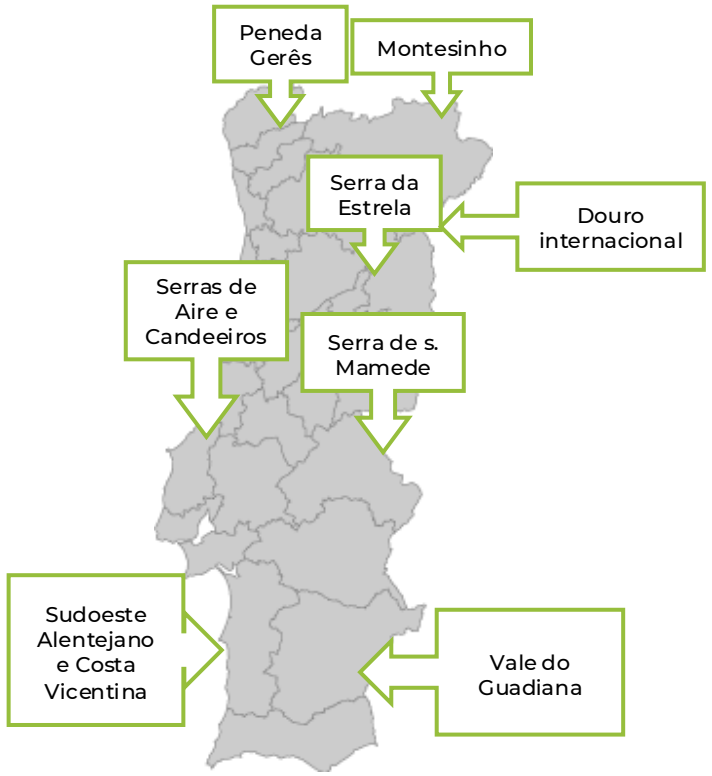


FGC (SPAN)



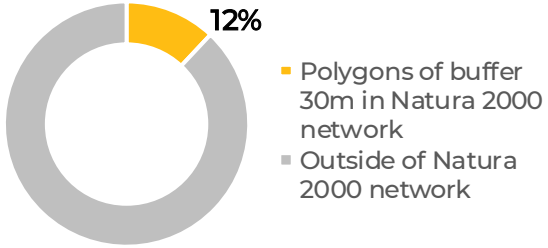
Results

Classified areas (Natura 2000 Network and protected areas)



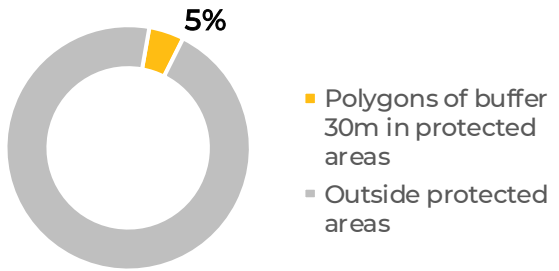
12%
of the analysed buffer lies within the Natura 2000 Network

Natura 2000 area	Area (ha) Buffer 30m	Area (ha) FGC
Costa Sudoeste	7 053	2 050
Sicó / Alvaiázere	3 122	988
Serras de Freita e Arada	3 101	970
Caia	3 097	927
Peneda / Geres	3 023	860
Comporta / Gale	2 736	841
Cabeção	1 839	559
Monchique	1 711	502



5%
of the analysed buffer is part of protected areas

Protected area	Area (ha) buffer 30m	Area (ha) FGC
Serra da Estrela	2 448	776
Sudoeste Alentejano e Costa Vicentina	2 201	618
Douro Internacional	2 080	575
Serra de São Mamede	1 778	492
Serras de Aire e Candeeiros	1 528	438
Vale do Guadiana	1 509	414
Montesinho	1 359	375
Peneda Gerês	1 094	311



Results

Ecosystem services

Through the mapping developed, it was possible to quantify the area associated with the services ecosystem services present in the project's area of influence.

Provisioning services, namely areas intended for cultivation and livestock rearing, stand out as the services most present in the analysis carried out.

These services contribute directly to the availability of biological resources.

45%
of the FGC areas is associated with provisioning ecosystem services

Ecosystem services sections	Buffer 30m % area	FGC % area[2]
Provisioning (biotic/biophysical)	45%	45%
Cultural	29%	29%
Regulation and Support	26%	26%
Provisioning (abiotic/geophysical)	0%	0%

Ecosystem services groups	Buffer30m (%)	FGC (%)
Provisioning (biotic/biophysical)	**45%**	**45%**
Animal genetic material	11%	11%
Genetic material from plants, algae or fungi	10%	10%
Cultivated terrestrial plants	10%	10%
Wild plants (terrestrial and aquatic)	8%	8%
Livestock	4%	4%
Wild animals (land and aquatic)	2%	2%

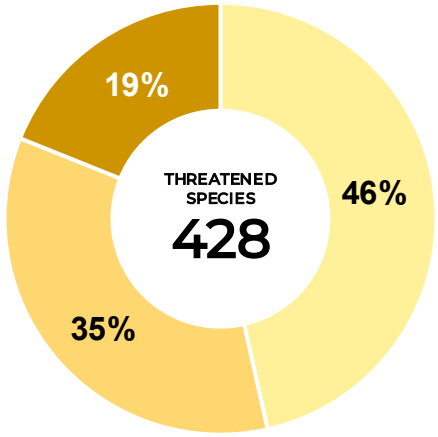
[2] *The indicators were calculated based on the total area occupied by the ecosystem services identified, noting that the same area may support multiple ecosystem services.*

Results

Species – fauna and flora

Threatened categories

NOT EVALUATED	DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	ENDANGERED	CRITICALLY ENDANGERED	EXTINCT IN THE WILD	EXTINCT
NE	DD	LC	NT	VU	EN	CR	EW	EX



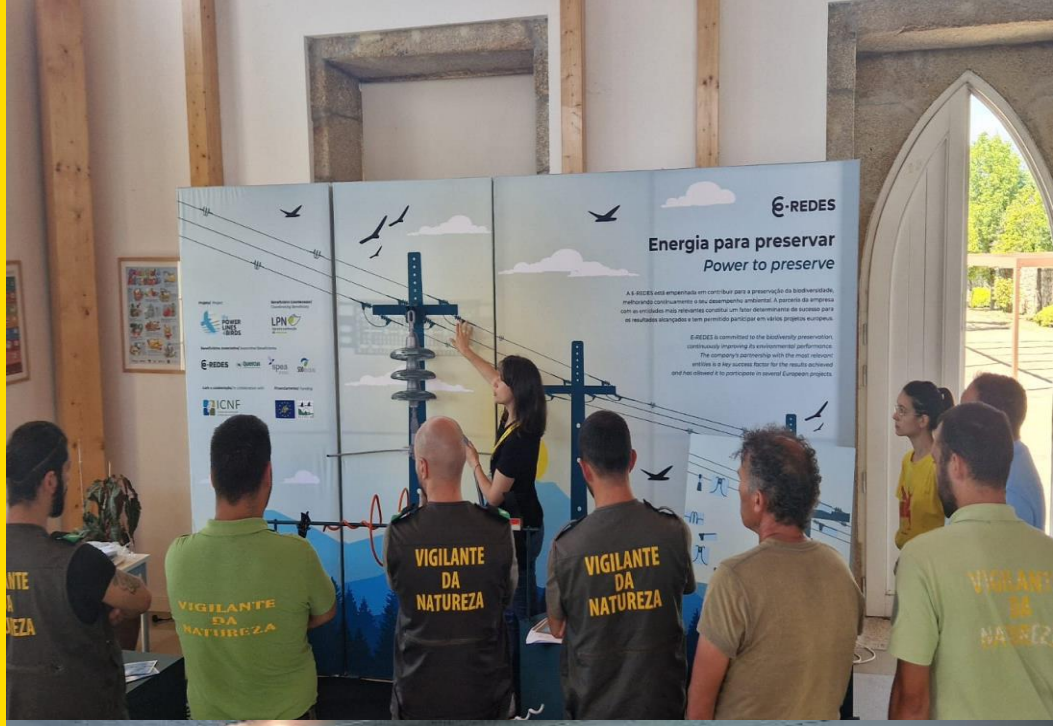
Number of focus species[1] identified (area E-REDES/Continental Portugal)					
Threat status	*Mammals*	*Birds*	*Amphibians and Reptiles*	*Plants*	TOTAL
VU	11/11	22/32	9/9	157/169	199/221
EN	10/10	16/21	2/2	120/128	148/161
CR	1/1	9/12	-	71/84	81/97
TOTAL	22/22	47/65	11/11	348/381	428/479

428
threatened species in E-REDES management areas

[1] *Threatened species of amphibians, reptiles, birds, mammals and plants in the study area.*

03

Phase 2: Conservation Planning



E-REDES

Objectives and approach

Phase 2: Conservation Planning

Baseline assessment (*baseline* biodiversity)

Phase 2 of the project is based directly on the results of Phase 1: Biodiversity Baseline.
The collected and analysed data were used, as well as the digital mapping produced, to support the definition of the monitoring areas.

Monitoring network design

The network design was developed in co-creation with E-REDES and other stakeholders, through the definition and assessment of different scenarios, considering ecological, operational and feasibility criteria.

Field validation

Field validation aimed to verify the suitability of the selected areas, confirming the presence of the identified natural values and adjusting the monitoring network whenever necessary.

Mapping *Conservation Planning*

This phase focused on defining a selection of monitoring areas.
The objective was to ensure coverage of the identified natural values, maximising representativeness within the smallest possible area.

Methodology

Marxan *Conservation Planning*

The *Conservation Planning* approach using Marxan was applied to the E-REDES network (~80 thousand ha, considering the area of the FGCs of power lines), enabling monitoring areas to be selected efficiently and based on ecological criteria.

FLEXIBILITY

The Marxan tool allows flexibility in its application, enabling its use:

- Extensively (across the entire network area)
- Strategically and selectively (in pilot areas) to obtain a representative sample of the network's biodiversity

ROBUSTNESS AND VALIDATION

The robustness of the Marxan model is demonstrated by its extensive application and rigorous validation:

- Widely tested and validated tool
- With particular emphasis on its use in linear systems (such as rivers, including a reference study for the Iberian Peninsula)

MARXAN

- The Marxan algorithm was used to support the definition of a biodiversity monitoring network.
- Selects **areas that meet conservation objectives** at minimum cost (smaller area, lower costs).
- The analysis is based on defining different **scenarios**, incorporating **valuation and penalty variables**, which influence the selection of areas.

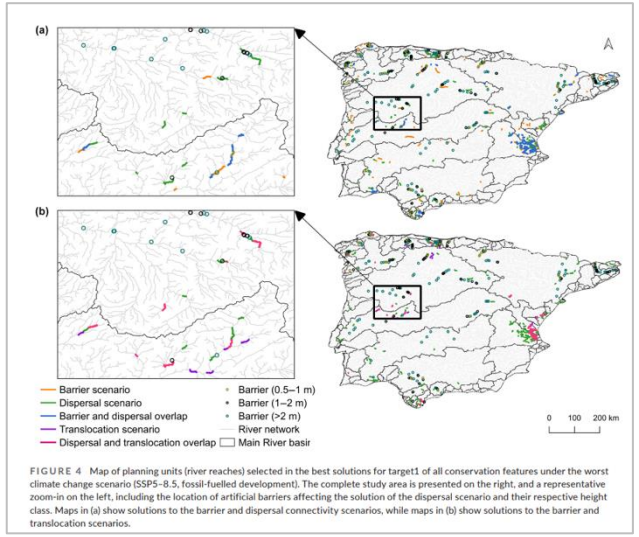


FIGURE 4 Map of planning units (river reaches) selected in the best solutions for target1 of all conservation features under the worst climate change scenario (SSP5–8.5, fossil-fuelled development). The complete study area is presented on the right, and a representative zoom-in on the left, including the location of artificial barriers affecting the solution of the dispersal scenario and their respective height class. Maps in (a) show solutions to the barrier and dispersal connectivity scenarios, while maps in (b) show solutions to the barrier and translocation scenarios.

Global Change Biology | Environmental Change Journal | Wiley Online Library

Methodology

Variables considered for selecting biodiversity monitoring areas

- The Spatial Conservation Planning with Marxan uses a scenario-based approach, incorporating valuation variables (conservation targets) and penalisation variables (constraints) for selecting monitoring areas.
- The scenarios were defined progressively, integrating different levels of constraint and valuation.
- These variables were agreed with E-REDES and relevant stakeholders.

SCENARIO SETTING

- The variables are combined into progressive scenarios, allowing different levels of constraint and valuation to be assessed.
- The results are subsequently combined, identifying areas of greatest consensus for monitoring.

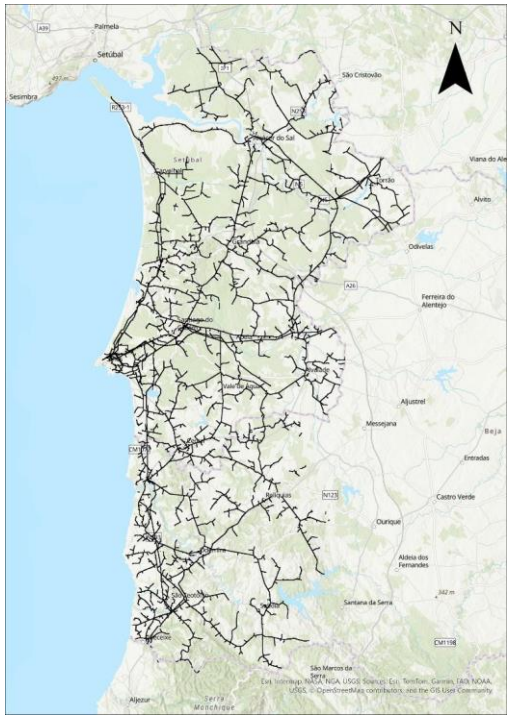
Valuation variables
Fauna species (CR, EN, VU)
COS - Land Use and Land Cover Map, reclassified
OSPOC (grassland, scrubland and agriculture)
Natura 2000 habitats
Protected areas and Natura 2000
NGO variables
→ Ecological corridors 2030
→ Critical bird areas
→ Micro-reserves
→ Critical areas for invertebrates
→ Important Bird Areas (IBA)
→ Biosphere Reserve Areas
→ RAMSAR areas
→ Biogenetic Reserves

Penalisation variables
Rural fire hazard map
Urban areas
National Road Network
Constraints identified by E-REDES

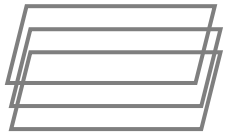
Methodology

Definition of monitoring areas – Scenario-building example (NUTSIII Alentejo)

Layout of E-REDES lines

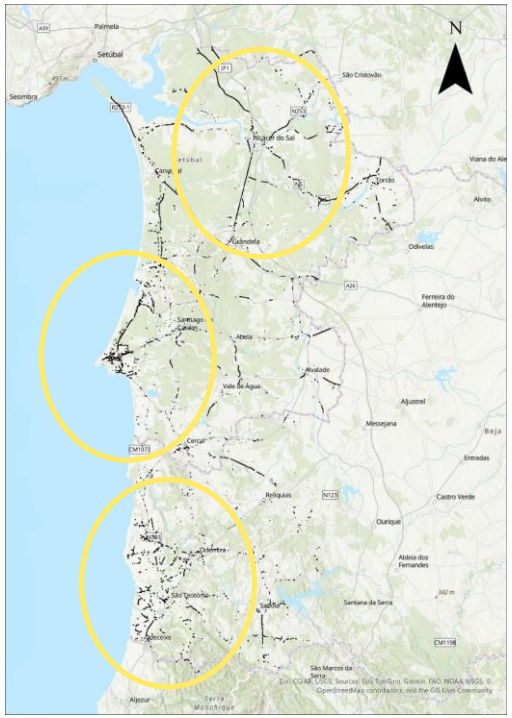


Scenario overlay (ensemble)

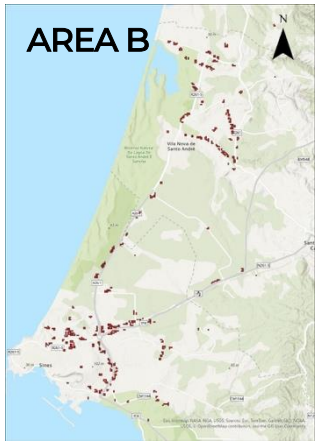


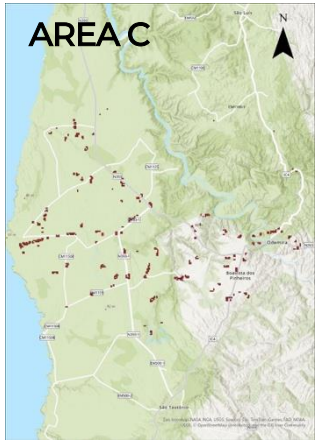
Overlaying the intermediate scenarios allows the identification of areas with greater consensus, prioritised for monitoring.

Final scenario



Selected priority areas



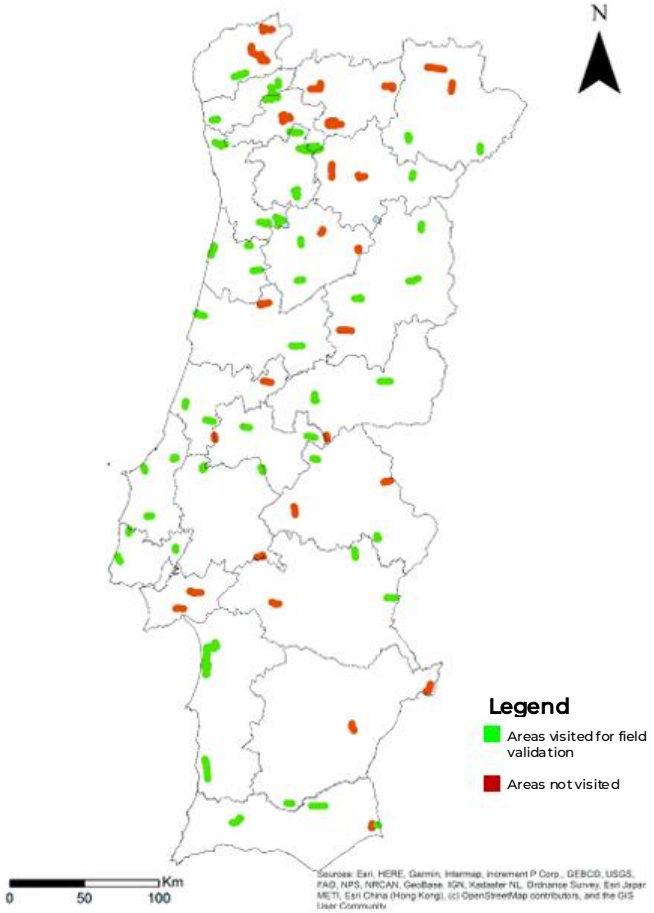


- Digital mapping of the monitoring network
- Definition of indicators by area (*Factsheets* biodiversity)

Results

Field validation

- Field validation is a fundamental step to ensure the practical suitability of the areas selected for the monitoring network.
- The field validation work aimed to **assess the robustness of identifying land cover classes** assigned to the selected areas obtained in *conservation planning*.
- Field validation included:
  - → Land cover classes validation
  - → Key species
  - → Accessibility conditions and operational constraints (cliffs, roads)
  - → Photographic record of the sites
  - → Information to support biodiversity management
  - → Presence of relevant plant species (threatened, invasive, dominant)
  - → Qualitative assessment of ecological potential (*Highlights* of the site)



National distribution of validated areas

50
areas visited in the field

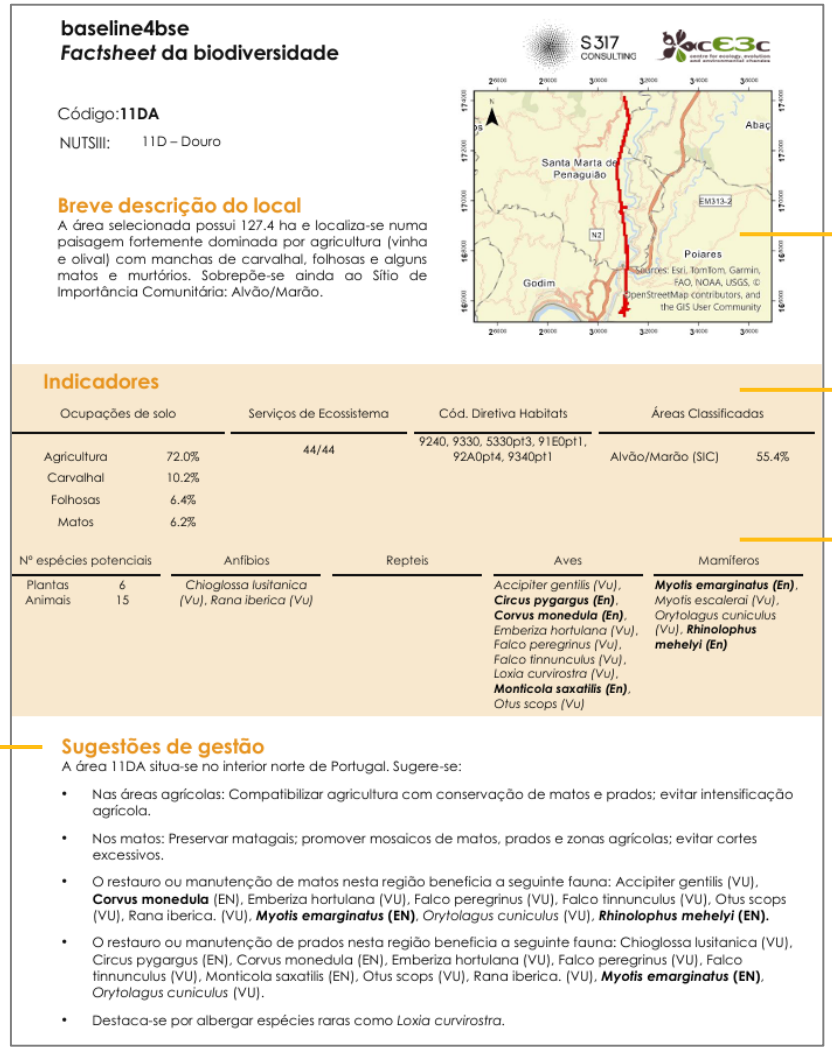
50
field sheets produced

data robustness confirmed
high agreement between baseline and field observations

Results

Biodiversity Factsheets

- In addition to the geographical information and the *shapefiles* from the monitoring network, which are the main output of the Conservation Planning phase, for each monitoring area, information sheets ('biodiversity factsheets').
- The factsheets include summaries of biodiversity indicators and tailored management recommendations based on the biodiversity observed in each area.



baseline4bse
***Factsheet* da biodiversidade**

S317 CONSULTING

Código:**11DA**

NUTSIII: 11D – Douro

Breve descrição do local

A área selecionada possui 127.4 ha e localiza-se numa paisagem fortemente dominada por agricultura (vinha e olival) com manchas de carvalhal, folhosas e alguns matos e murtórios. Sobrepõe-se ainda ao Sítio de Importância Comunitária: Alvão/Marão.

Indicadores

Ocupações de solo		Serviços de Ecossistema	Cód. Diretiva Habitats	Áreas Classificadas	
Agricultura	72.0%	44/44	9240, 9330, 5330pt3, 91E0pt1, 92A0pt4, 9340pt1	Alvão/Marão (SIC)	55.4%
Carvalhal	10.2%				
Folhosas	6.4%				
Matos	6.2%				

Nº espécies potenciais		Anfíbios	Repteis	Aves	Mamíferos
Plantas	6	*Chioglossa lusitanica (Vu), Rana iberica (Vu)*		*Accipiter gentilis (Vu),* ***Circus pygargus (En),*** ***Corvus monedula (En),*** *Emberiza hortulana (Vu), Falco peregrinus (Vu), Falco tinnunculus (Vu), Loxia curvirostra (Vu),* ***Monticola saxatilis (En),*** *Otus scops (Vu)*	***Myotis emarginatus (En),*** *Myotis escalerai (Vu), Orytolagus cuniculus (Vu),* ***Rhinolophus mehelyi (En)***
Animais	15				

Sugestões de gestão

A área 11DA situa-se no interior norte de Portugal. Sugere-se:

- Nas áreas agrícolas: Compatibilizar agricultura com conservação de matos e prados; evitar intensificação agrícola.
- Nos matos: Preservar matagais; promover mosaicos de matos, prados e zonas agrícolas; evitar cortes excessivos.
- O restauro ou manutenção de matos nesta região beneficia a seguinte fauna: Accipiter gentilis (VU), **Corvus monedula** (EN), Emberiza hortulana (VU), Falco peregrinus (VU), Falco tinnunculus (VU), Otus scops (VU), Rana iberica. (VU), ***Myotis emarginatus* (EN)**, *Orytolagus cuniculus* (VU), ***Rhinolophus mehelyi* (EN).**
- O restauro ou manutenção de prados nesta região beneficia a seguinte fauna: Chioglossa lusitanica (VU), Circus pygargus (EN), Corvus monedula (EN), Emberiza hortulana (VU), Falco peregrinus (VU), Falco tinnunculus (VU), Monticola saxatilis (EN), Otus scops (VU), Rana iberica. (VU), ***Myotis emarginatus* (EN)**, *Orytolagus cuniculus* (VU).
- Destaca-se por albergar espécies raras como *Loxia curvirostra*.

Monitoring area map

Land-use, ecosystem services and protected areas indicators, and habitat types present (with Natura 2000 habitat codes)

Target species (fauna and flora), including the number of potential species and threat status

Biodiversity management suggestions and general recommendations, and notes on rare natural values that merit special highlight

76
factsheets produced

04

Main project outputs

Key project outputs

1

Biodiversity baseline

Complete baseline for the entire E-REDES network in Mainland Portugal, with indicators for fauna, flora, land cover, protected areas and ecosystem services (at the FGC level and 30 m buffer).

2

Monitoring network

Mapping of a monitoring network designed with scientific rigour (MARXAN), covering 79 priority areas across 24 NUTS III, with co-creation and consultation with stakeholders.

3

Field validation

Field validation with 50 field forms produced confirms the robustness of the data: significant agreement between the baseline and field observations for OSPOC classes.

4

Biodiversity Factsheets

Factsheets of biodiversity (76) bring together scattered information and present, for the first time, the association between species and OSPOC by region.

Report: Summary of Indicators and Mapping (*Baseline* biodiversity)

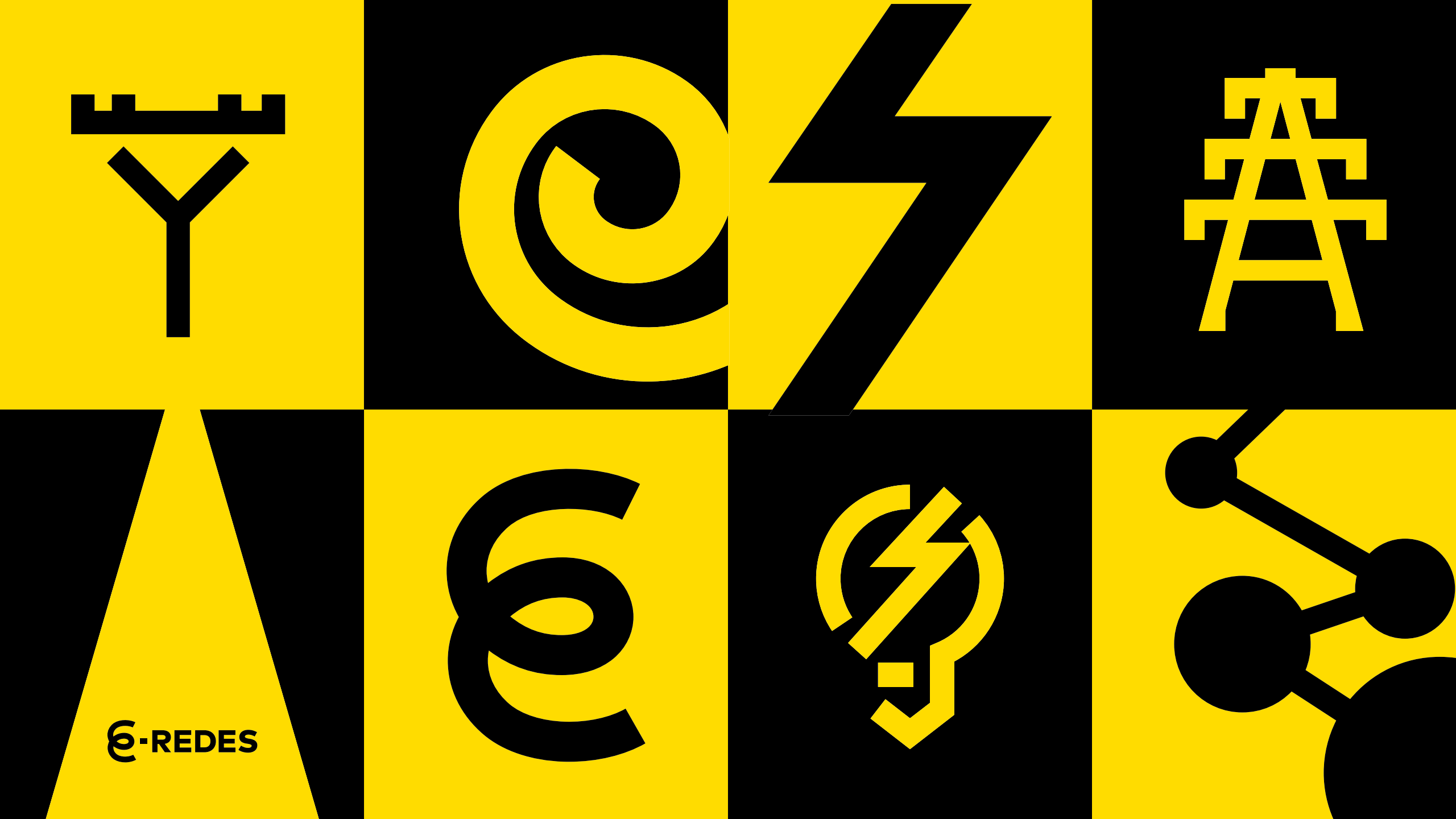
Report: Monitoring Network (incl. *Biodiversity Factsheets*)

Mapping*: Baseline* biodiversity

- *Land cover*
- *Classified areas (RN200, protected areas)*
- *Ecosystem services*
- *Species (fauna and flora) – potential distribution, richness, threat status*

Mapping: Monitoring Network

- *Selected areas*
- *Scenarios*
- *Areas visited for validation*


E-REDES