

SYMBIOSIS

Mid-Term Conference

Plenary

18 June 2026

*The project is supported by the Europe's Rail Joint Undertaking and its members.
Funded by the European Union. Views and opinions expressed are, however, those of the author(s)
only and do not necessarily reflect those of the European Union or Europe's Rail Joint Undertaking.
Neither the European Union nor the granting authority can be held responsible for them.*




Funded by
the European Union

Building Nature-Positive Railways Through Cross-Sector Learning

How can we develop the railway of the future while preserving biodiversity and strengthening climate resilience?



Agenda

Time	Topic	Lead
09:30 – 09:45	Welcome and Introduction to SYMBIOSIS Updates from ERJU	UIC ERJU PO
09:45 – 10:30	Update on WP3: Operational toolkit	UPM/Minuartia
10:30 – 11:15	Update on WP4: Standardising Biodiversity Data Collection and Integration	UKCEH
11:15 – 11:30	Coffee Break	
11:30 – 12:15	Update on WP5: Assessment of societal challenges in sustainable transport development	CERTH/FFE
12:15 – 12:30	Opportunities to Connect with the SYMBIOSIS Community	FEHRL/ICSI

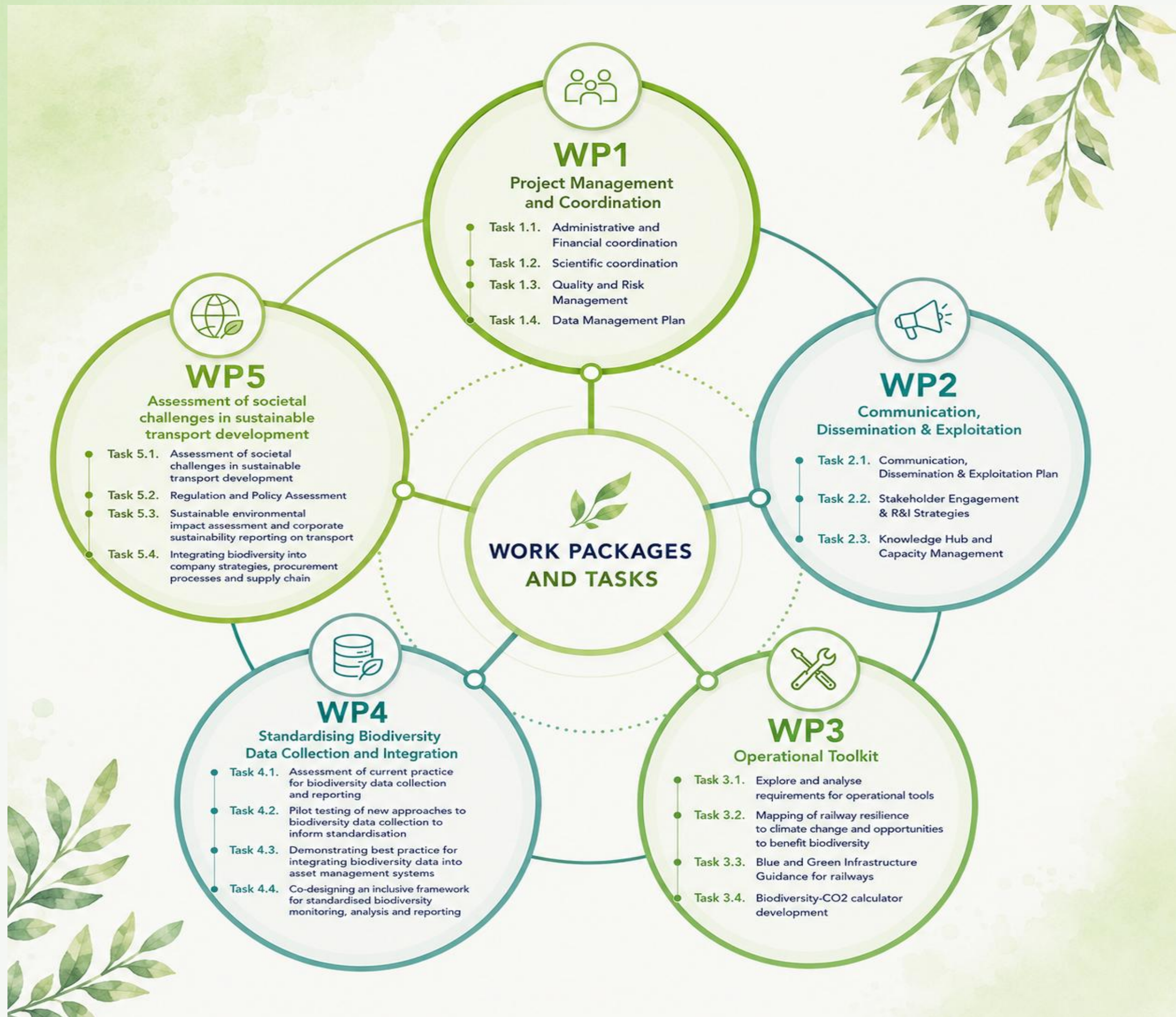


The Consortium



External Stakeholders





What is New Since March 2025?



KEY MESSAGE

The project has moved from planning to implementation — combining governance, stakeholder collaboration, biodiversity intelligence, and technical innovation to support more sustainable and resilient European railway infrastructure.



- Latest public event: “**SYMBIOSIS Stakeholder Engagement Workshop**”, organised on 25 September 2025.
- Visit our website to access the latest deliverables, news, and project updates: <https://symbiosis-transport.eu/>



Key Deliverables Status

Reporting Period 1 - September 2024 – March 2026

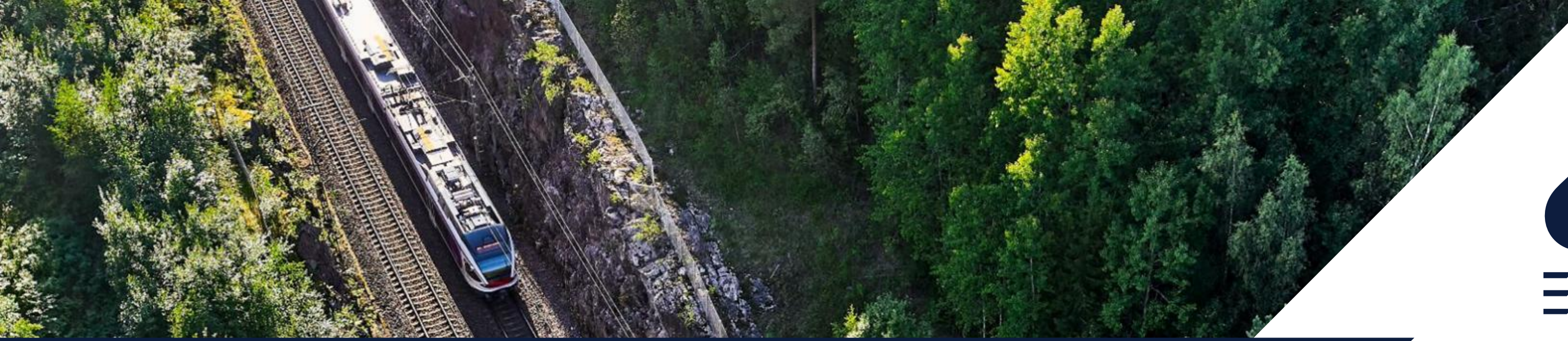
- **D2.2** – Knowledge Transfer and Capacity Building Strategy
- **D3.1** – Impact Assessment Tools for Linear Infrastructures)
- **D4.1** Report on ‘Transformative Insights and Strategies for Biodiversity Monitoring in European Railway’



Available soon
on
the SYMBIOSIS website

Reporting Period 2 - April 2026 – August 2027

- **D5.1** -Analysis report on assessing societal priorities on sustainable transport development
- **D4.2** – Advancements in Automated Biodiversity Monitoring for European Railways
- **D3.2** – Harmonised methodology to prioritise NbS for Climate-Resilient Infrastructure
- **D4.3** – Assessment of the benefits and challenges to integrating real-time biodiversity data into rail infrastructure GIS and BIM alongside data on economic performance and carbon emissions
- **D5.2** – Recommendations for enhancing cross-cutting biodiversity and climate policies on railway infrastructure
- **D3.3** – Decision support Guidelines to reinforce Blue and Green Infrastructure on transport and energy infrastructure
- **D3.4** – Biodiversity-CO2 calculator for the railway sector. Methodology, case studies and its evaluation.
- **D2.5** – Report on the R&I strategic recommendations
- **D2.6** – Knowledge & Learning Hub
- **D4.4** – Recommendations for new approaches for standardised biodiversity monitoring.
- **D5.3** – Recommendations on environmental impact assessment of the cumulative effects of pairing infrastructure development.
- **D5.4** – Recommendations for mainstreaming biodiversity within the procurement process, as well as for improving the disclosure regarding biodiversity in the supply chain in compliance with the new standards



SYMBIOSIS

Mid-term Plenary Meeting

18 June 2026



Merve DEMIRKAN AYDOGAN

Programme Manager
Europe's Rail JU



DELIVER AN INTEGRATED EUROPEAN RAILWAY NETWORK BY DESIGN



DEVELOP A UNIFIED OPERATIONAL CONCEPT AND A FUNCTIONAL SYSTEM ARCHITECTURE FOR INTEGRATED EUROPEAN RAIL TRAFFIC AND CCS/AUTOMATION



DELIVER A SUSTAINABLE AND RESILIENT RAIL SYSTEM



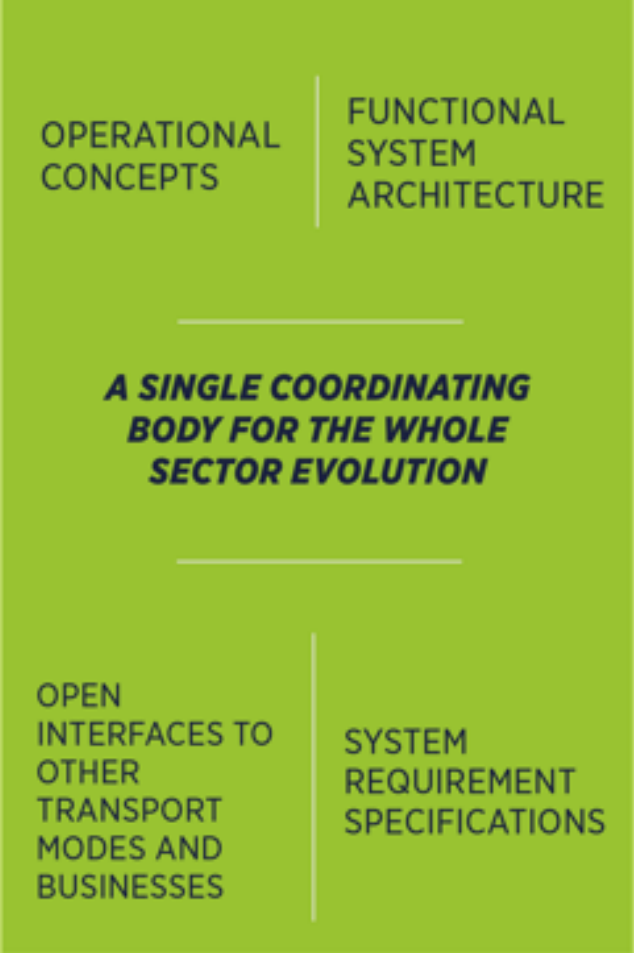
DELIVER A COMPETITIVE, GREEN RAIL FREIGHT FULLY INTEGRATED INTO THE LOGISTICS VALUE CHAIN



DEVELOP A STRONG AND GLOBALLY COMPETITIVE EUROPEAN RAIL INDUSTRY

EUROPE'S RAIL: ONE INTEGRATED R&I PROGRAMME

SYSTEM PILLAR



INNOVATION PILLAR



- 1 **EUROPEAN RAIL TRAFFIC AND MOBILITY MANAGEMENT**
 - Manage and improve rail traffic at EU level
 - Adjust rail traffic management in function of the mobility demand
- 2 **DIGITALISATION & AUTOMATION IN TRAIN OPERATIONS**
 - ATO implementation
 - Digital train operations
- 3 **SUSTAINABLE AND DIGITAL ASSETS**
 - Integrated assets testing & life-cycle framework
 - Zero-emission, silent rail system
- 4 **COMPETITIVE, DIGITAL, GREEN RAIL FREIGHT**
 - New digital customer interaction & innovative rail freight services
 - Multimodal and rail freight innovation integration
- 5 **REGIONAL RAIL SERVICES IN LOW DENSITY AREAS**
 - New system approach to regional rail services in low density areas

DEPLOYMENT GROUP

FUTURE SOLUTIONS DEPLOYED IN A COORDINATED AND CONSISTENT WAY AT EUROPEAN LEVEL, TAKING INTO ACCOUNT ALTERNATIVE ROLLOUT SCENARIOS, BEHAVIOURAL AND ORGANISATIONAL CHANGES, SYNERGIES WITH OTHER MODES OF TRANSPORT

Europe's Rail JU

- Our vision is to deliver a fully integrated European railway network for citizens and cargo.
- 150MN EUR of EU funding only through its latest calls in 2025 and 2026.

High capacity



Flexible



Interoperable



Multimodal



Sustainable



Reliable



Competitive



Inclusive





- SYstemic Mobilisation for Joint Biodiversity and Infrastructure
- Ambition to move beyond isolated studies
- Addressing the need for common methodologies, better knowledge and practical tools
- Contribution to several key European policy objectives
- Possibility to support various areas of Europe's Rail programme



SYMBIOSIS

Updates

- Administrative deliverables submitted and approved.
- Three technical deliverables have been submitted. D4.1 and D2.2 are being revised by the consortium.
- D3.1 is under JU's review.
- Technical Report for the RP1 is being revised by the consortium following JU's feedback.



Thank you for your attention.

White Atrium Building, 2nd Floor
Avenue de la Toison d'Or 56-60
B1060, Brussels - Belgium

www.rail-research.europa.eu

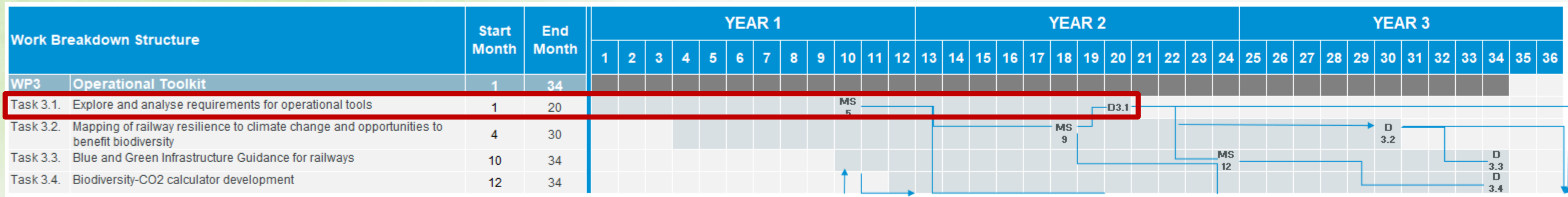


WORK PACKAGE 3:

OPERATIONAL TOOLKIT



3.1: Characterization of operational tools



September to November 2024 (M1-M3)

- ✓ Goal definition
- ✓ Compilation of bibliographic sources

December 2024 to March 2025 (M4-M7)

- ✓ Analysis and classification

April to June 2025 (M8-M9)

- ✓ Report writing and layout

July 2025 (M10)

- ✓ First draft completed (Milestone 5)

August 2025 to April 2026 (M12-M20)

- ✓ Revisions and final draft



Characterisation of operational tools that focus on the assessment of impacts on ecological qualities and biodiversity values during all life cycle phases

Milestone 5 (MS5)

Alvarez, Sergio (UPM); Morillas, Carlos (UPM); Gil, Rodrigo (UPM); Alonso, Carlos (UPM); Franzoni, Lorenzo (UIC); Yilmazer, Pinar (UIC); Ollerton, Jeff (UKCEH); Fernández, Luis M. (Minuartia)



3.1: Characterization of operational tools



Analytical framework:

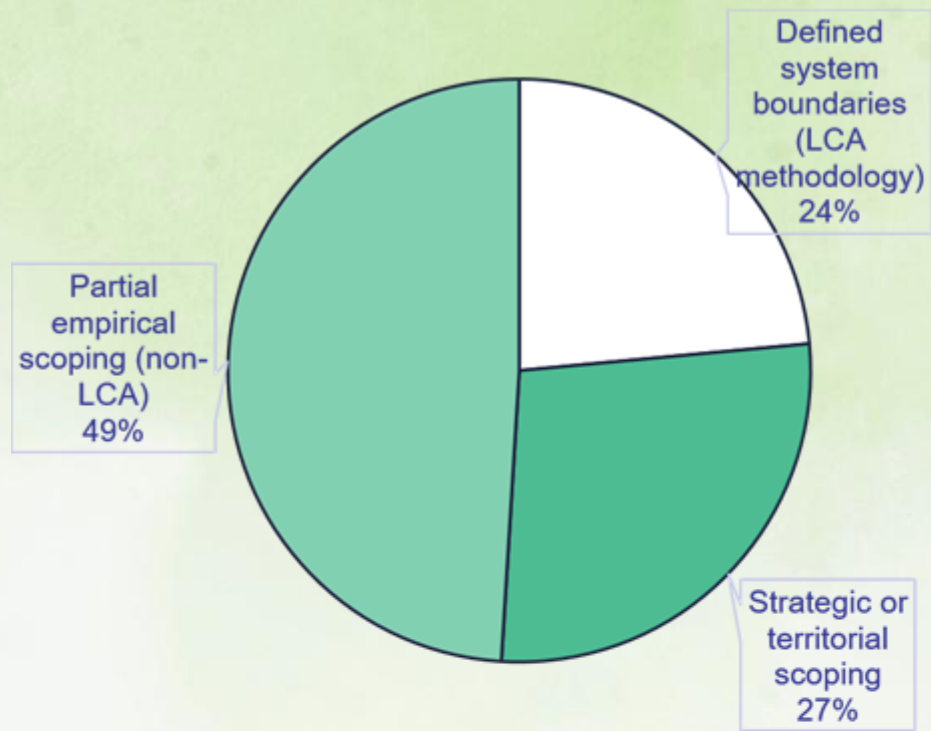
- 🌿 Nature of the activity
- 🌿 Life cycle phases
- 🌿 Goal definition
- 🌿 Scoping
- 🌿 Nature of inventory data
- 🌿 Quality assessment
- 🌿 Impact assessment
- 🌿 Benefit assessment methods

Case study no.1	Case study no.2	Case study no.3	Case study no.4
Name:	Name:	Name:	Name: <i>Roads reduce amphibian abundance in ponds across a fragmented landscape</i>
Country:	Country:	Country:	Country: Hungary (2021)
Assessed activity:	Assessed activity:	Assessed activity:	Assessed activity: Impact of roads and railways on amphibian abundance in ponds within a fragmented landscape
Nature of the activity:	Nature of the activity:	Nature of the activity:	Nature of the activity: Transport
Life cycle phases:	Life cycle phases:	Life cycle phases:	Life cycle phases: Operation and maintenance of road and railway infrastructure
Goal definition:	Goal definition:	Goal definition:	Goal definition: Assessing the relationship between amphibian abundance and proximity to roads/railways to determine the extent of road-effect zones and inform conservation strategies
Target audience:	Target audience:	Target audience:	Target audience: Scientists, conservationists, policymakers, environmental agencies
Scoping:	Scoping:	Scoping:	Scoping: Investigates how road infrastructure affects amphibian populations by analyzing habitat accessibility, road density, and species abundance in freshwater ponds
Nature of inventory data:	Nature of inventory data:	Nature of inventory data:	Nature of inventory data: <ul style="list-style-type: none"> • Field surveys conducted at 30 freshwater ponds in a peri-urban/agricultural landscape • Measurement of landscape variables within a 1000-m radius around ponds • Analysis of larval amphibian abundance in relation to road proximity and habitat fragmentation
Quality assessment:	Quality assessment:	Quality assessment:	Quality assessment: <ul style="list-style-type: none"> • Use of multi-species abundance models (MSAM) and N-mixture models for statistical analysis • Application of Bayesian inference for species-level responses • Consideration of habitat quality and pond characteristics
Impact assessment:	Impact assessment:	Impact assessment:	Impact assessment: <ul style="list-style-type: none"> • Analysis of the road-effect zone extending up to 1 km from highways • Comparison of accessible vs. total habitat as predictors of amphibian abundance • Assessment of species-specific responses to road and habitat fragmentation
Environmental impact categories:	Environmental impact categories:	Environmental impact categories:	Environmental impact categories: <ul style="list-style-type: none"> • Habitat fragmentation due to road networks • Reduction in amphibian abundance near highways • Negative effects on species dispersal and breeding site connectivity • Potential road-induced mortality and pollution effects on aquatic ecosystems
Benefit assessment methods:	Benefit assessment methods:	Benefit assessment methods:	Benefit assessment methods: Benefit assessment framework not included

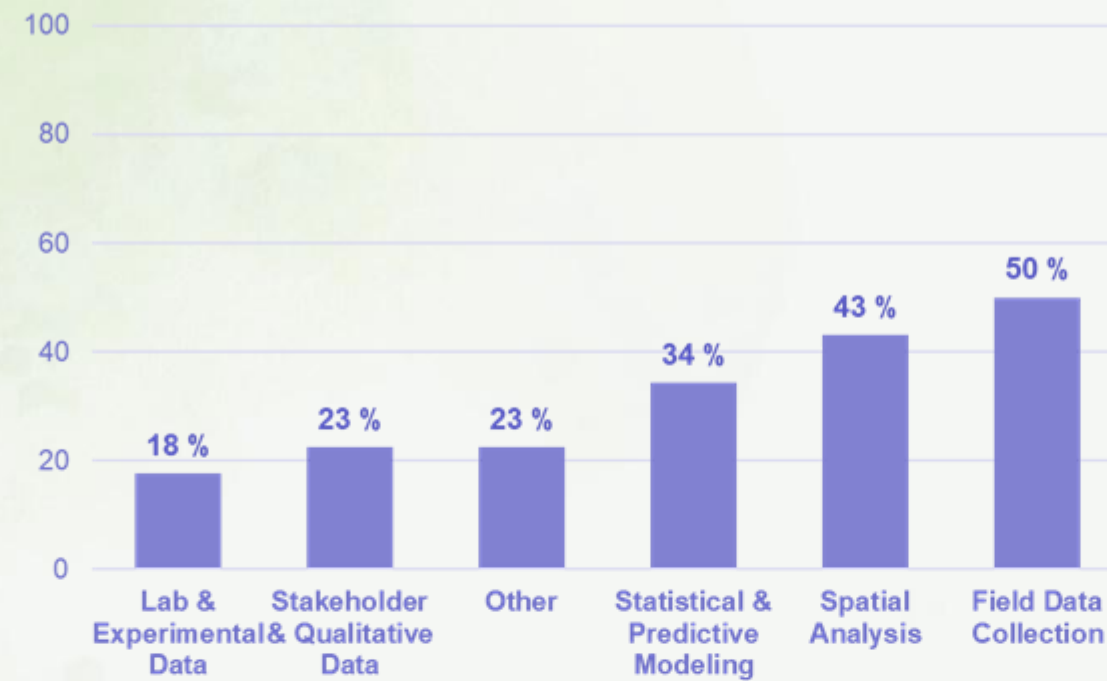


3.1: Characterization of operational tools

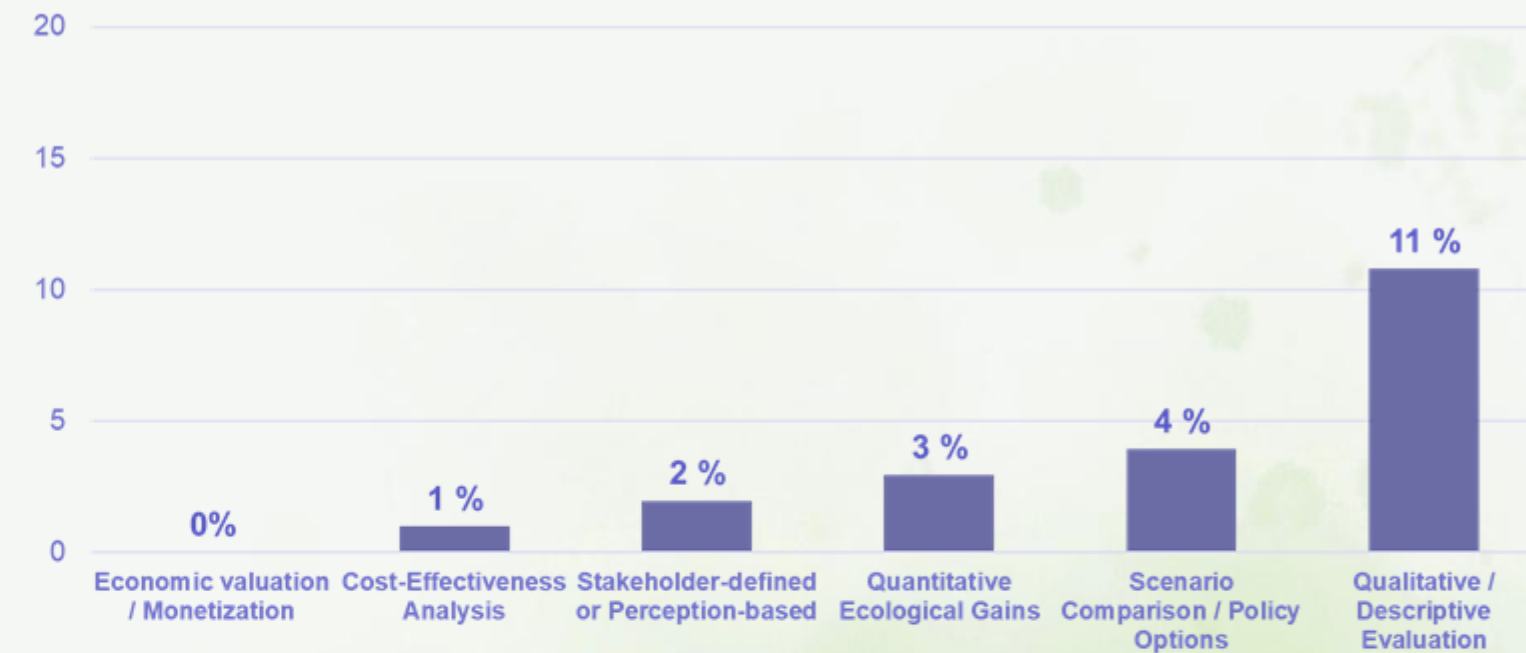
System boundaries



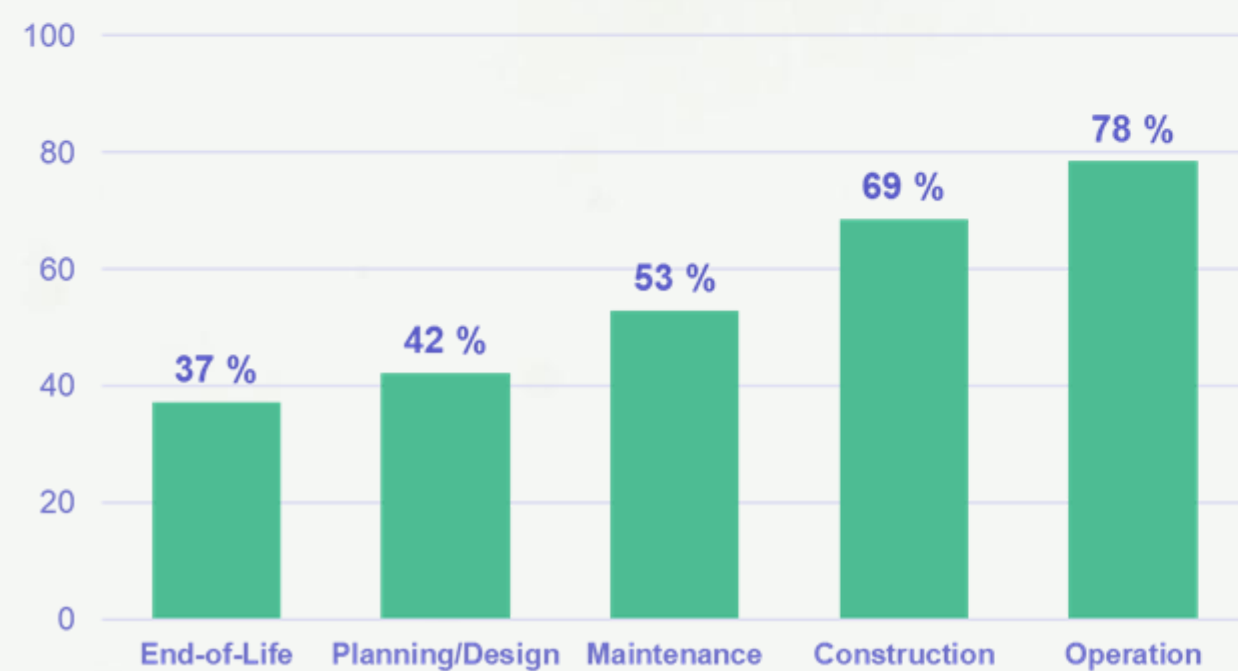
Inventory data



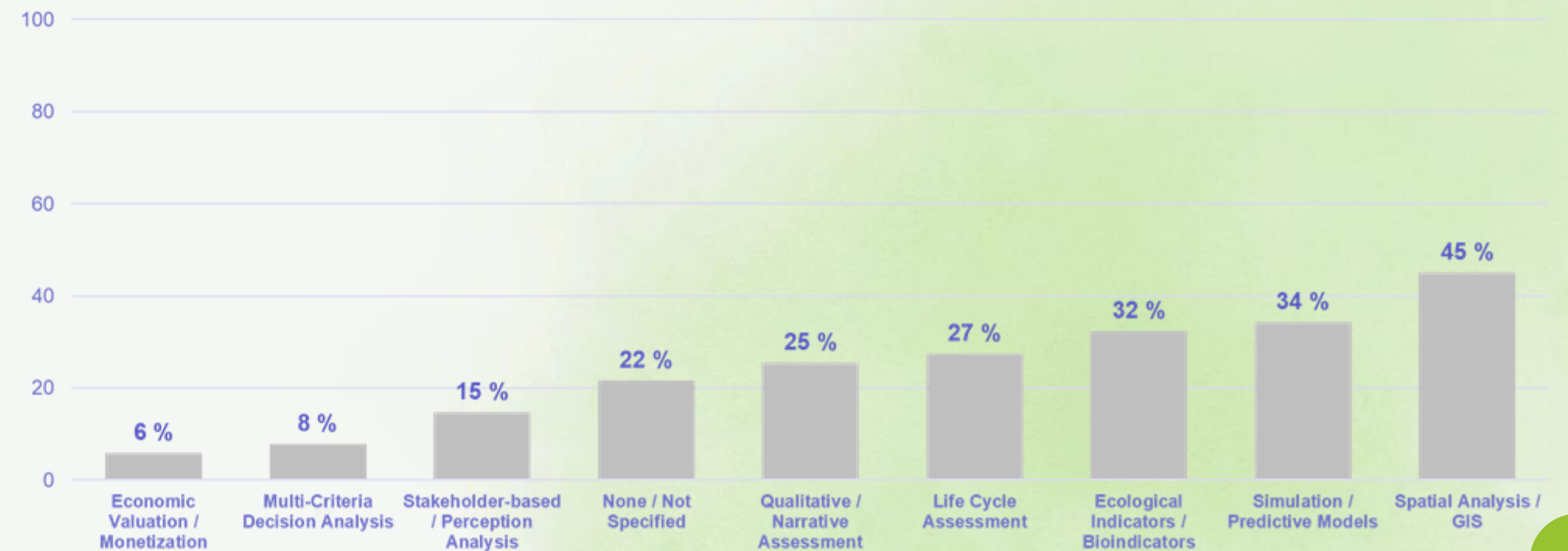
Benefit assessment method



Life cycle phases considered



Impact assessment method



3.1: Characterization of operational tools



Operational Tools for Assessing Environmental Impacts and Benefits in Linear Infrastructure

A Systematic Review

Carlos Morillas, Rodrigo Gil, Sergio Alvarez, Sara Martinez, Pinar Yimazer and Lorenzo Franzoni.

20/05/2026



Task 3.2: Mapping of railway resilience to climate change and opportunities to benefit biodiversity

Work Breakdown Structure		Start Month	End Month	YEAR 1												YEAR 2												YEAR 3																									
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36														
WP3	Operational Toolkit	1	34																																																		
Task 3.1.	Explore and analyse requirements for operational tools	1	20											MS 5																																							
Task 3.2.	Mapping of railway resilience to climate change and opportunities to benefit biodiversity	4	30																MS 9													D3.1																					
Task 3.3.	Blue and Green Infrastructure Guidance for railways	10	34																																			MS 12															
Task 3.4.	Biodiversity-CO2 calculator development	12	34																																																	D 3.3	D 3.4

May to September 2025 (M9 – M13)
Data collection and processing (GIS layers + railway characterisation data)



Identification of priority areas

October 2025 to February 2026 (M14 – M18)
Data collection and processing (GIS layers + ecological variables data)



MS9 - Preliminary Draft of Integrated Ecological Connectivity, Biodiversity and Climate Risk Mapping developed with stakeholder feedback



March to December 2026 (M19 – M28)
Integration of information (Task 3.3) + Methodology description



DRAFT D3.2 - Harmonised methodology to prioritise NbS for Climate-Resilient Infrastructure

January to February 2027 (M29 – M30)
Deliverable review



Submission D3.2



Task 3.2: Milestone 9 - Submitted



Milestone 9

Preliminary draft of “integrated ecological connectivity, biodiversity and climate risk mapping” developed with stakeholder feedback

Submitted

Luis M. Fernández, Carme Rosell, Joan Marull, Sergi Cano (Minuartia)
28/02/2026

Grant Agreement No 101177281.
Funded by the European Union. Views and opinions expressed are, however, those of the author(s) only and do not necessarily reflect those of the European Union or EU-RAIL. Neither the European Union nor the granting authority can be held responsible for them.



1 Literature review

- Identify relevant climate-related hazards
- Define the state of the art of NbS in transport infrastructure climate change adaptation
- Review European and transport sectorial approaches to climate change adaptation



2 Integration of cartographic information

- Climate-related hazards
- Surrounding ecosystems
- Environmental benefits



3 Detailed study cases

Select the most appropriate NdS for climate change adaptation and biodiversity enhancement

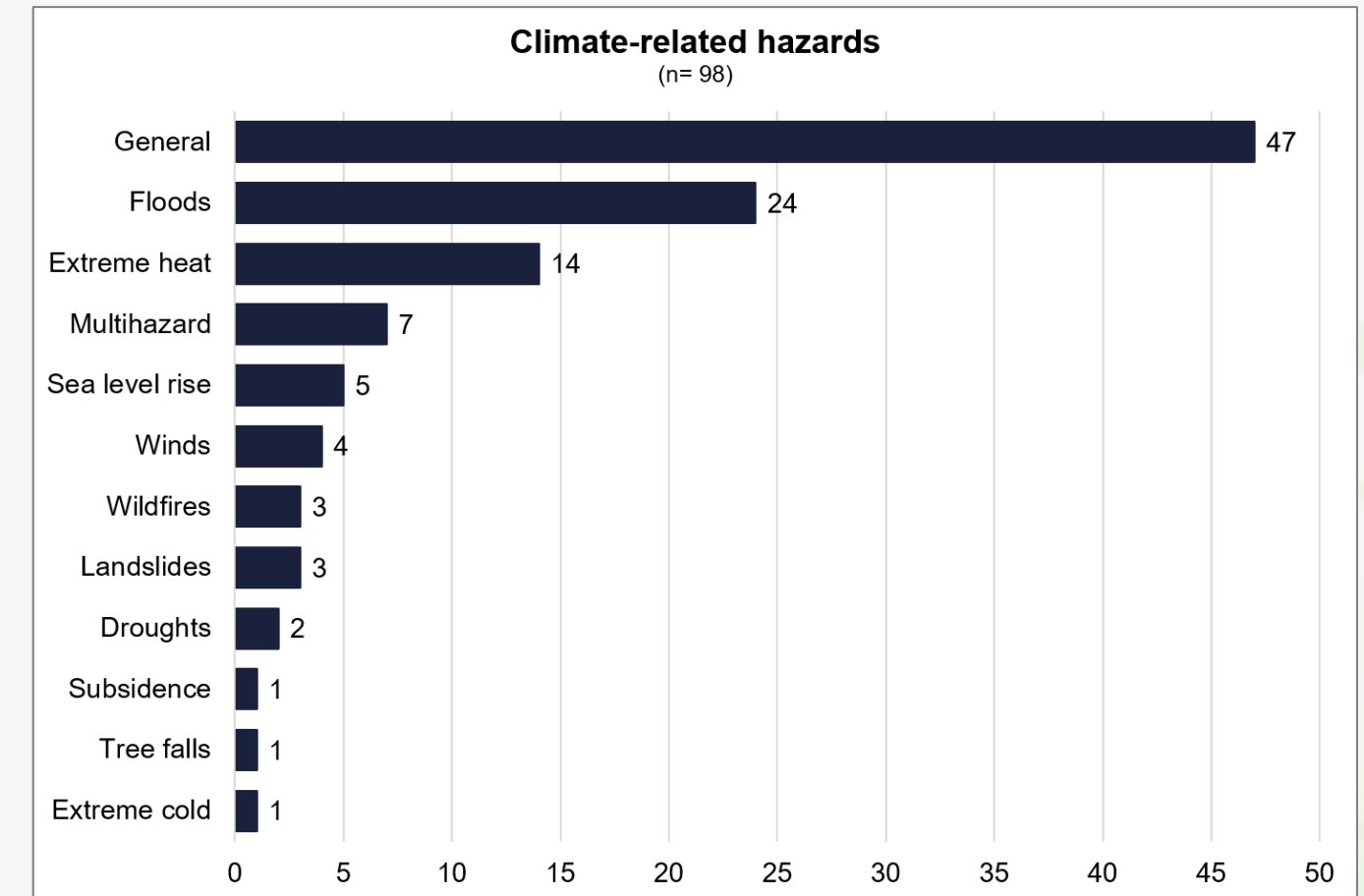


Table 1. Cartographic sources for the different elements used in the present task.

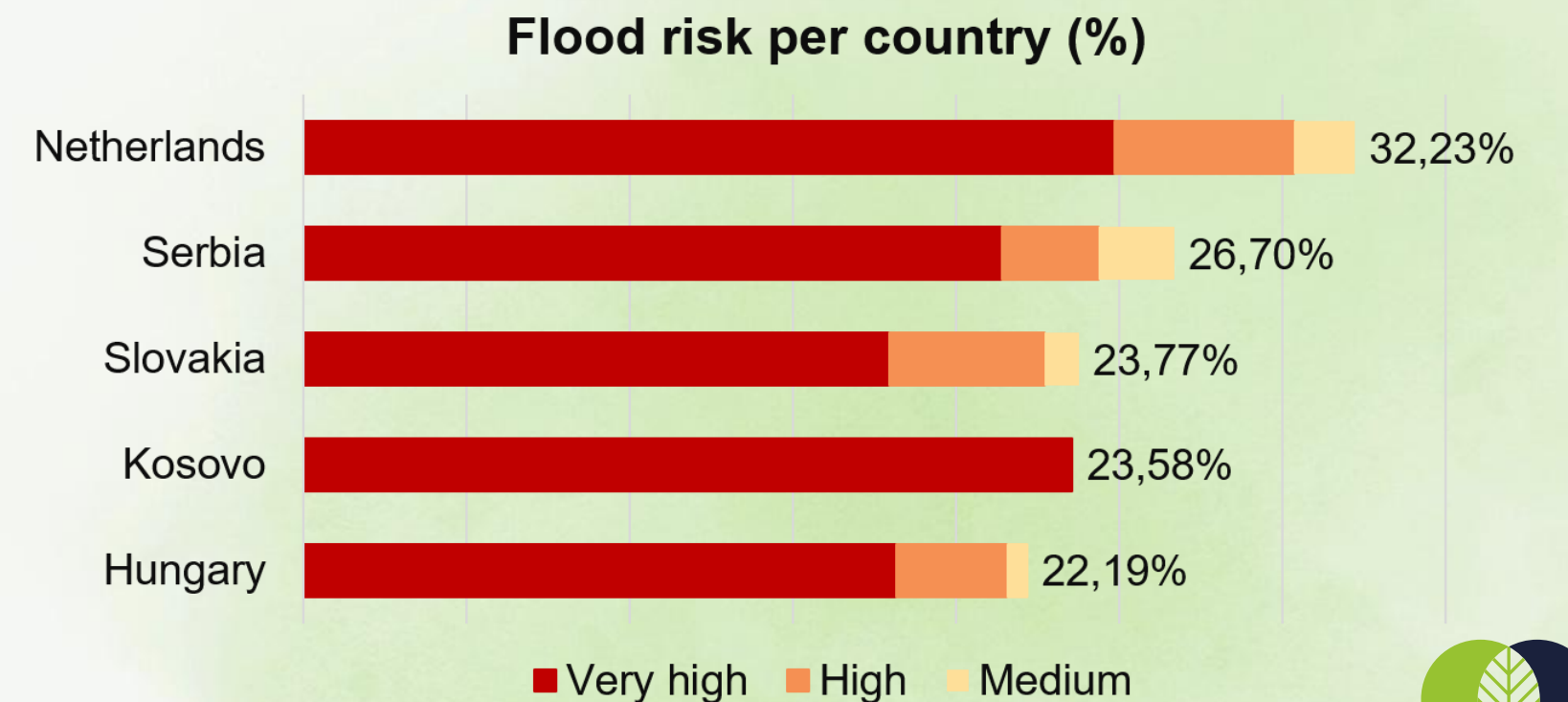
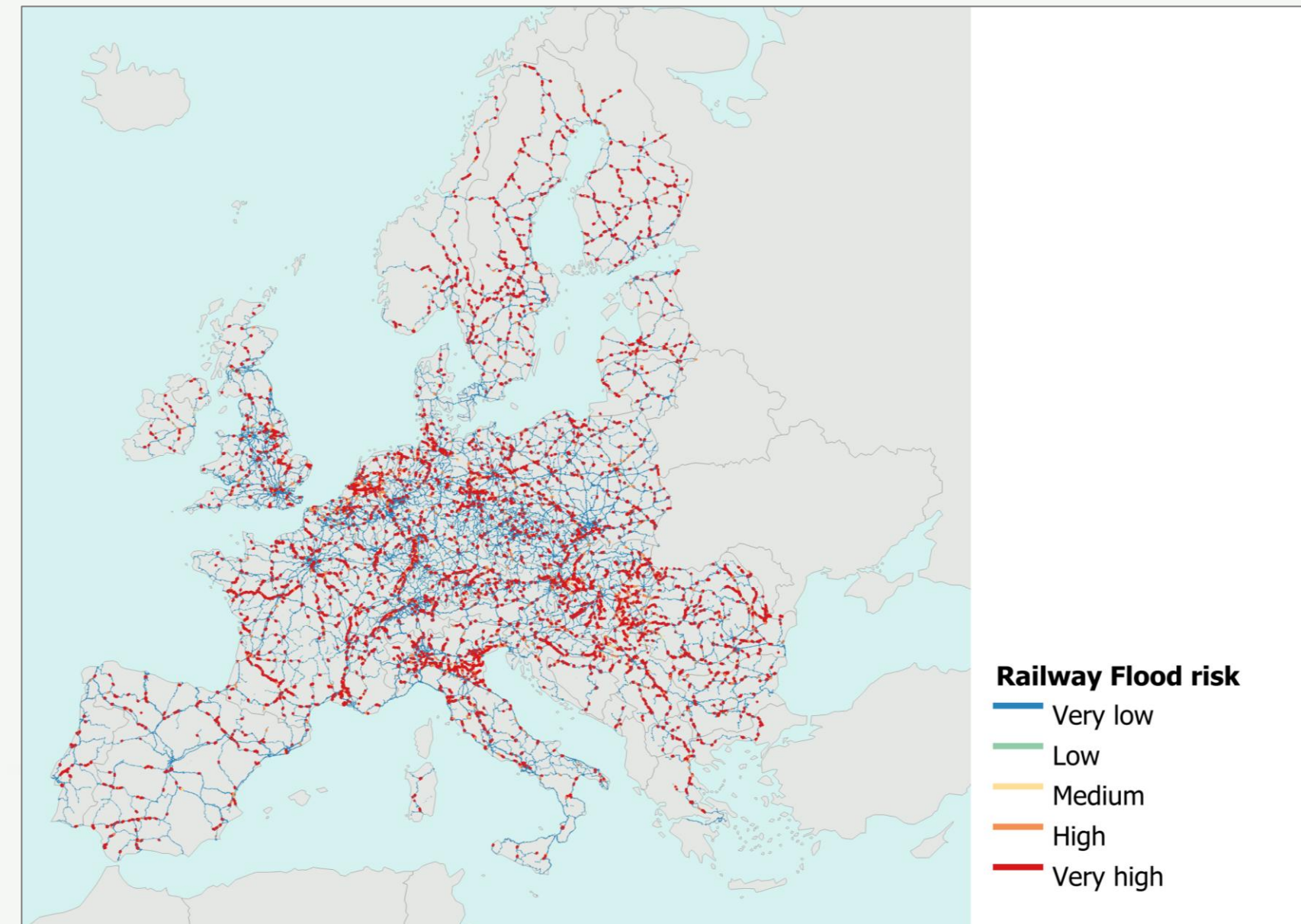
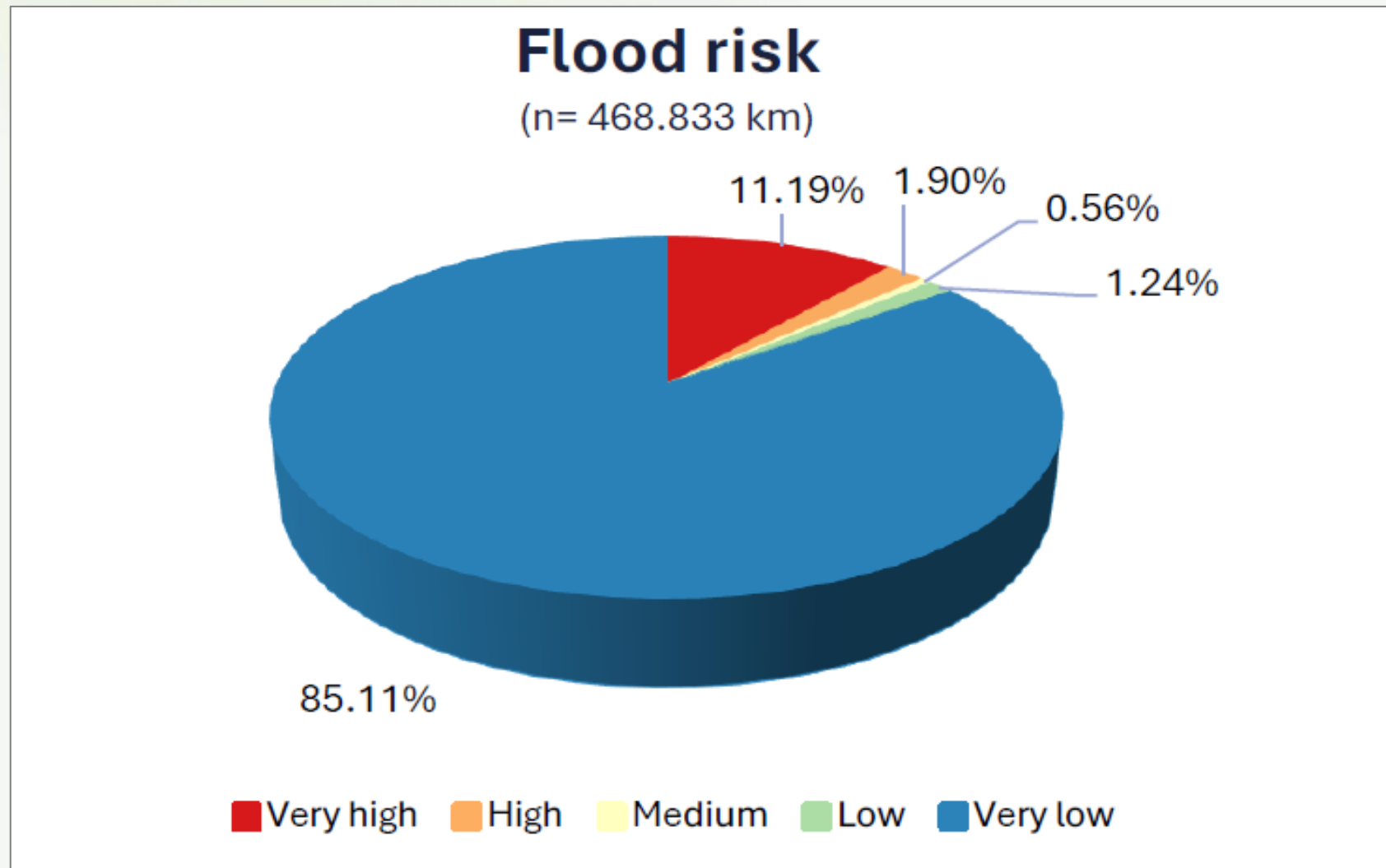
Element	Source	Link
Railway infrastructure	Open Railway Map	https://www.openrailwaymap.org/
Flood risk	Joint Research Center (Baugh et al., 2024)	http://data.europa.eu/89h/1d128b6c-a4ee-4858-9e34-6210707f3c81
Extreme heat risk	Copernicus Climate Change Service Climate Data Store	https://cds.climate.copernicus.eu/
Natural Protected Areas	European Environment Agency´s Datahub	https://www.eea.europa.eu/en/datahub
Land cover	Copernicus Land Monitoring Service	https://land.copernicus.eu/en
Habitats included in the Directive Habitats	European Environment Agency	https://sdi.eea.europa.eu/catalogue/srv/api/records/7c0cf3f2-ab54-4cd0-a635-b322df7197f6
Species included in the Directive Habitats	International Union for Conservation of Nature (IUCN) Red List of threatened Species	https://www.iucnredlist.org/
Landscape fragmentation	European Environment Agency´s Datahub	https://www.eea.europa.eu/en/datahub/datahubitem-view/886719fc-8112-4cea-8579-33819dea8415

Task 3.2: Milestone 9 - Submitted

Two main risks identified:

1.- Floods: Indicator based on return periods.

(Source: Joint Research Centre; Baugh et al., 2024)

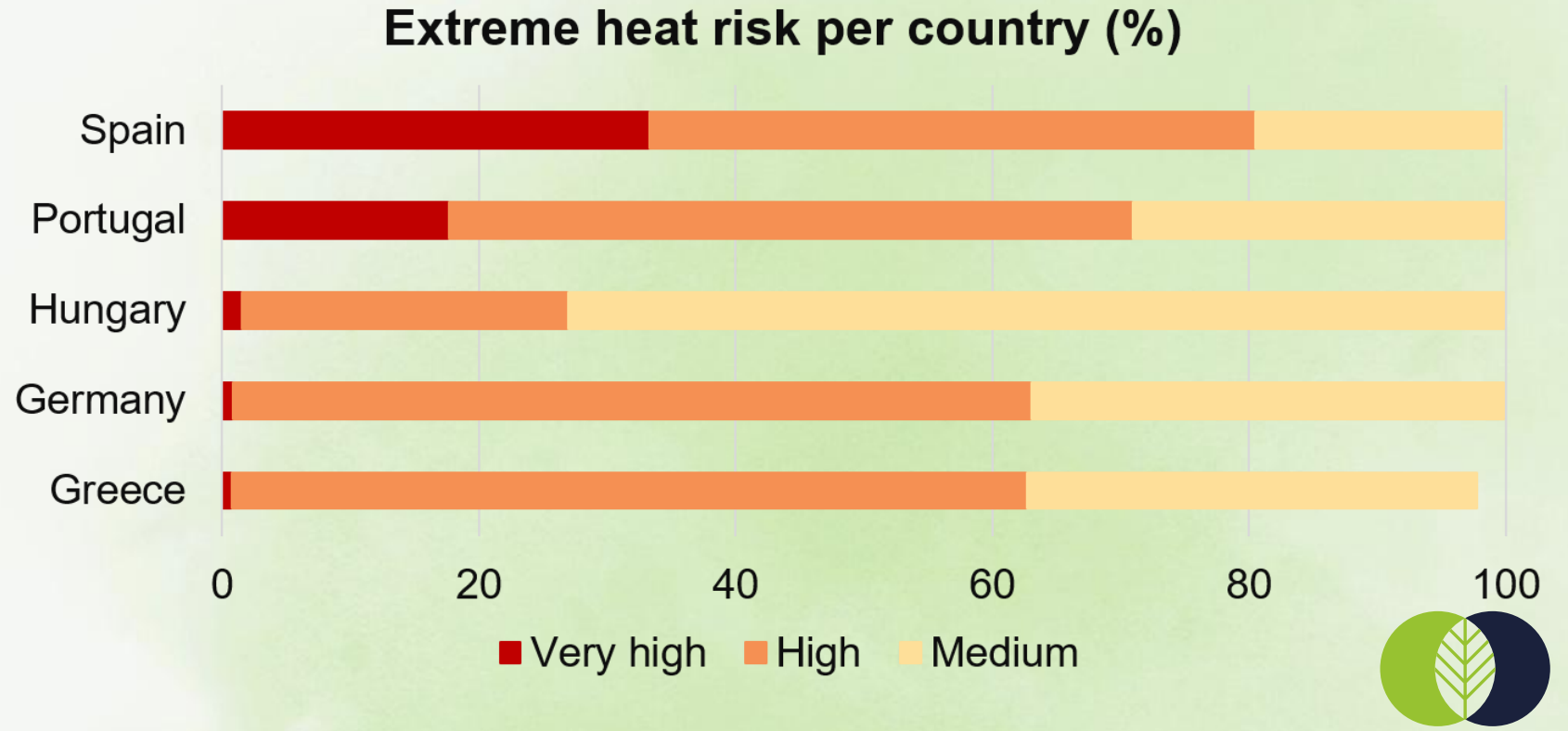
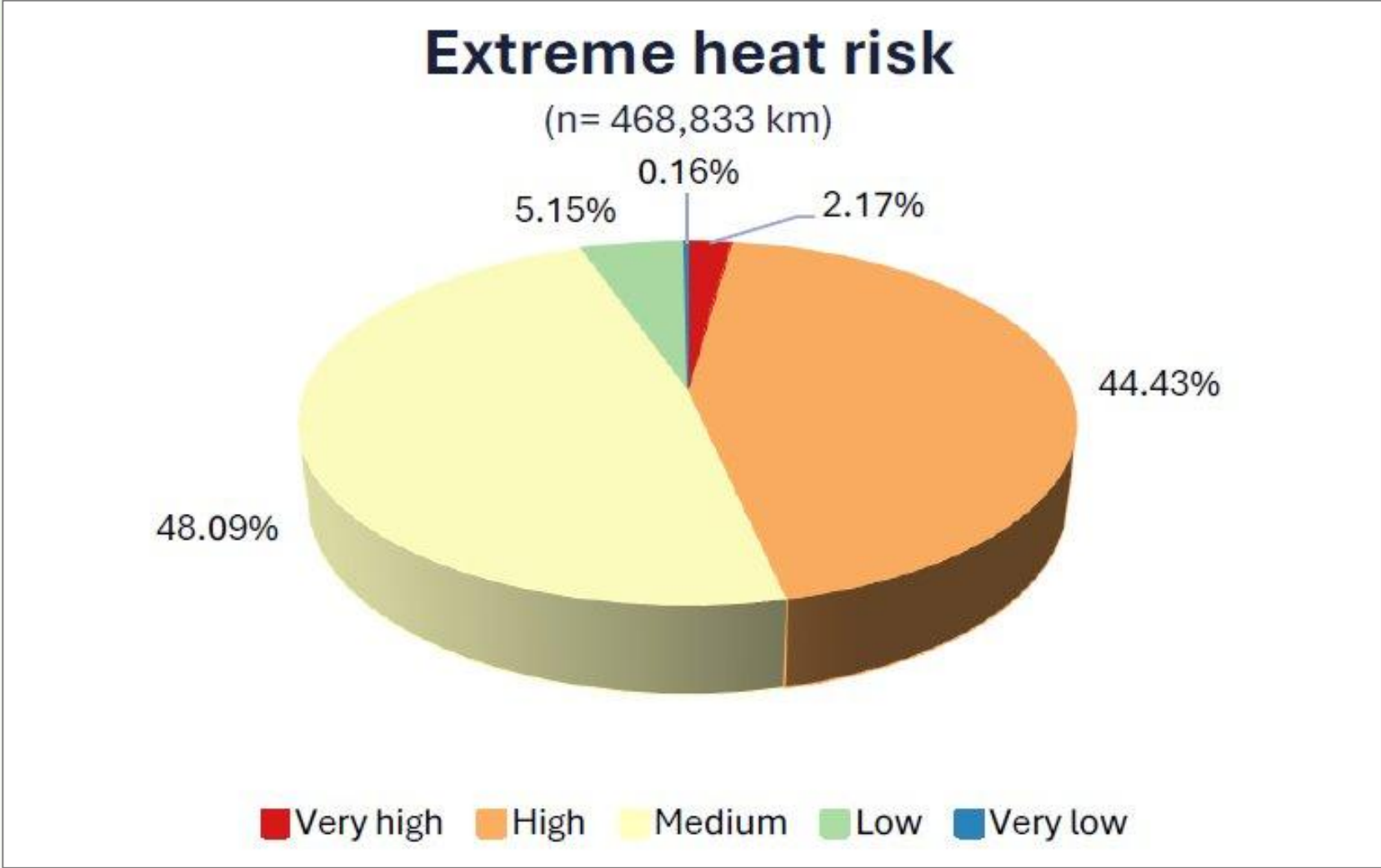
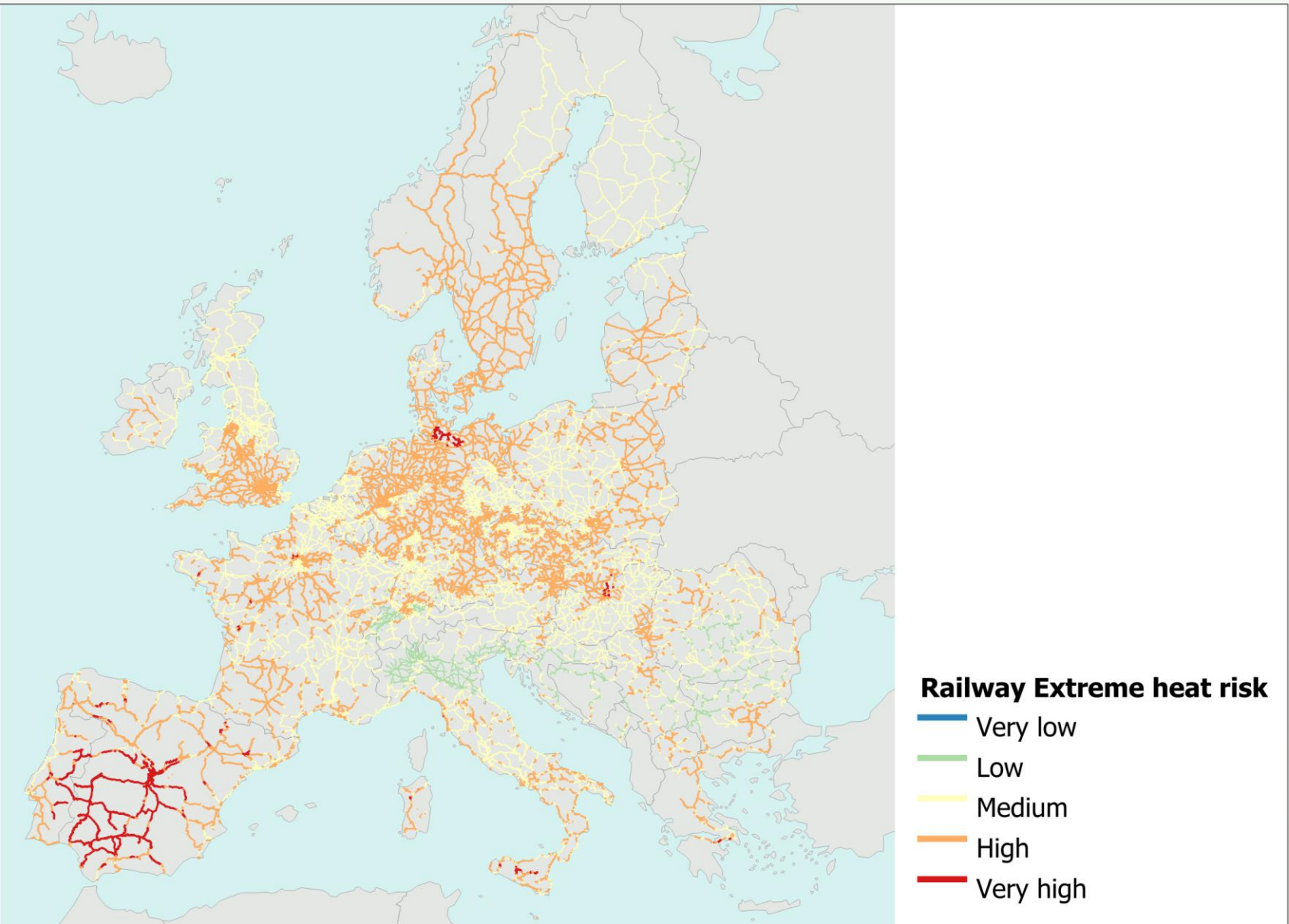


Task 3.2: Milestone 9 - Submitted

2.- Extreme heat: Indicator based on

- increase average temperature;
- heatwaves: intensity, number and duration.

(Source: Copernicus Climate Change Service).



Task 3.2: Dissemination of results

Transport Research Area

Budapest 18-21/05/2026



Accepted as poster communication

Sustainable transport infrastructure: Climate adaptation through Nature-based Solutions. A cost-effective resilient approach

Fernández, L.M.^{1,2}; Marull, J.¹; Álvarez, S.³; Yilmazer, P.⁴; Franzoni, L.⁴; Maillard, J.⁵ & Rosell, C.^{1,2}

¹Minuartia; ²Universitat de Barcelona; ³Universidad Politécnica de Madrid; ⁴Internacional Union of Railways; ⁵Forum of European National Highway Research Laboratories



Abstract

Climate change poses growing risks to linear transport infrastructure (LI) including floods, landslides and other climate-related hazards, causing significant infrastructure damage and economic losses. Nature-based Solutions (NbS) are cost-effective adaptive alternatives providing synergic benefits to infrastructure, society, and biodiversity. NbS are adaptive and multifunctional, allowing to better deal with the uncertainties of climate change projections and scenarios. However, current lack of standards, harmonized guidance, and indicators are among the main barriers for upscaling their implementation in the sector. EU-Rail SYMBIOSIS (Systemic Mobilisation for Joint Biodiversity and Infrastructure) project aims to overcome these barriers by developing i) a harmonized methodology to prioritise NbS for climate resilient infrastructure, and ii) guidelines to reinforce Blue and Green Infrastructure on transport and energy networks.

Introduction

Climate-related hazards, such as floods or landslides, are affecting transport infrastructure, causing important infrastructure damage, service disruption and costs (Figure 1). These impacts highlight the need to implement adaptation policies and measures. Risk assessment methodologies and frameworks are being developed to anticipate these impacts and mitigate climate effects increasing infrastructure resilience. Nevertheless, adaptation measures envisaged are still focused on traditional engineering solutions, which potential are jeopardized by climate projection uncertainties.

Transport infrastructure also have important negative effects on the environment, being one of the main causes of habitat fragmentation and posing a great threat to biodiversity. The need to restore ecological connectivity has been stressed in numerous key international documents, such as the Kunming-Montreal Global Biodiversity Framework, the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, or the Biodiversity Strategy for 2030, among others.

However, there are opportunities to implement measures lacking these impacts synergically, contributing to increase infrastructure resilience, climate change mitigation and biodiversity conservation. Transport infrastructures include large surfaces of public lands, known as Right of Way (ROW), including terrestrial and aquatic ecosystems. These areas can be strategically planned for the implementation of NbS as cost-effective adaptive alternatives of providing synergic co-benefits and contributing to international sustainability goals. NbS implementation in urban settings have proven to benefit public health and alleviate climate change effects, but they are rather unexplored in transport networks, where they could also provide numerous environmental services, allowing to better deal with the uncertainties of climate change projections and scenarios.



Figure 1. Railway infrastructure management provide opportunities to reduce climate-related hazards and benefit biodiversity (Fernández et al. Generalitat de Catalunya).

Our research, included in the EU-Rail funded project SYMBIOSIS (Systemic Mobilisation for Joint Biodiversity and Infrastructure) aims to overcome barriers identified to upscale NbS implementation in transport infrastructure, such as the lack of standards or the quantification of NbS co-benefits, by developing a harmonized methodology to prioritise NbS for climate resilient infrastructure, and guidelines to implement them on transport networks.

Methodology

Literature review has been conducted to define the state of the art regarding the implementation of NbS for climate change adaptation in transport infrastructure, identifying main climate-related hazards affecting railways and current adaptation measures being implemented.

In parallel, cartographic information has been identified and analysed to locate 'high risk' and 'high opportunities' areas for the implementation of NbS, maximising synergic benefits. Potential locations considered were those where railway infrastructure is threatened by climate-related hazards and measures applied can provide important benefits for biodiversity. Cartographic information collected included: i) railway infrastructure at European scale; ii) specific climate-related hazards (floods and extreme heat); iii) protected areas; iv) habitats included in the Habitats Directive; v) endangered species, among others.

1 Literature review

- Identify relevant climate-related hazards
- Define the state of the art of NbS in transport infrastructure climate change adaptation
- Review European and transport sectorial approaches to climate change adaptation

2 Integration of cartographic information

- Climate-related hazards
- Surrounding ecosystems
- Environmental benefits

3 Detailed study cases

Select the most appropriate NbS for climate change adaptation and biodiversity enhancement

Figure 2. Schematic representation of the methodology.

Results

Literature review has showed the wide variety of climate-related hazards that can affect transport infrastructure in general and railways in particular (Figure 3). Floods and extreme heat being the most important in terms of expected frequency and intensity, causing the strongest impact in railway networks.

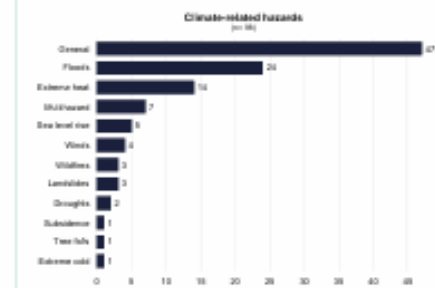


Figure 3. Climate-related hazards affecting railway infrastructure identified in the literature review.

For floods and extreme heats, existing and publicly accessible cartographic information have been downloaded to identify the sections of European railways at higher risks by 2100 in the RCP8.5 scenario.

By analysing the European rail network regarding the flood risk areas (Baugh et al., 2024) a 11.19% can be considered at a very high risk, 1.50% at high risk, and 0.96% at medium risk (Figure 4). By combining all these categories, a total of 13.65% of the European railway network is under risk of flooding by 2100. The five most affected countries are showed in Figure 5.

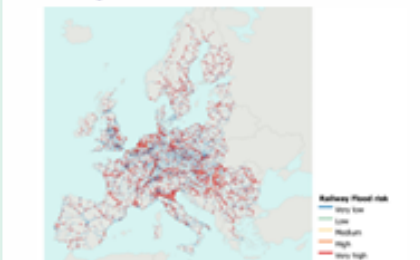


Figure 4. European railway network regarding flood risk.

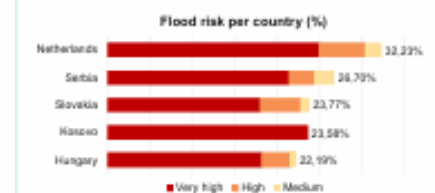


Figure 5. Proportion of railway network at risk of flooding in the five most affected countries.

For the extreme heat, two indicators have been used: temperature increase (analysed as the increase in the average temperature of the warmest month) and heatwaves (analysed combining their intensity, number and duration). These two indicators show a different distribution of the risk throughout Europe.

Regarding temperature increase, higher risk is experienced in the Scandinavian region, with Finland (90.6%) and Sweden (82.7%) showing the higher percentage at high risk, followed by Denmark (80.5%). For the impact of heatwaves, the higher risk is concentrated in Southern Europe. The Iberian Peninsula is the most affected region, with Portugal (36.6%) and Spain (28.0%) as the two most affected countries by this risk, followed by Greece (12.7%), Bulgaria (7.0%), and Hungary (2.2%). When combining both indicators, a high proportion of the European railway network can be considered exposed to extreme heat risk, with higher proportion of very high-risk sectors located in Spain (Figure 6).

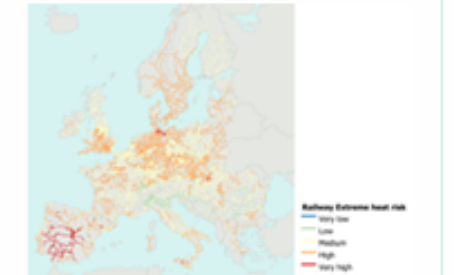


Figure 6. European railway network regarding extreme heat risk.

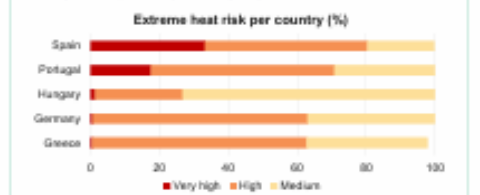


Figure 7. Proportion of railway network at risk of flooding in the five most affected countries.

Conclusions

Operational tools enabling stakeholders to identify and prioritise specific solutions maximising cost-benefit ratio is key to achieve a sustainable and resilient transport network. Implementing measures that address several challenges synergically is an effective way of make progression this direction. Nature based Solutions are good examples of this strategy and are considered 'no regret investments' or 'win-win' measures due to their wide array of co-benefits and flexibility to adapt to future climate scenarios and provide biodiversity net gain.

Floods and extreme heat represent the main climate-related hazards affecting railways infrastructure at European scale. Existing approach to climate adaptation in the railway infrastructure are still largely focused on traditional engineering solutions, while NbS are rarely considered as an alternative despite their potential to provide multiple benefits. The characterisation of European railway networks regarding these climatic hazards allow to identify high risk areas. Results obtained have identified that a high proportion of the European railway network is exposed to flood and extreme heat risk by 2100.

These findings highlight the importance of developing integrated approaches addressing climate resilience and biodiversity opportunities in railway infrastructure planning to enhance infrastructure resilience while simultaneously supporting biodiversity conservation and ecosystem services.

Acknowledgments

Project funded by the European Union under the Horizon Europe program (Grant Agreement No 101177281). Views and opinion expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Europe's Rail Joint Undertaking. Neither the European Union nor the granting authority can be held responsible for them. The project SYMBIOSIS is supported by the Europe's Rail Joint Undertaking and its members. L.M. Fernández also acknowledges support from the Industrial PhD Programme of the Government of Catalonia (2024-DI-00145) and from Dr. Santi Sabaté from the Faculty of Biology, University of Barcelona.

Contact information

Luis Manuel Fernández

MINUARTIA Tel: +34 93 514 0860
C/ Aragó 208, 7 Email: luis.fernandez@minuartia.com
Barcelona (ES) Web: www.minuartia.com

Task 3.3: Blue and Green Infrastructure Guidance for Railways

Work Breakdown Structure		Start Month	End Month	YEAR 1												YEAR 2												YEAR 3											
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
WP3	Operational Toolkit	1	34																																				
Task 3.1.	Explore and analyse requirements for operational tools	1	20											MS 5																									
Task 3.2.	Mapping of railway resilience to climate change and opportunities to benefit biodiversity	4	30																MS 9													D 3.1							
Task 3.3.	Blue and Green Infrastructure Guidance for railways	10	34										MS 12																	D 3.2									
Task 3.4.	Biodiversity-CO2 calculator development	12	34												MS 12																	D 3.3	D 3.4						

June 2025 to February 2026 (M10 – M18)
Literature review and collect current and practices



Preliminary NbS to be included in the catalogue



March 2026 to August 2026 (M14 – M24)
Process stakeholder workshop review and define indicators to be considered/evaluated



MS12 - Preliminary report on the 'State of the Art' about railway ecological asset design and management, with special focus on the application of NbS and other measures to reinforce BGI in railway infrastructure



September 2026 to April 2027 (M25 – M32)
Final description of NbS + Integration of methodology



DRAFT D3.3 - Decision support Guidelines to reinforce Blue and Green Infrastructure on transport and energy infrastructure



May to June 2027 (M23 – M34)
Deliverable review and submission



Submission D3.3



Task 3.3: Analysis of NbS in European Railways

Analysis of Nature-Based Solutions (NbS) in European Railways					
NbS Type	Technical Description	European Examples	Engineering & Environmental Benefits	Operational Disadvantages & Technical Risks	Sourcing & Reference Framework
Vegetated Trackbeds	Integrating low-growing, drought-resistant sedum or local grasses within trackbeds.	Light-rail and tram networks in Germany, France, and Spain.	Lowers track ambient temperatures by up to 50%, mitigating track buckling risks. Absorbs noise and airborne particulate matter (PM _{2.5} and PM ₁₀).	High risk of decreased friction (wheel slip) if organic debris accumulates on rail heads. Requires specialized irrigation during extreme, prolonged droughts.	GEI Consultants Framework
Sustainable Drainage Systems (SuDS)	Constructing vegetative swales, retention ponds, and bioswales parallel to track beds.	Deployed by Network Rail (UK) across flood-prone regional lines.	Acts as a natural sponge buffer, significantly reducing stormwater runoff peaks. Filters heavy metals, hydrocarbons, and brake dust before they reach local aquifers.	Demands a large geographic footprint (land take) right next to the railway line. Subject to clogging from silt, requiring regular sediment dredging.	https://doi.org/10.1016/j.nbsj.2024.100126
Vegetated Slope Automation (VSA)	Planting deep-rooted native tree/shrub species or using live geotextile fascines on embankments.	Heavy rail cuttings in Yorkshire, United Kingdom.	Plant roots mechanically bind the soil, preventing landslides and mudslips. Significantly cheaper asset lifecycle cost compared to steel mesh or concrete shotcrete.	High establishment period lag (takes 3–5 years for roots to reach full structural strength). Risk of root networks disrupting buried signaling or power cables.	University of Glasgow Repository
Habitat Restoration & Ecological Corridors	Classifying and managing lineside right-of-way land to foster native flora and wildlife.	Trafikverket (Sweden) biological diversity classification system.	Connects fragmented habitats, drastically reducing wildlife-train collisions. Fulfills strict European Union biodiversity net-gain legal mandates.	Attracts large herbivores closer to tracks if fencing fails, creating safety hazards. Requires continuous ecological mapping, increasing administrative overhead.	UIC rEVeRsE Project
Zero-Chemical Vegetation Management	Replacing chemical glyphosates with mechanical mowing and slow-growing grass seed mixes.	Mainline inspection paths managed by ProRail (Netherlands) and Infrabel (Belgium).	Eliminates toxic herbicide runoff, protecting track-worker health and local water tables. Prevents chemical resistance build-up in aggressive invasive weed species.	Requires higher initial frequency of interventions compared to long-lasting chemicals. Mechanical machinery increases energy consumption and local track-access downtime.	https://uic.org/projects-99/article/life-naturerail
Lineside Vegetation Shading	Strategic positioning of mature, wind-resilient tree canopies to shade critical trackside assets.	Pilot testing zones across Central European infrastructure operators.	Cools critical trackside signaling cabins and rails, reducing thermal stress. Provides a natural windbreak, protecting overhead lines from crosswind damage.	Fall hazards during severe storms can down Overhead Line Equipment (OLE). Leaves on the line create "black ice" track conditions, disrupting braking distances.	https://doi.org/10.1016/j.nbsj.2022.100013



Task 3.3: Participation – Question 1



Do you identify any other **Type of NbS** to be added to the Catalogue?



menti.com
6926 3767



Task 3.3: Preliminary Decision Flowchart for Railway NbS

[START: Identify Railway Infrastructure Vulnerability or Policy Goal]



1 Is the primary issue related to EXCESS WATER or recurrent track/ballast flooding?

|—— YES —▶ **2** Do you have a WIDE RIGHT-OF-WAY (RoW) available outside the trackbed?

|—— YES —▶ [**SELECT:** Sustainable Drainage Systems (SuDS)]

|—— NO —▶ [**WARNING:** Revert to traditional grey drainage]

|—— NO —▶ **3** Is the primary issue SLOPE INSTABILITY, minor landslides, or soil erosion?

|—— YES —▶ **4** Can the asset wait 3–5 YEARS for root systems to fully mature?

|—— YES —▶ [**SELECT:** Vegetated Slope Automation (VSA)]

|—— NO —▶ [**SELECT:** Hybrid Solution: VSA + Steel Mesh]

|—— NO —▶ **5** Is the primary issue EXTREME HEAT (track buckling or asset thermal stress)?

|—— YES —▶ **6** Is the thermal risk concentrated on the RAILS or trackside CABLES/CABINS?

|—— RAILS —▶ [**SELECT:** Greening Tracks]

|—— CABINS —▶ **7** Is there a SAFE SETBACK to prevent tree-fall?

|—— YES —▶ [**SELECT:** Lineside Shading]

|—— NO —▶ [**WARNING:** Use artificial shade]

|—— NO —▶ **8** Is the primary goal compliance with ENVIRONMENTAL REGULATION (Biodiversity/Glyphosate)?

|—— YES —▶ **9** Is the restriction specifically targeting CHEMICAL HERBICIDES?

|—— YES —▶ [**SELECT:** Zero-Chemical Management]

|—— NO —▶ **10** Do you have land to connect fragmented wildlife habitats?

|—— YES —▶ [**SELECT:** Ecological Corridors]

|—— NO —▶ [**REVIEW:** Consult UIC Frameworks]

|—— NO —▶ [**END:** Re-evaluate if the problem requires standard grey engineering solutions]



Task 3.3: Participation – Question II



Do you identify any other **Criteria** to be considered?



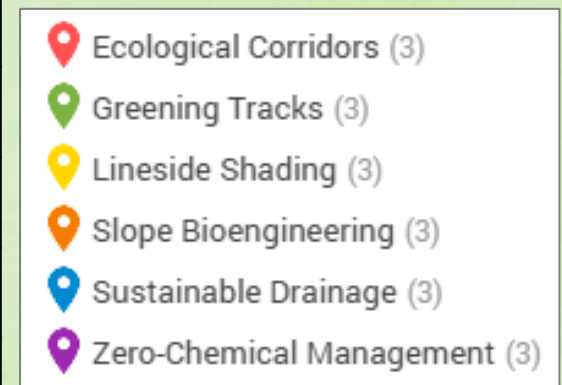
menti.com
2280 9974



Task 3.3: Case Study Directory of NbS in European Railways

Catalogue of Nature-Based Solutions (NbS) in European Railways

NBS Type	Successful European Operational Case Studies	Technical Implementation & Infrastructure Context	Reference & Framework
Vegetated Trackbeds	Warsaw Tramways Network, Poland .	Warsaw: Replaced classic stone ballast with extensive low-growing Sedum mats across urban corridors to mitigate summer track buckling risks by dropping local rail head temperatures.	Tramwaje Warszawskie / Sempergreen Cases
	Barcelona Tram System, Spain .	Barcelona: Integrated native grass trackbeds along urban avenues like Avinguda Diagonal to act as passive noise-dampening buffers and filter urban airborne particulates (PM10).	ATM Barcelona Sustainability Reports
	Freiburg Light Rail, Germany .	Freiburg: Developed lawn-tracks (Rasenkleis) that combine storm run-off storage with trackbed greening, lowering city noise levels by 3 to 4 decibels.	VAG Freiburg Light Rail Engineering Guide
Sustainable Drainage Systems (SuDS)	Network Rail Northern Region, United Kingdom .	Yorkshire: Replaced standard concrete lineside troughing with engineered bioswales and gravel-filled infiltration trenches to prevent recurrent ballast flooding during intense North Sea storms.	University of Glasgow Climate Research
	SNCF Réseau Pilot Sites, France .	Hauts-de-France: Constructed nature-based vegetated filter-strips parallel to high-speed lines to catch, treat, and slow down muddy runoff coming from adjacent agricultural plains.	SNCF Réseau Innovation Open Data
	ProRail Mainline Retentions, The Netherlands .	Utrecht: Installed large, interconnected landscape retention basins near low-lying railway junctions to safely absorb sudden stormwater peaks without disrupting train operations.	ProRail Water Management Blueprints
Vegetated Slope Automation (VSA)	Southern England Mainlines, United Kingdom .	London: Deployed live fascines (bundles of live branches) and deep-rooting grasses on clay railway cuttings to provide immediate mechanical soil-binding and prevent devastating landslips.	University of Glasgow Geotechnical Rep.
	ÖBB Mountain Passes, Austria .	Innsbruck: Substituted costly steel avalanche/rockfall barriers with thick bioengineered forestry shields on steep mountain slopes to block heavy debris from falling onto tracks.	ÖBB Infrastructure Environmental Policy
	SBB CFF FFS Alpine Corridors, Switzerland .	Bern: Used specialized live willow-wattle fencing along unstable Alpine embankments to naturally pump out excess pore water from the soil via plant transpiration.	SBB Sustainability & Engineering Codes
Habitat Restoration & Ecological Corridors	Trafikverket Lineside Classifications, Sweden .	Borlänge: Categorized over 1,400 rail stations and lineside areas into strict conservation tiers to legally preserve and connect meadows for wild pollinators across industrial zones.	UIC / Green Policy Platform (Trafikverket)
	Infrabel Biodiversity Corridors, Belgium .	Brussels: Formed strategic partnerships to transform standard railway perimeters into continuous ecological stepping-stones, integrating ecoducts for safe wildlife crossings.	Infrabel Corporate Biodiversity Strategy
	Deutsche Bahn, Germany .	Frankfurt: Dedicated thousands of kilometers of unused lineside right-of-way land to create safe animal migration tracks and protected micro-habitats for endangered reptiles.	DB Sustainability Portal (Das ist grün)
Zero-Chemical Vegetation Management	ProRail Mainline Operations, The Netherlands .	Rotterdam: Banned standard chemical glyphosate usage along track walkways, substituting it with high-temperature water/steam machinery mounted on specialized maintenance railcars.	International Union of Railways (UIC)
	Infrabel Inspection Paths, Belgium .	Antwerp: Deployed automated high-voltage Electroherb systems that run on tracks and shock weed root networks, stopping invasive growth near critical signaling systems.	Infrabel Non-Chemical Tech Reviews
	CFF Swiss Network Trials, Switzerland .	Zurich: Implemented precision hydro-mowing and seeded competitive, slow-growing grass species along ballast shoulders to naturally crowd out aggressive weeds.	SBB Vegetation Control Standards
Lineside Vegetation Shading	Network Rail Regional Lines, United Kingdom .	Fort William: Actively preserved natural woodland canopies along steep, sun-exposed cutting walls to provide continuous shading, reducing the maximum summer rail temperature.	Network Rail Media Centre / Trials
	SNCF Réseau Central Zones, France .	Orléans: Conducted thermal mapping trials to protect sensitive lineside signaling cabins and outdoor electronic relay boxes from overheating using strategic hedge layouts.	ScienceDirect / Transport Policy Data
	DB Netz Climate Resilience Pilots, Germany .	Berlin: Positioned wind-resilient, deep-rooted native tree rows along flat rural corridors to act as both a passive summer thermal shield and a winter crosswind break for overhead line wires.	DB Netz Climate Adaptation Guidelines



Task 3.3: Participation – Question III



Do you know any **Study Case** that can be considered a successful application of NbS to railway or other infrastructure?

Please send us a proposal by mail and we will consider including it at the Catalogue.

Email: luis.fernandez@minuartia.com and joan.marull@minuartia.com

Subject: **NbS Study Case**



Task 3.3: Dissemination of results

Infrastructure & Transport Network Europe

Bristol 21-25/09/2026

- Stakeholder workshop will be conducted at IENE 2026 Conference.
- Presentation of best practices and gather stakeholder feedback about NbS compiled.



Home Registration For Participants Programme Sponsors & Exhibitors Call for Proposals Contact information About IENE

IENE 30 YEARS
Infrastructure & Ecology Network Europe
Harmonizing Transportation and Nature

The Value of Nature in Resilient Infrastructure

21 -25 September 2026
UWE Bristol, UK

IENE 2026

Celebrating 30 years of Harmonising Transportation and Nature

IENE Conference 2026 'The Value of Nature in Resilient Infrastructure'
21 -25 September 2026. UWE Bristol, UK

Abstract

Title

From Grey to Green Infrastructure: Upscaling NbS in Railways

Abstract/proposal (short summary/description) * (max 250 words)

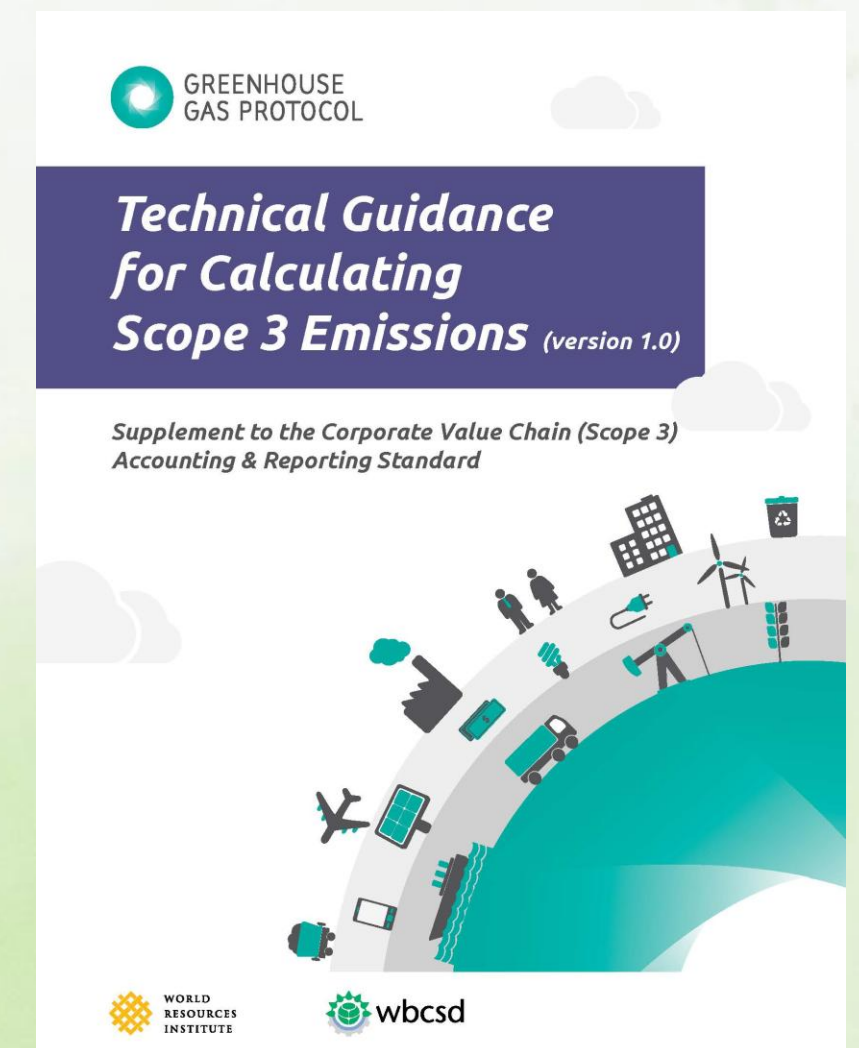
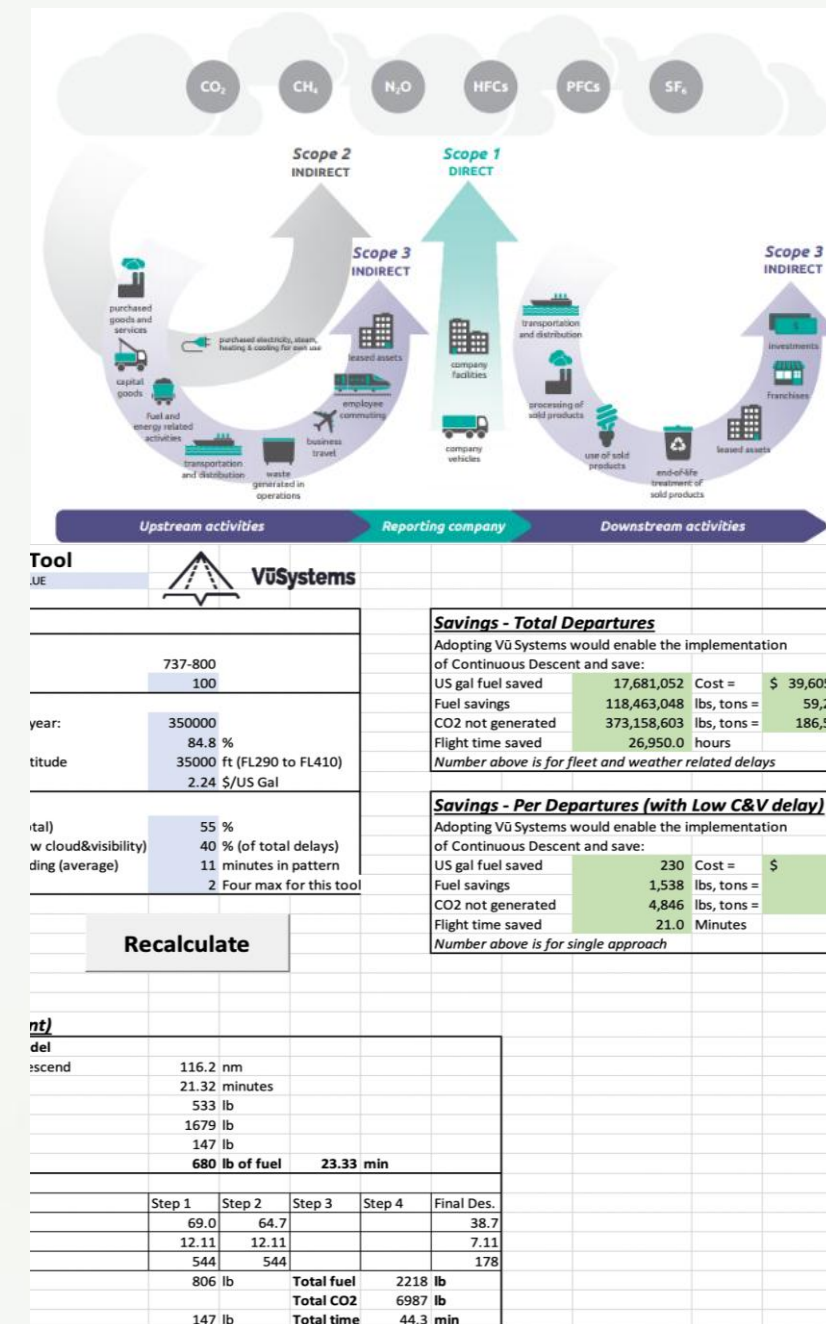
Climate change poses increasing risks to railway networks, causing infrastructure damage and economic losses that require the implementation of adaptation plans to enhance infrastructure resilience. Mitigation actions are often undertaken without considering Nature-based Solutions (NbS), despite their potential to deliver multiple co-benefits for infrastructure performance, society, and biodiversity, including climate change adaptation and habitat connectivity. Within the framework of the EU-RAIL SYMBIOSIS project, the state of the art of ecological asset design and management across European railways has been assessed. European railway networks encompass extensive public owned land, including aquatic and terrestrial ecosystems, which can be strategically managed to strengthen Blue and Green Infrastructure. Flooding and extreme heat have been identified as main climate-related hazards affecting railway resilience in Europe, requiring adaptation measures that are still predominantly focused on grey infrastructure, relying on artificial containment elements such as concrete or metal. **This workshop will present a catalogue of key NbS suitable for implementation within railway rights-of-way, supported by selected case studies.** Presentations will be followed by moderated discussions to examine the feasibility, costs, and benefits of each solution, as well as key considerations for their design, implementation, and maintenance. The session will evaluate the potential of NbS to reinforce Blue and Green Infrastructure and enhance the resilience of European railway networks. The outcomes will contribute to the development of guidelines to support decision-making, promoting solutions that enhance ecological processes while reducing climate-related risks through the application of NbS on land owned by railway operators.

Abstract pending approval



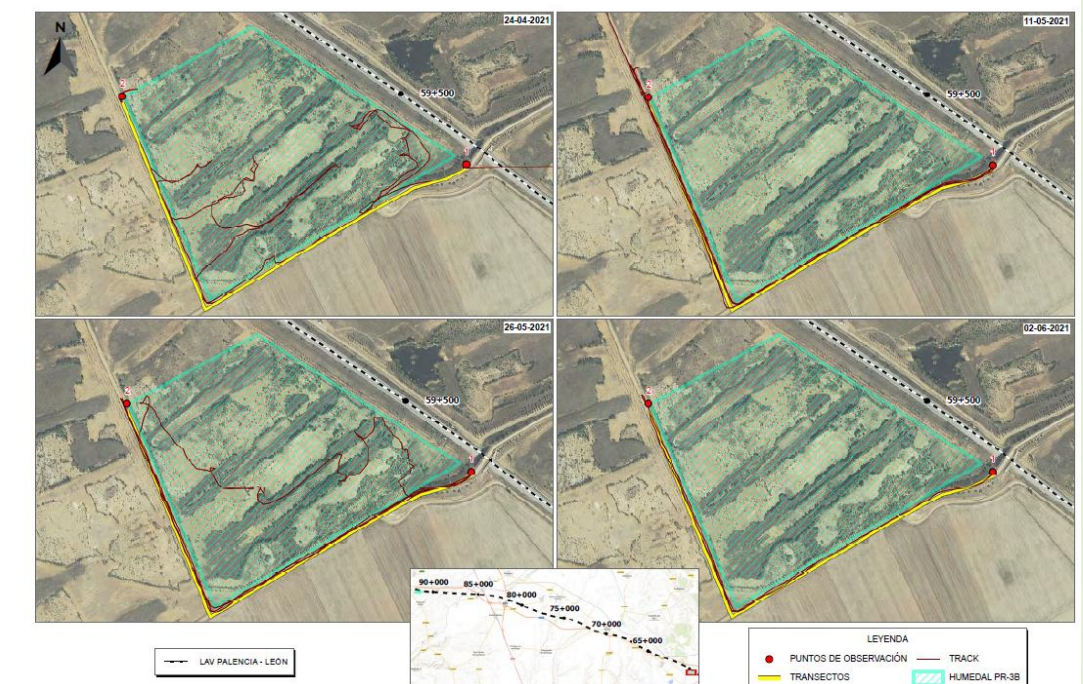
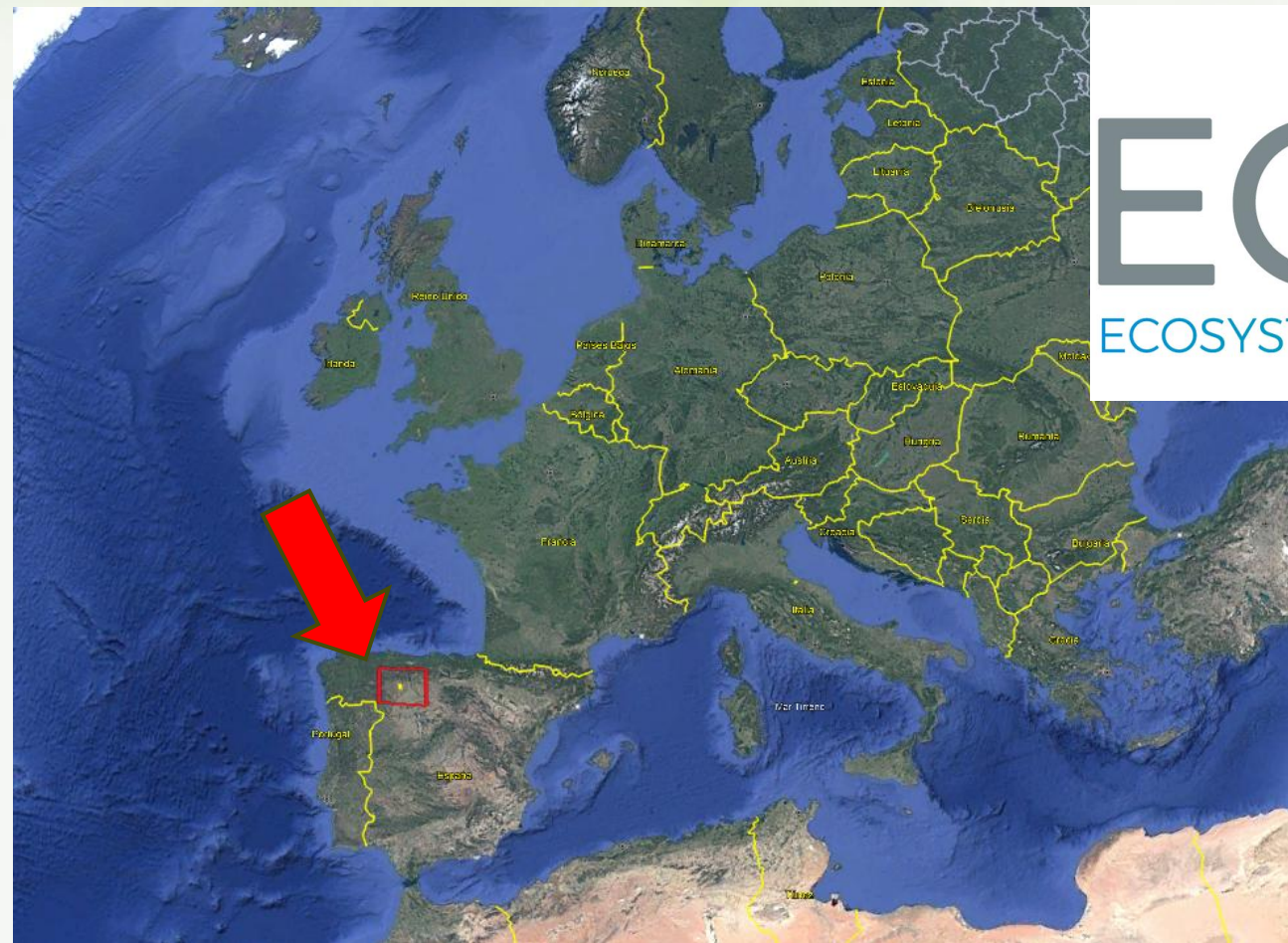
3.4 Biodiversity CO2 Calculator

- Methodological foundation
 - Discarded several outdated or less sound calculators
- Defining system boundaries and key parameters based on task 3.1 outputs
- User interface principles established
- Pending establishing coordination with WP4 to ensure inter-operability and matching data requirements



3.4 Biodiversity CO2 Calculator

- Selection of case study



3.4 Biodiversity CO2 Calculator

Next steps ahead

- Future work will focus on delivering a first working prototype. In order to do so, we will:
 - **Consolidate biodiversity indicator database** — drawing on existing frameworks (TNFD, GRI 304, EU Nature Restoration Law) to define the variables to be integrated as emission factors in the calculator
 - **Apply the GHG Protocol-based structure** to the ADIF case study — first full calculation run
 - **Integrate biodiversity factors** calibrated against UKCEH's ecological indicator expertise and WP4 monitoring data
 - **Internal validation round** with task contributors (FFE, IFEU, MINUARTIA, SLU) before wider consortium review
 - **Advisory Board feedback** on scope, usability and alignment with reporting standards



3.4 Biodiversity CO2 Calculator

What are some key biodiversity variables that you think should be integrated in the Biodiversity-CO2 Calculator?





WORK PACKAGE 4:

STANDARDISING BIODIVERSITY DATA COLLECTION AND INTEGRATION

- Key objectives
- Update on progress achieved, including reported deliverables
- Planned next steps with WP/task partners

WP4 Scope

Create a framework for harmonised collection, analysis, and integration of high-quality biodiversity data



Review current biodiversity data collection practices in European railways



Demonstrate new approaches to biodiversity monitoring



Integrate real-time biodiversity data into digital railway asset management systems



Co-design a best practice framework for biodiversity monitoring and reporting with operators and NGOs.

TASKS

4.1: Assessment of current practice for biodiversity data collection and reporting

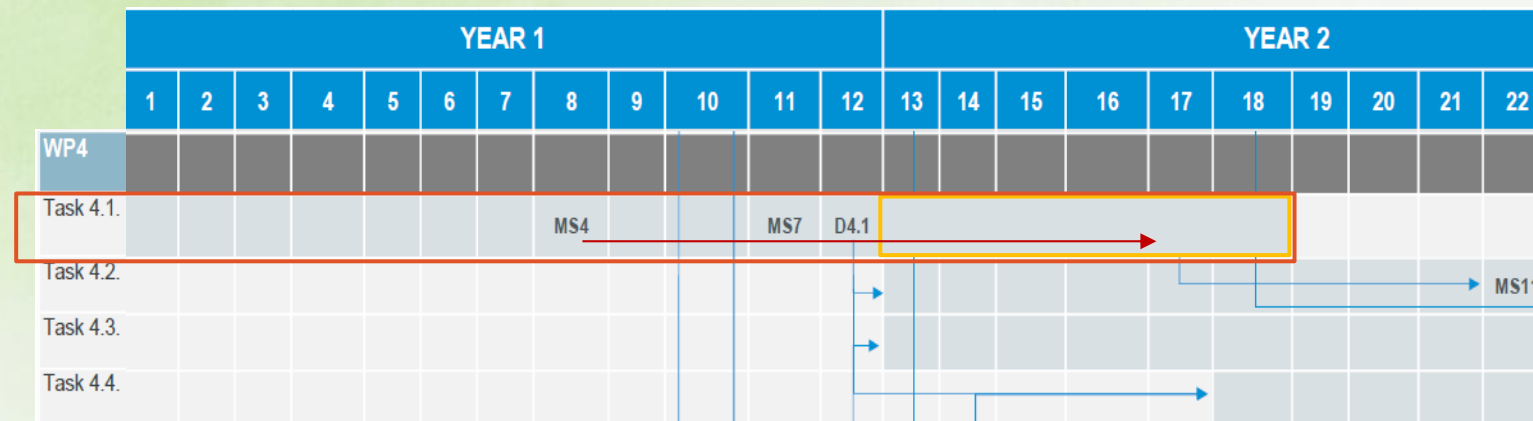
4.2: Pilot testing of new approaches to biodiversity data collection to inform standardisation

4.3: Demonstrating best practice for integrating biodiversity data into asset management systems


4.4: Co-designing an inclusive framework for standardised biodiversity monitoring, analysis and reporting



Task 4.1: Assessment of current practices for biodiversity data collection and reporting



- Review of the Reverse and Bison project surveys
- Development of SYMBIOSIS Questionnaire,
- Ethics committee approval,
- Online survey deployment (June 2025)
- Dissemination (summer 2025)
- Analyses of participants' Responses (November-October 2025)
- Integration of strategy and new approaches for streamlining Biodiversity Monitoring and Reporting




Deliverable 4.1

Transformative Insights and Strategies
for Biodiversity Monitoring
in European Railways

Schmucki, R., Kam, H., Freeman, M., Serra Gallego, J.,
Gerard, F., Lawson, J.L., Marston, C., Pywell, R. and
Ollerton, J. (2026)
04/06/2026

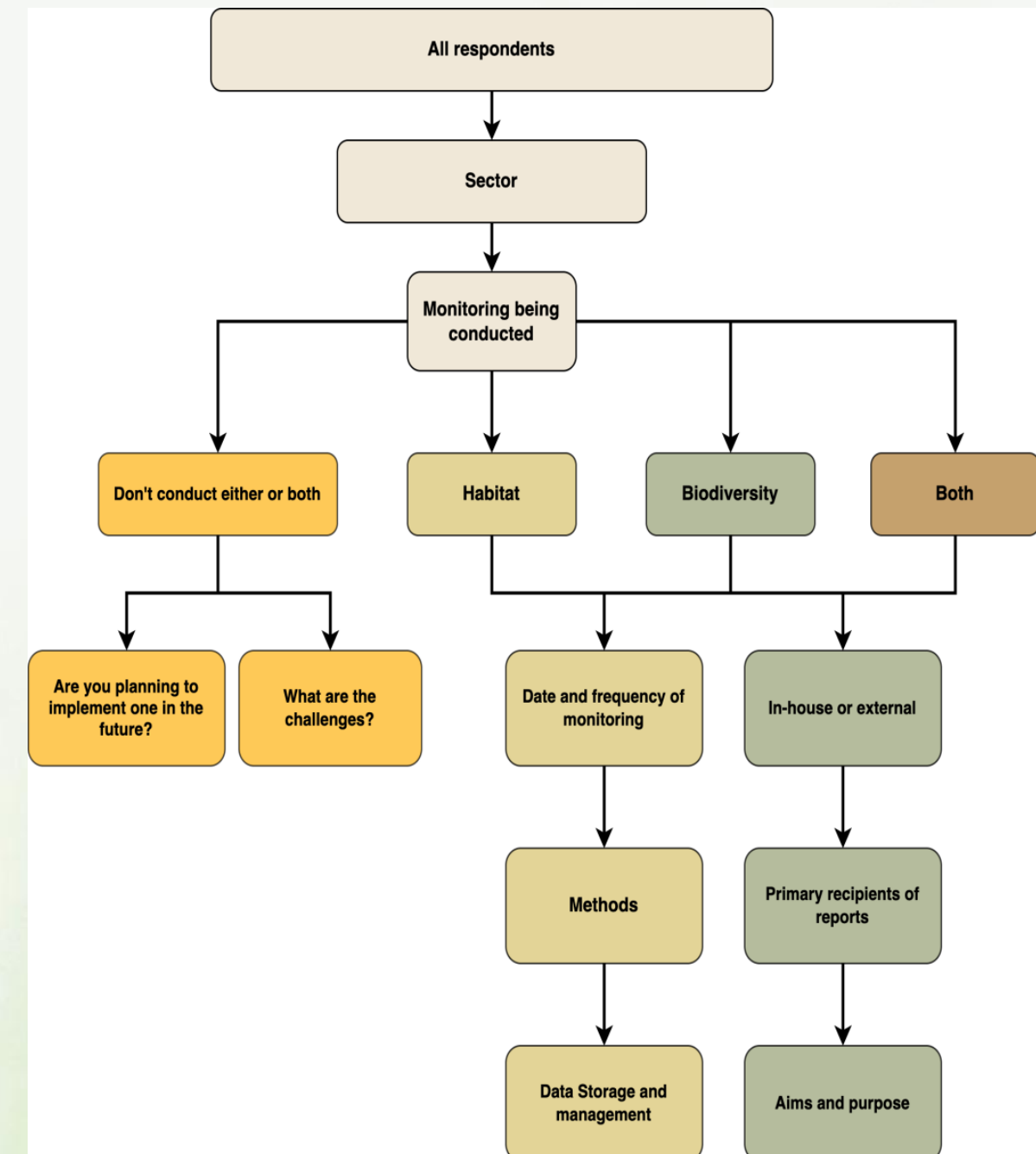
The project is supported by the Europe's Rail Joint Undertaking and its members.
Funded by the European Union. Views and opinions expressed are, however, those of the author(s)
and do not necessarily reflect those of the European Union or Europe's Rail Joint Undertaking.





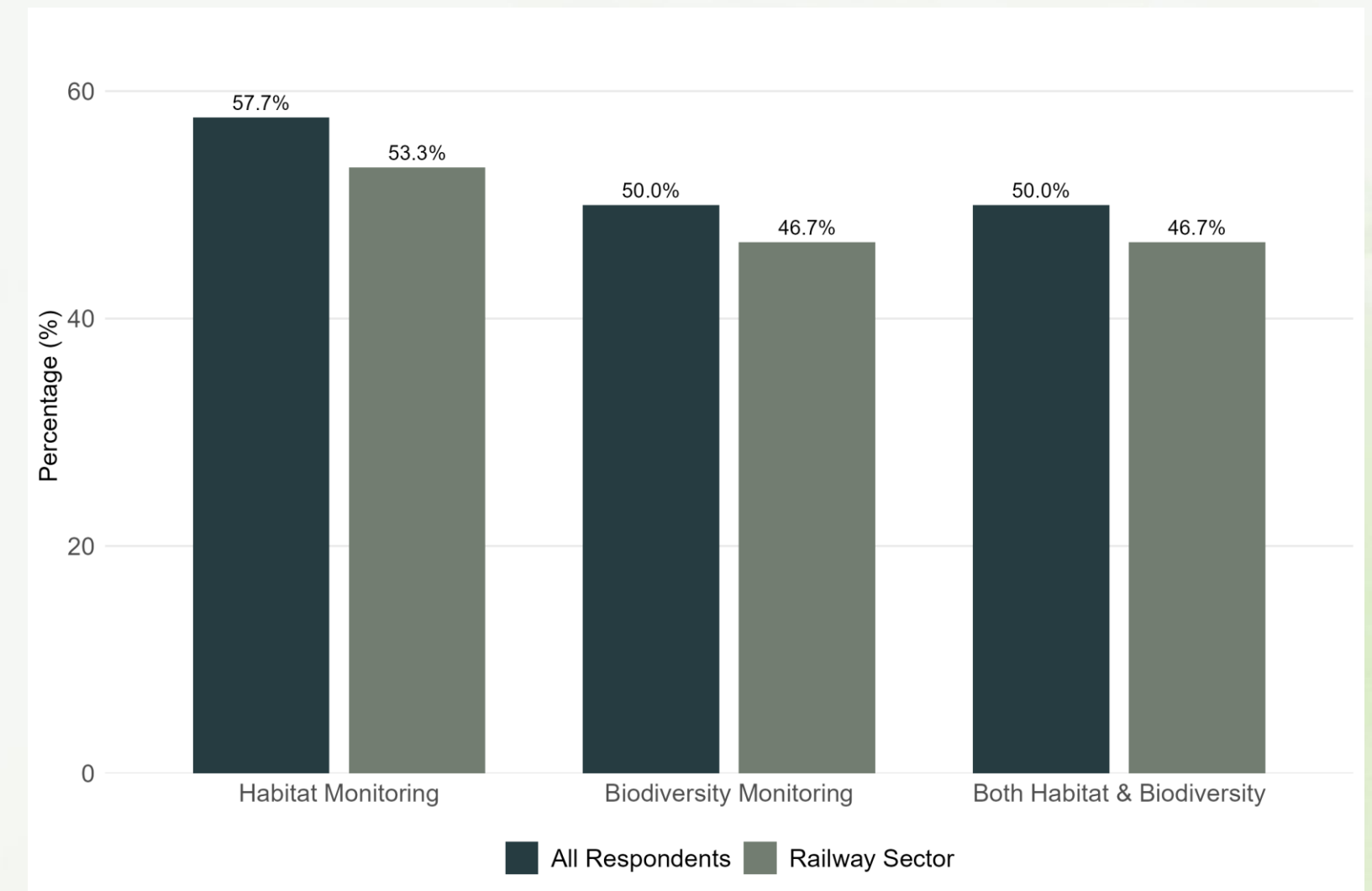
4.1 Questionnaire objective, logic and structure

- **Methods and protocols** used to monitor habitat and biodiversity.
- **Motivation and purpose** of monitoring.
- **Challenges** affecting habitat and biodiversity monitoring.
- **Perceptions and attitudes** towards the integration of monitoring standards.
- How monitoring data are **used and integrated** in decision-making and reporting.



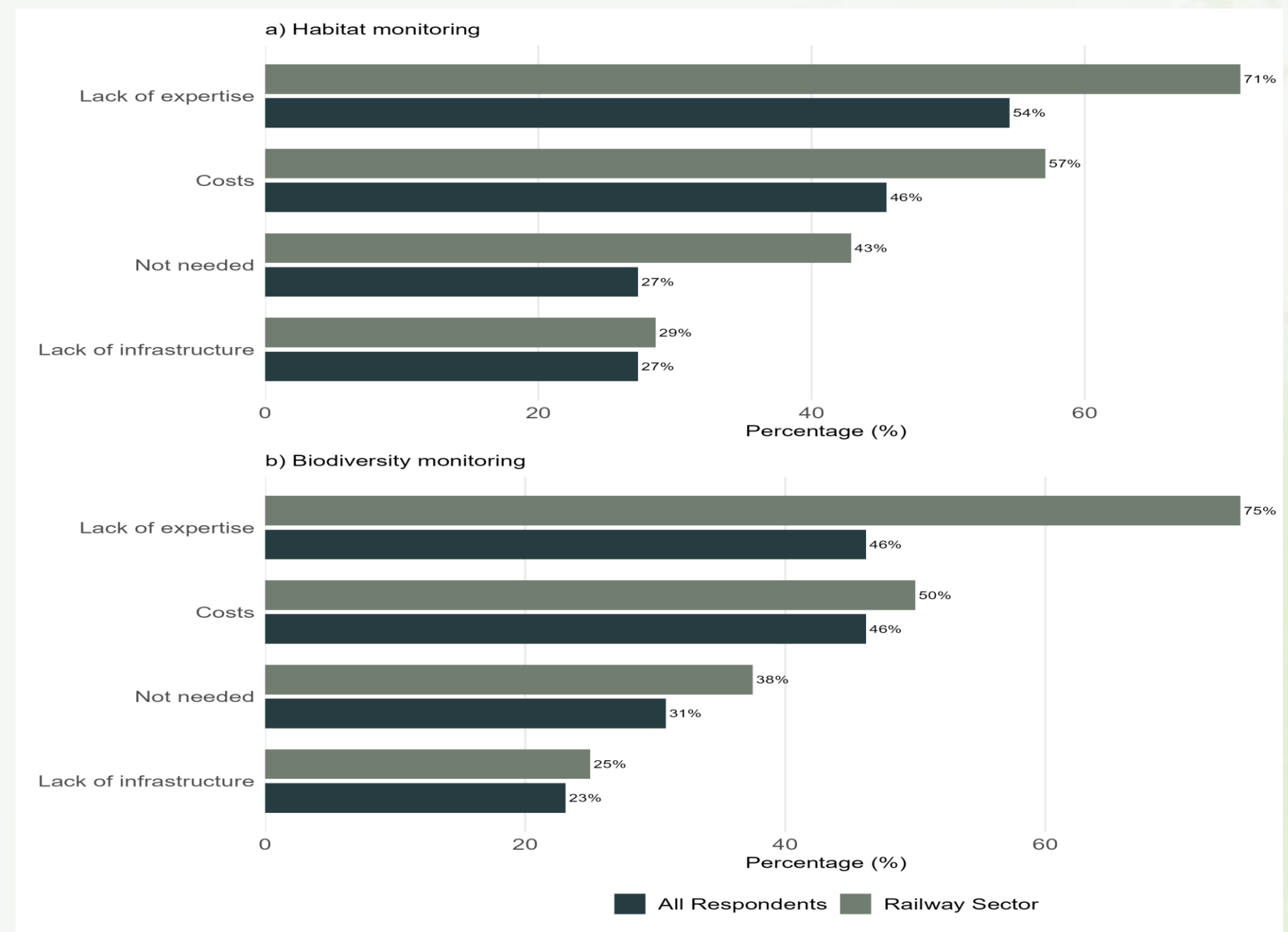
4.1 Key findings

- Around half of respondents conduct habitat (58%) or biodiversity (50%) monitoring.



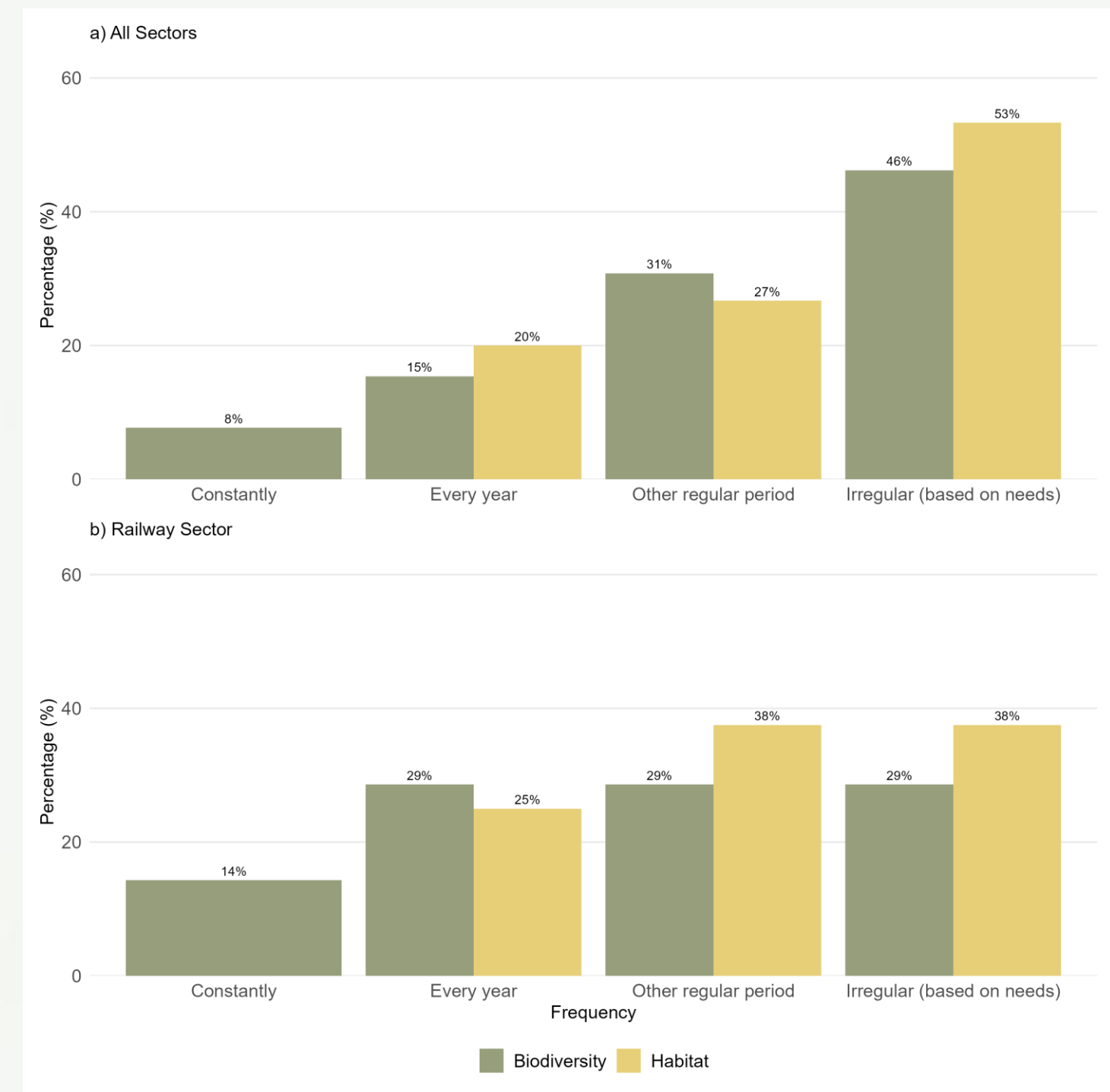
4.1 Key findings

- Around half of respondents conduct habitat (58%) or biodiversity (50%) monitoring.
- Lack of internal expertise (46–75%) and cost (46–57%) were the most frequently cited obstacles by organisations that do not currently monitor habitat or biodiversity.



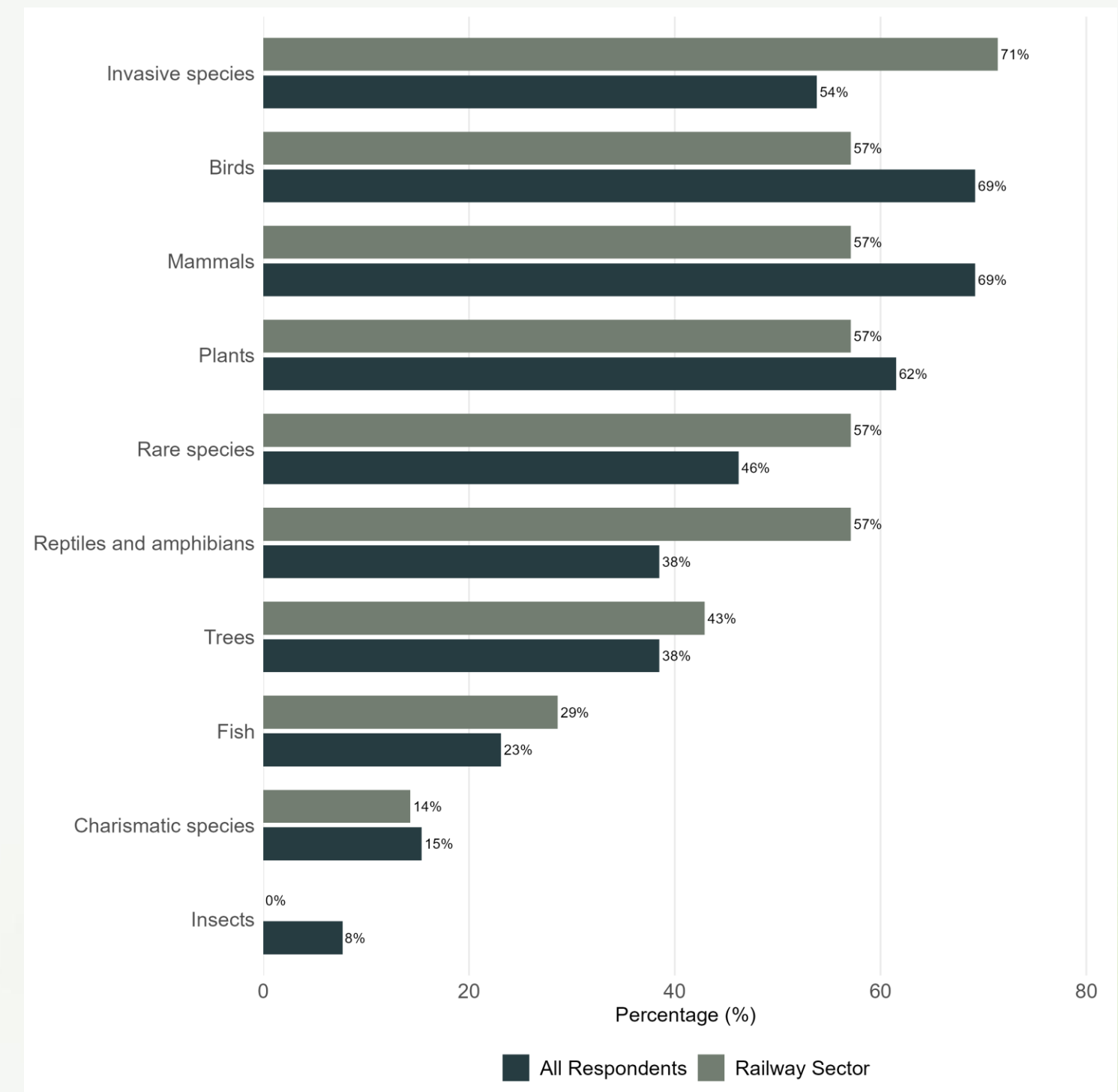
4.1 Key findings

- Around half of respondents conduct habitat (58%) or biodiversity (50%) monitoring.
- Lack of internal expertise (46–75%) and cost (46–57%) were the most frequently cited obstacles by organisations that do not currently monitor habitat or biodiversity.
- Ad hoc surveys are more frequent than systematic monitoring.



4.1 Key findings

- Around half of respondents conduct habitat (58%) or biodiversity (50%) monitoring.
- Lack of internal expertise (46–75%) and cost (46–57%) were the most frequently cited obstacles by organisations that do not currently monitor habitat or biodiversity.
- Ad hoc surveys are more frequent than systematic monitoring.
- Main focus is on invasive species, birds, mammals, plants and rare species.



4.1 Key findings

- **No standardised approach** to monitoring was evidenced across respondents.
- **Conformity with regulations** and reporting to authorities were by far the most frequently cited purposes of monitoring
- **Growing interest** (69% -77%) in incorporating monitoring data into planning, management, and reporting.



Q11: Is there growing interest in including habitat or biodiversity monitoring data in the planning, management, and reporting processes?

REPORTING	All Respondents	Railways Sector
Habitat	69% Yes	68% Yes
	19% No	20% No
	12% I don't know	13% I don't know
Biodiversity	77% Yes	73% Yes
	23% No	27% No



4.1. Transformative Insights

Action on three fronts

1. Technological innovation

- remote sensing,
- automated monitoring,
- AI-assisted classification,
- cost-effective sensor-based approaches such as passive acoustic monitoring.

2. Data standardisation and integration

- adopting interoperable data standards (Darwin Core, robust metadata),
- building on existing frameworks (IENE/BISON handbook),
- using ecological modelling platforms to translate monitoring data into actionable management insights.

3. A fundamental shift in culture and perception - from a regulatory obligation to an essential source of knowledge

- sustainable management,
- risk mitigation
- adaptation.



4.1. Transformative Insights

BOX 1: EARTH OBSERVATION AS A NEW LENS ON TRANSPORT CORRIDORS

Earth observation (EO), specifically optical satellite imagery and airborne LiDAR, is poised to transform how transport infrastructure managers map and monitor habitats. Commercial satellites now deliver frequent sub-metre optical imagery, while Sentinel-2 satellites provide free 10m continent-wide optical coverage fortnightly, making repeatable, large-scale habitat assessment both feasible and affordable. Airborne LiDAR adds a third dimension, revealing canopy height, understory structure, and features invisible from above.

Crucially, many railway and road operators already hold substantial EO data. Collected for engineering purposes, so far these data remain an untapped resource for ecological insight. When coupled with AI-driven classification, these combined data streams can detect habitat change, map invasive species, and support near-real-time environmental monitoring across thousands of kilometres of linear landscape features (ecological corridors) at a fraction of the cost required for traditional field surveys.

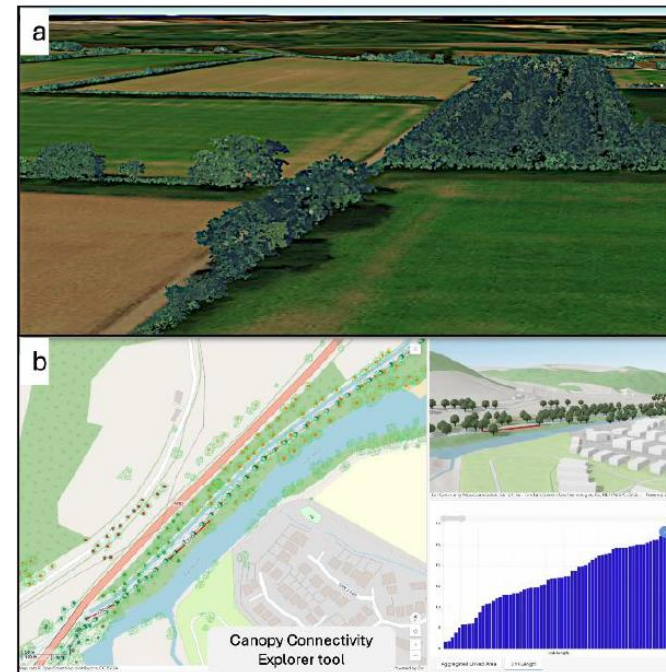
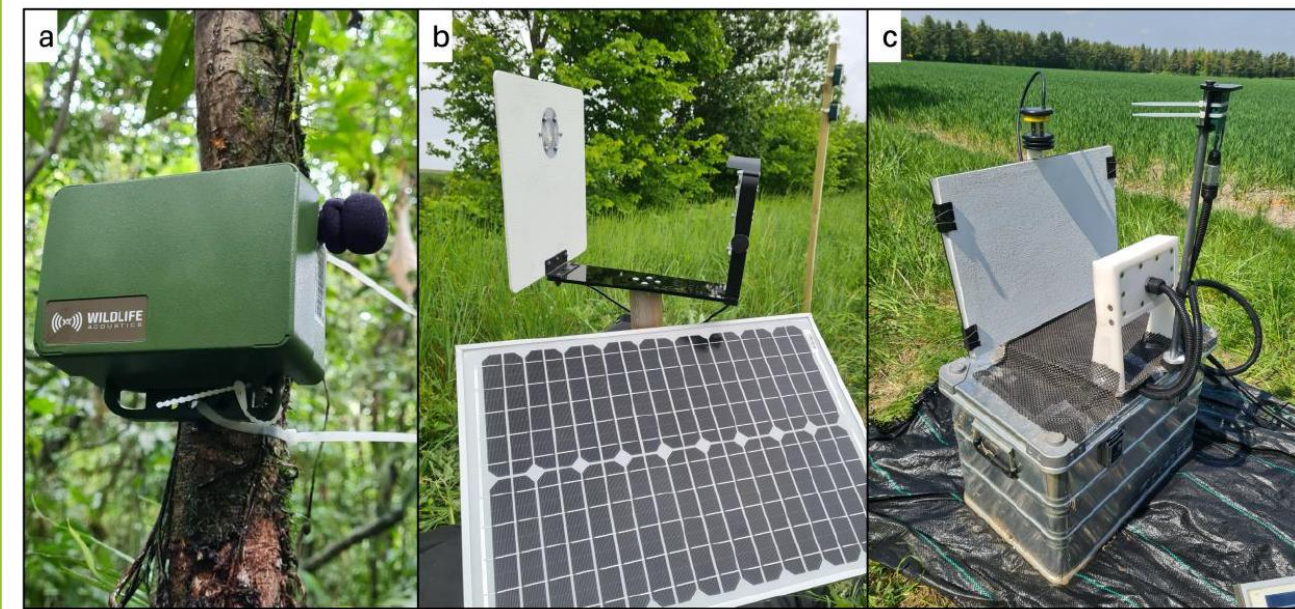


Illustration of a) a hybrid 3D flythrough visualisation that combines high-resolution optical imagery with LiDAR-derived terrain and linear vegetation structure, and b) an interactive tool for exploring and assessing canopy connectivity in linear features.

BOX 2: AUTOMATED BIODIVERSITY MONITORING USING ACOUSTIC AND IMAGE-BASED SENSORS

Camera traps, acoustic recorders, and integrated sensor stations can now operate continuously with minimal human intervention, collecting data on species presence and activity across sites that are often difficult or unsafe to survey in the field (Besson et al., 2022). When paired with AI, these systems automatically process thousands of images and sound recordings, classifying species and detecting temporal patterns in activity. Passive acoustic monitoring alone can cut person-hour requirements compared with traditional field surveys. Fully integrated monitoring stations, such as those developed by UKCEH in collaboration with Network Rail, combine acoustic sensors, light traps, and camera traps in a single solar-powered unit, demonstrating that continuous, multi-taxa biodiversity surveillance at scale is within reach. These technologies do not replace ecological expertise; rather, they extend the capacity to collect standardised data across days, months, and seasons. This bridges the gap between ad hoc, obligation-driven surveys and the systematic monitoring required for effective biodiversity assessment and habitat management.



Images of a) [Wildlife Audio Recorders](#) for singing birds, b) a [UKCEH LepiSense system](#), an autonomous affordable option for night flying insect (moths) monitoring and c) a [UKCEH Automated Insect Monitoring system](#) that can be coupled with acoustic (birds and bats) sensors for integrated monitoring.

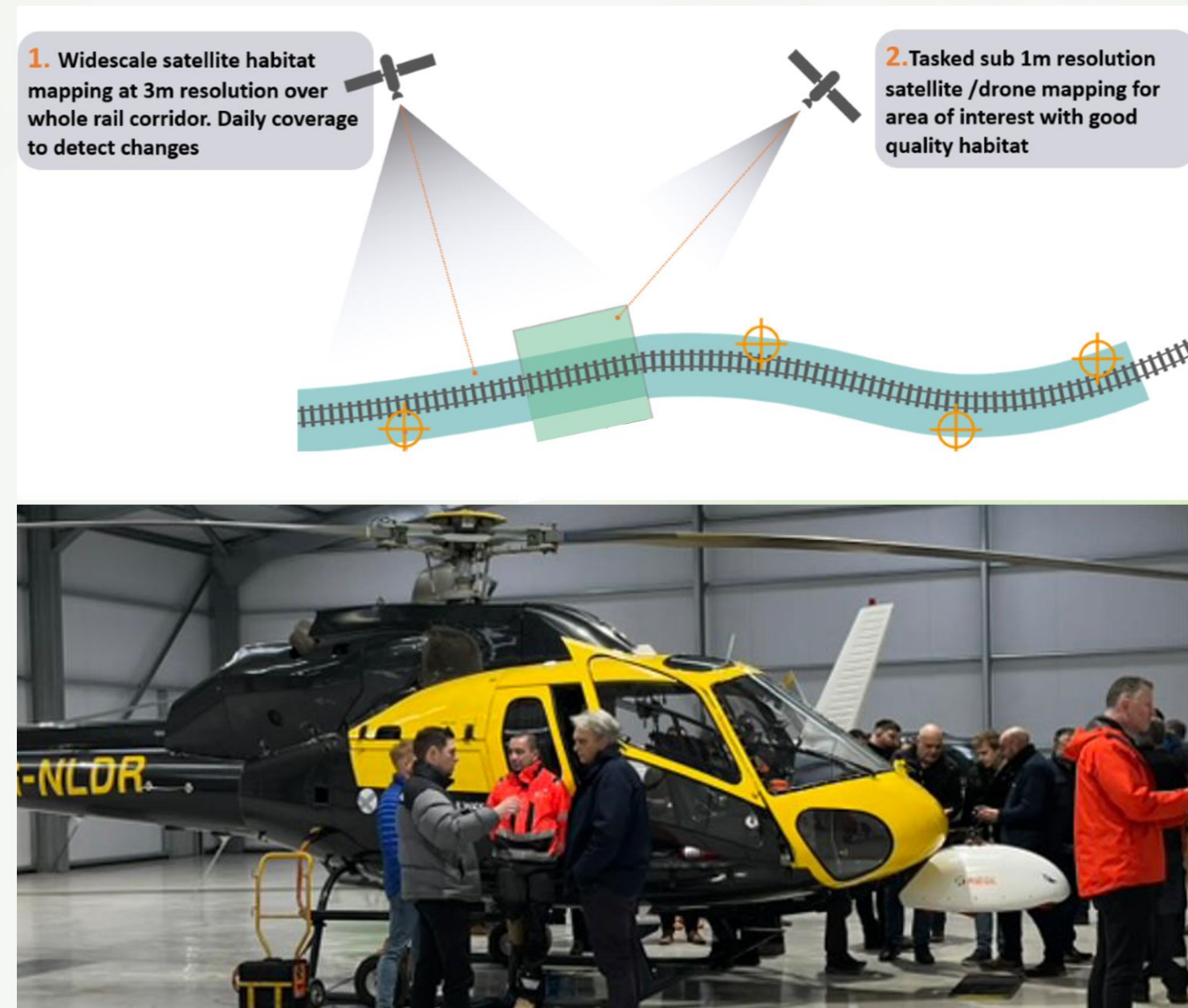
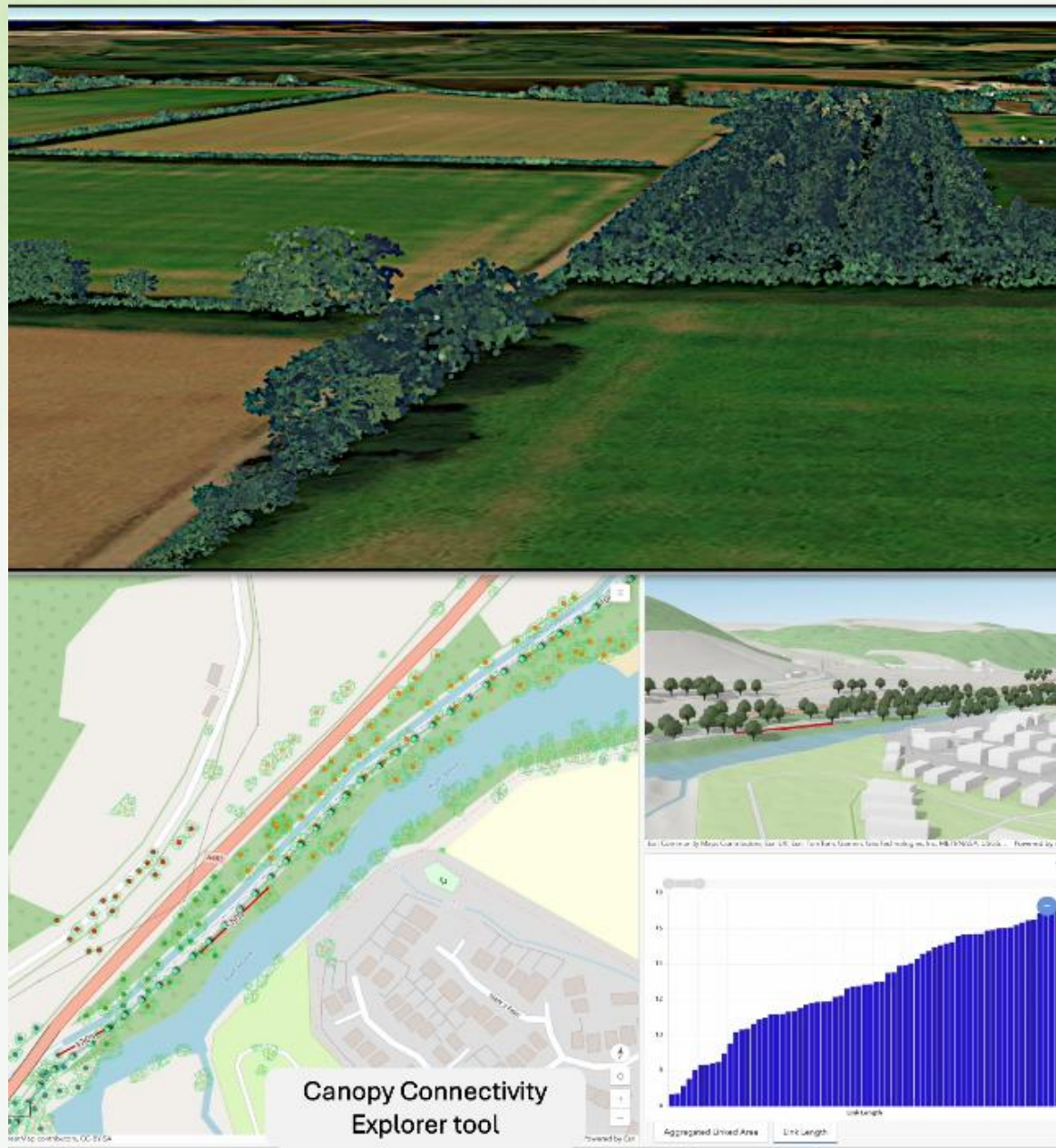


Task 4.2: Pilot testing of new approaches to biodiversity data collection to inform standardisation

1. Improve spatial and thematic resolution, including habitat structure
2. Deploy non-invasive and autonomous technology for biodiversity monitoring
3. Develop workflow to standardise data collection, documentation, analysis and reporting (feed task 4.3)
4. Develop an integrative platform for near-real-time information (feed 4.3)
5. Document challenges, costs and opportunities of the approaches (feed 4.4)



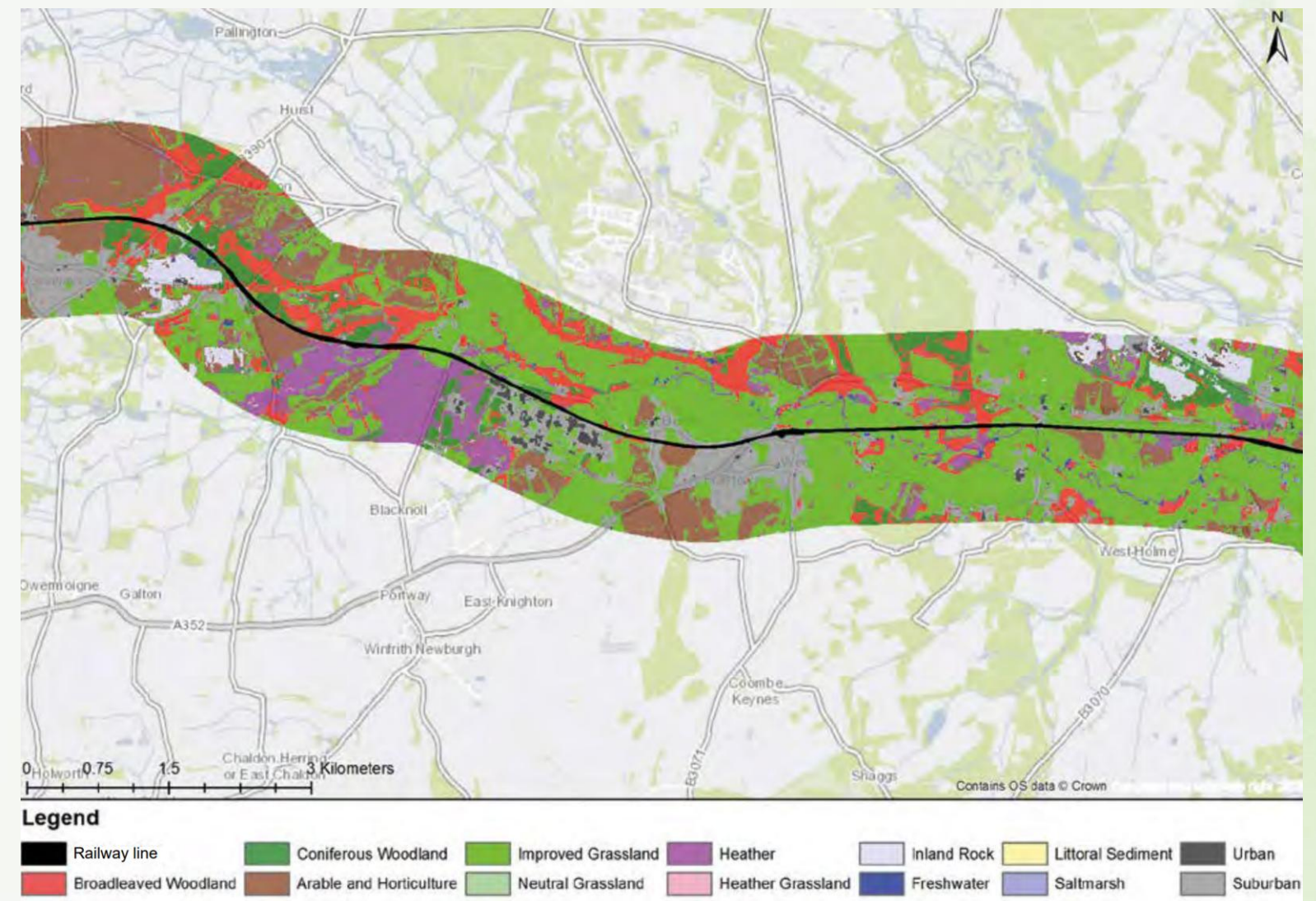
Task 4.2: Earth Observation as a new lens on transport corridors



Task 4.2: Earth Observation as a new lens on transport corridors

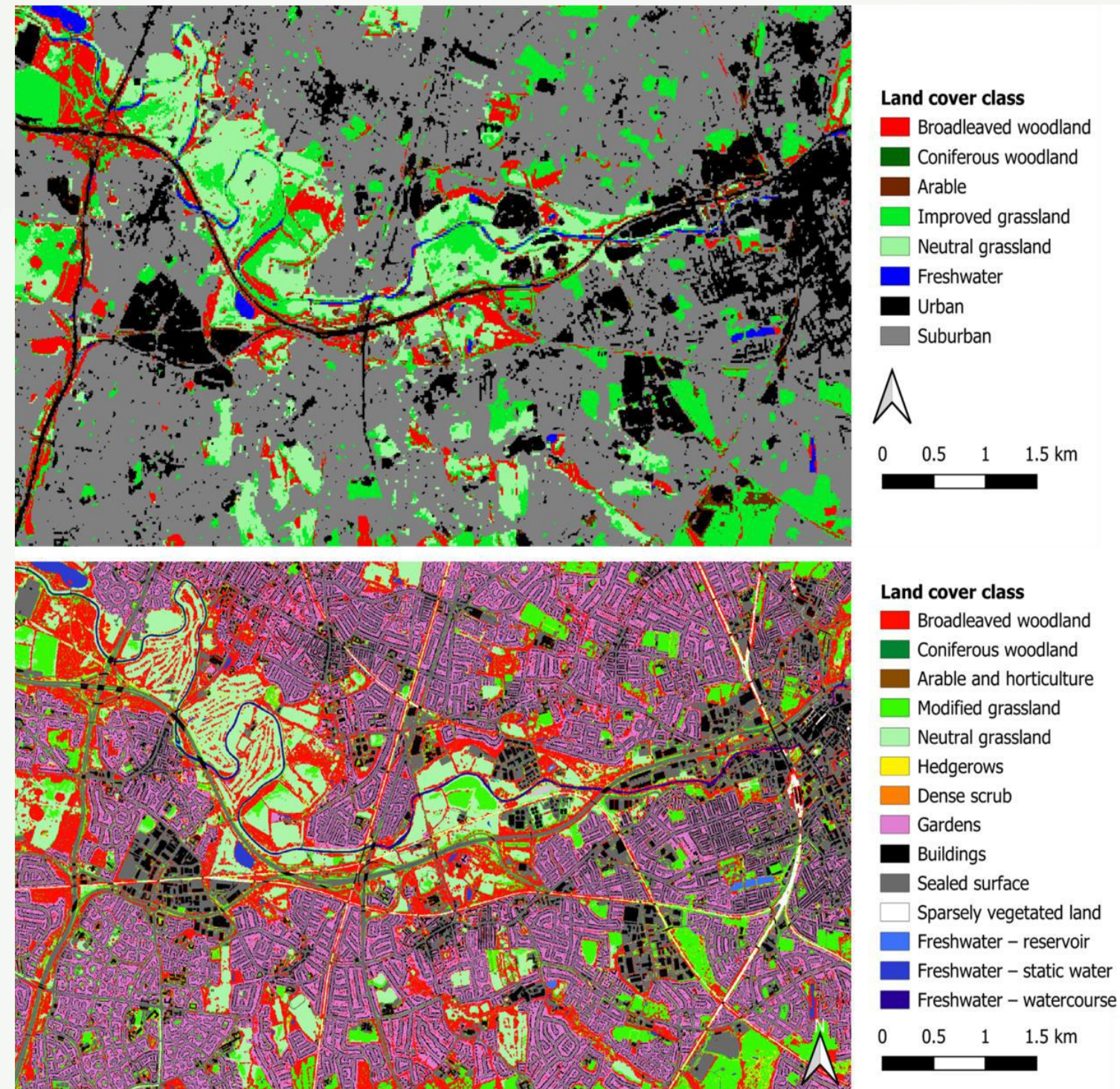
- Land cover map UKCEH along railway corridors [Network Rail Biodiversity Action Plan \(2020-2035\)](#)
- Network Rail [Annual State of Nature 2024](#)

similarity. Consequently, whilst the 10 m land cover classification data are useful in providing an overview of the land cover trends, they are not currently sensitive enough to confidently detect the relatively small levels of change in many land cover classes over relatively short time periods (5 years or less). It is likely that future development of higher resolution 3 m (and higher resolution) land cover classification methods could improve capabilities and accuracies of these activities. Should high



Task 4.2: Earth Observation as a new lens on transport corridors

- A 3-meter resolution habitat map is a clear improvement for monitoring changes in habitat type and quality.
 - source satellite imagery PlanetScope (3 m)
 - consistent, repeatable, affordable habitat assessment.



Task 4.2: Earth Observation as a new lens on transport corridors

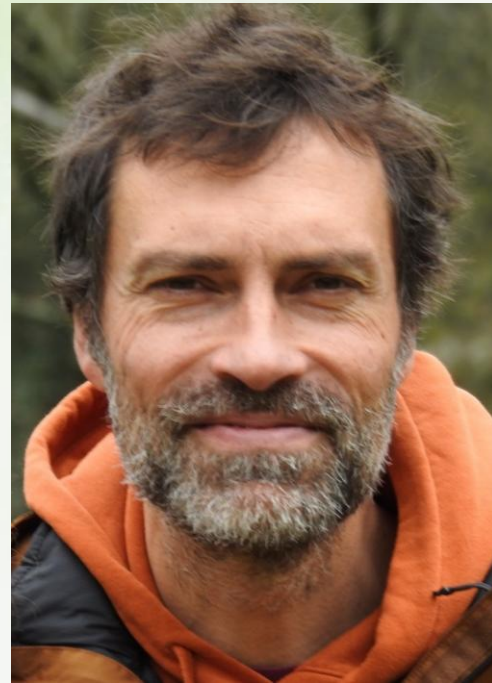
- A 3-meter resolution habitat map is a clear improvement for monitoring changes in habitat type and quality.
- Increased thematic resolution (number of habitat types)



Task 4.2: Mapping microhabitat refuges along railway verges using microclimate and vegetation structure



Dr Adriana Príncipe



Dr Fernando Ascensão

Can we use topography-driven microclimatic conditions associated with maximum vegetation height as an indicator of microhabitat diversity with the potential to enhance local biodiversity?

FCiencias.ID, University of Lisbon, Portugal



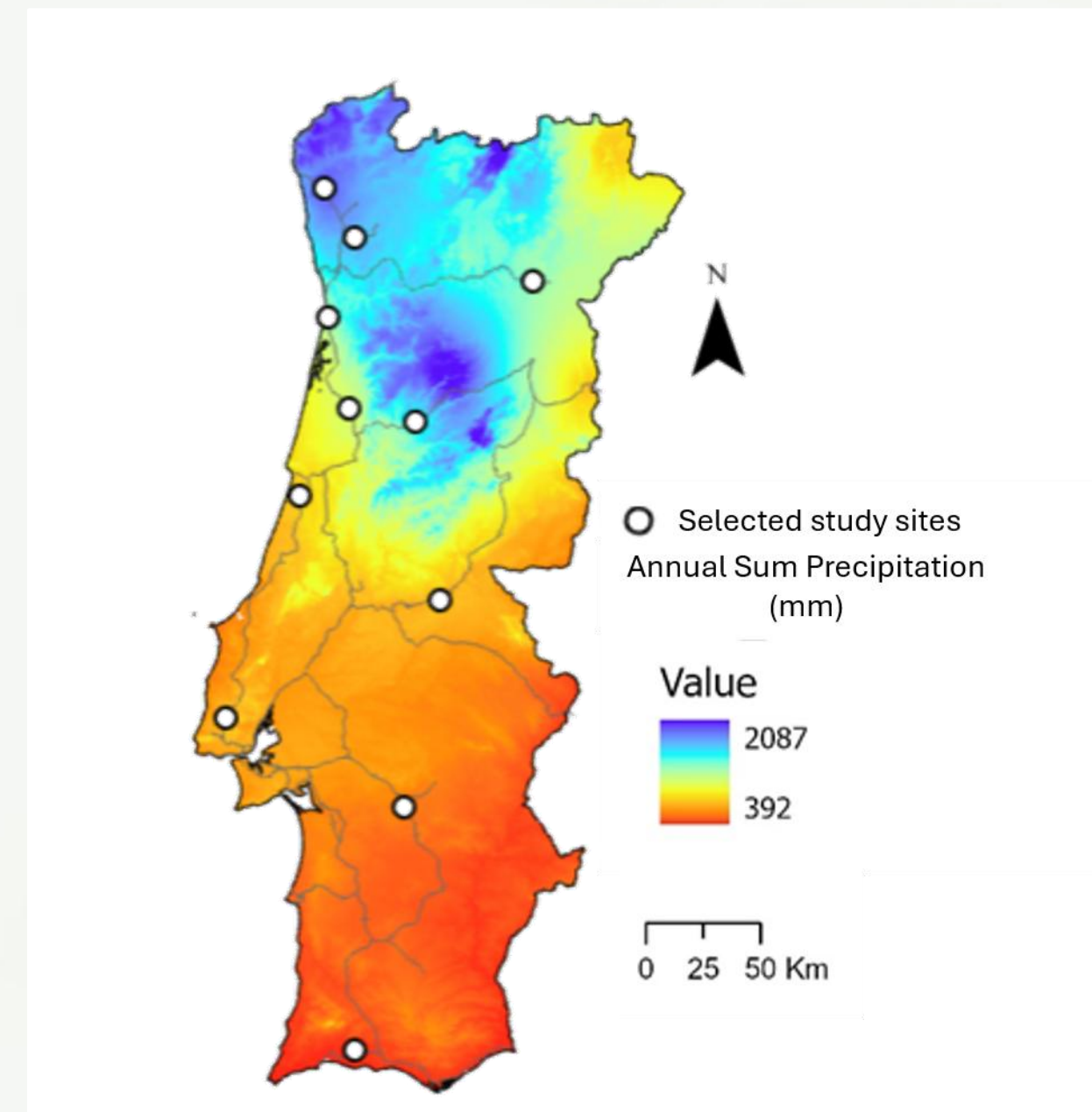
Task 4.2: Mapping microhabitat refuges along railway verges using microclimate and vegetation structure

- Railway networks increase landscape fragmentation but also create new ecological opportunities, creating ecological corridors and refuges supporting biodiversity.
- Railway verges can host diverse vegetation structures and rare species, form microhabitats and stepping stones for species movement (Toffolo et al. 2021, Cork et al., 2026, Galera et al., 2014).
- Vertical structure (e.g., canopy height) is a key factor influencing species diversity and habitat availability (Moudry et al., 2023; Bakx et al., 2019; Rada et al., 2022).
- Vegetation structure and growth can be limited by climatic conditions (e.g., precipitation) and local microclimatic conditions, such as solar radiation, mainly in Mediterranean climates (Crowther et al., 2015; Berdugo et al., 2019; Lenoir et al., 2017).
- Remote sensing (e.g., LiDAR, DEMs) enables detailed analysis of vegetation and microclimates at fine spatial resolution.



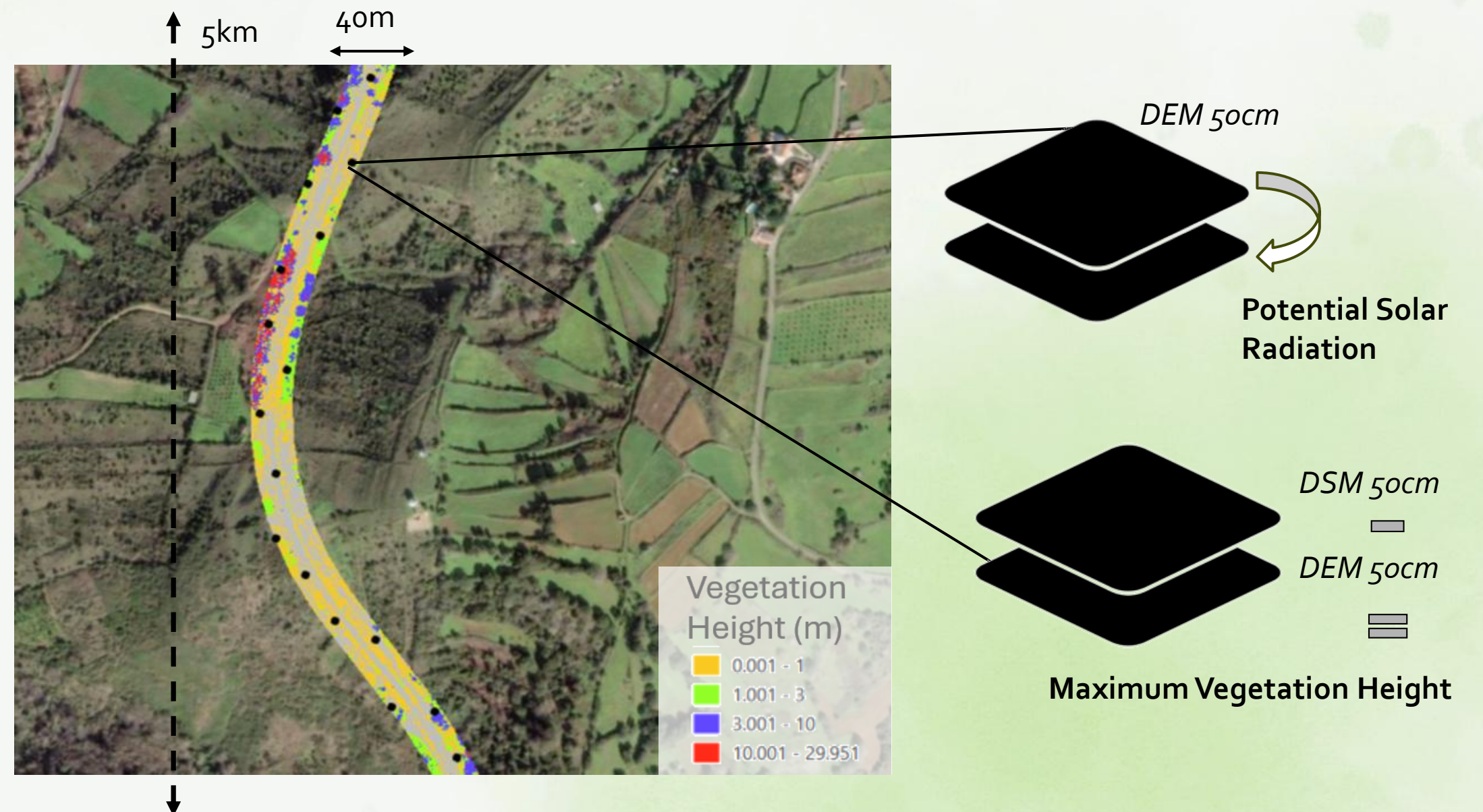
Task 4.2: Mapping microhabitat refuges along railway verges using microclimate and vegetation structure

- 11 study sites across Portugal, randomly distributed along:
 - main active railway line in Portugal
 - stratified by macroclimatic conditions
- Focus on Annual Total Precipitation (BIO12 – WorldClim)
 - *Strong limiting factor in Mediterranean climates for vegetation structure and growth*



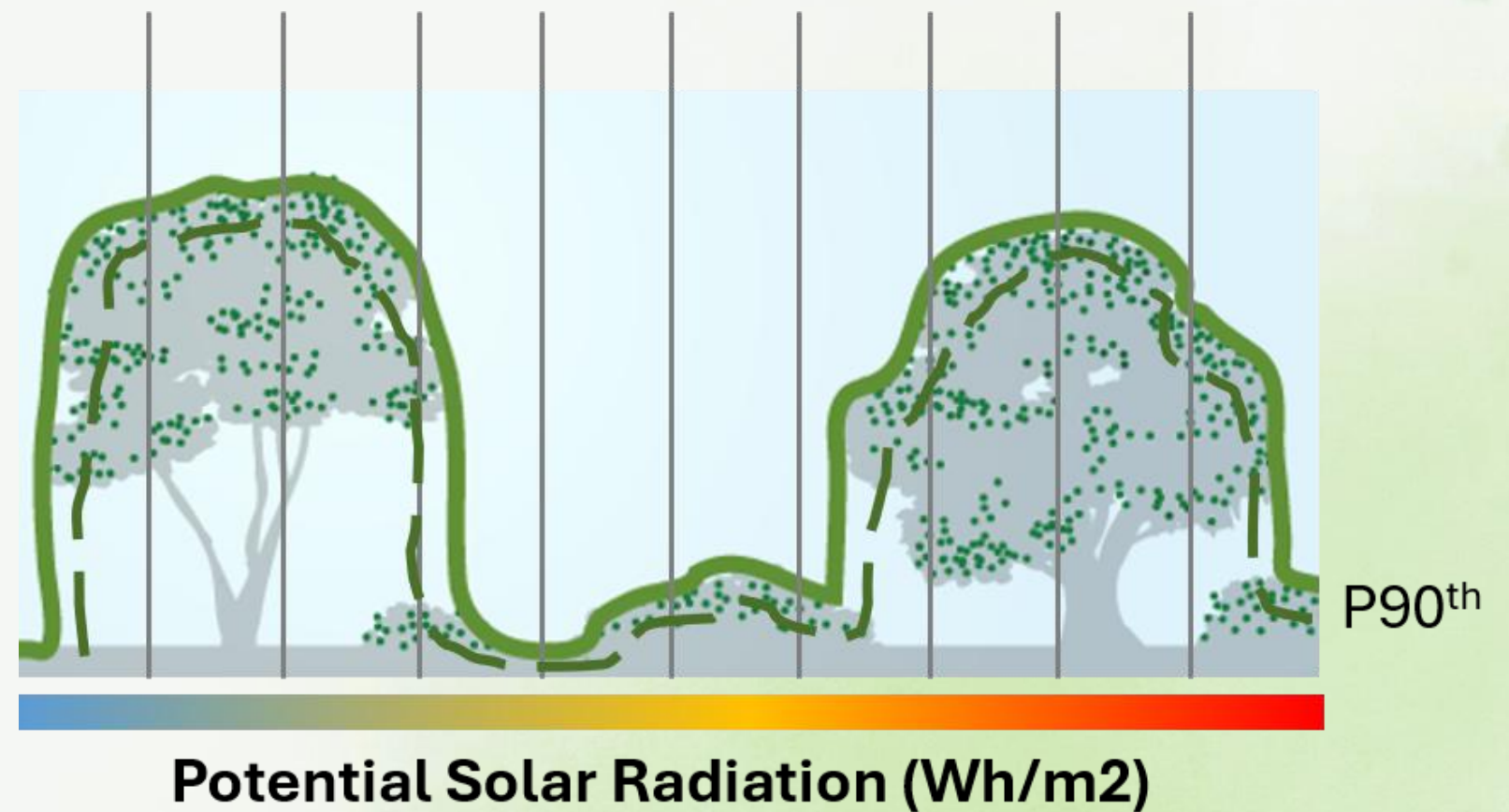
Task 4.2: Mapping microhabitat refuges along railway verges using microclimate and vegetation structure

- Vertical vegetation structure
- Fine resolution (50 cm)
- Aspect and topography



Task 4.2: Mapping microhabitat refuges along railway verges using microclimate and vegetation structure

- Control for management
- Response variable
 - Maximum potential of vegetation height (90th percentile of vegetation height)
- Predictor variables
 - PSR grouped into 10 quantile classes.
 - Annual Sum Precipitation
- Model
 - Generalised Linear Model (Gamma distribution)



Task 4.2: Mapping microhabitat refuges along railway verges using microclimate and vegetation structure

Preliminary results

- Solar radiation (PSR) and annual sum precipitation are significant predictors of the maximum potential of vegetation height
- Higher PSR is associated with lower vegetation height
- High-spatial resolution topographic variables can be effective proxies for microhabitat diversity
- Vegetation height can indicate habitat heterogeneity along railway verges



Task 4.2: Mapping microhabitat refuges along railway verges using microclimate and vegetation structure

Future work

- Include additional vegetation structural metrics
- Assess habitat connectivity
- Create maps of microclimatic/microhabitat hotspots
- Validate with biodiversity data (birds and bats)
- Estimate carbon sequestration



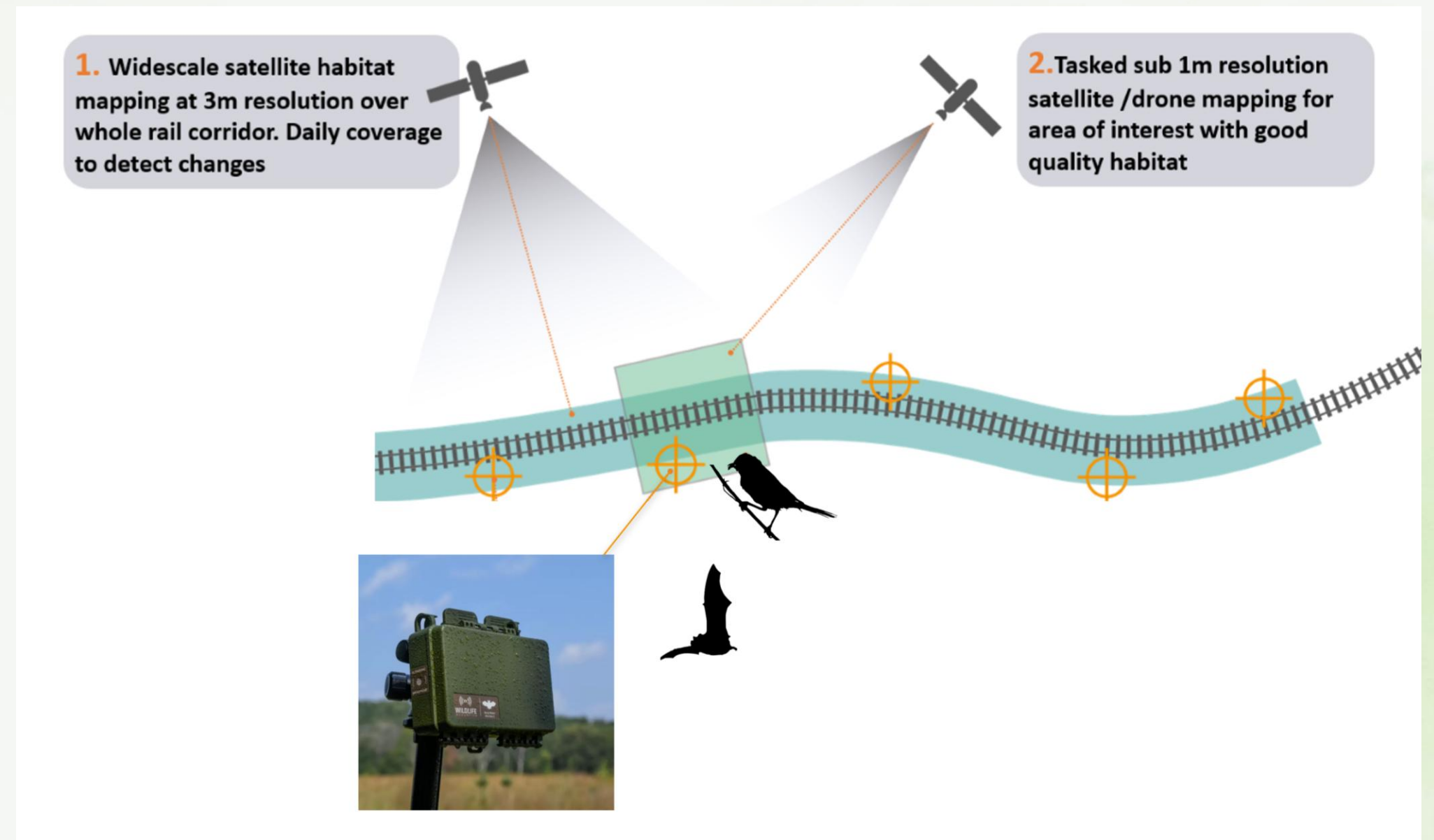
Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

Continuous, multi-taxa monitoring

- Captures birds and bats across days, months and seasons.
- A deploy-ready, mature technology

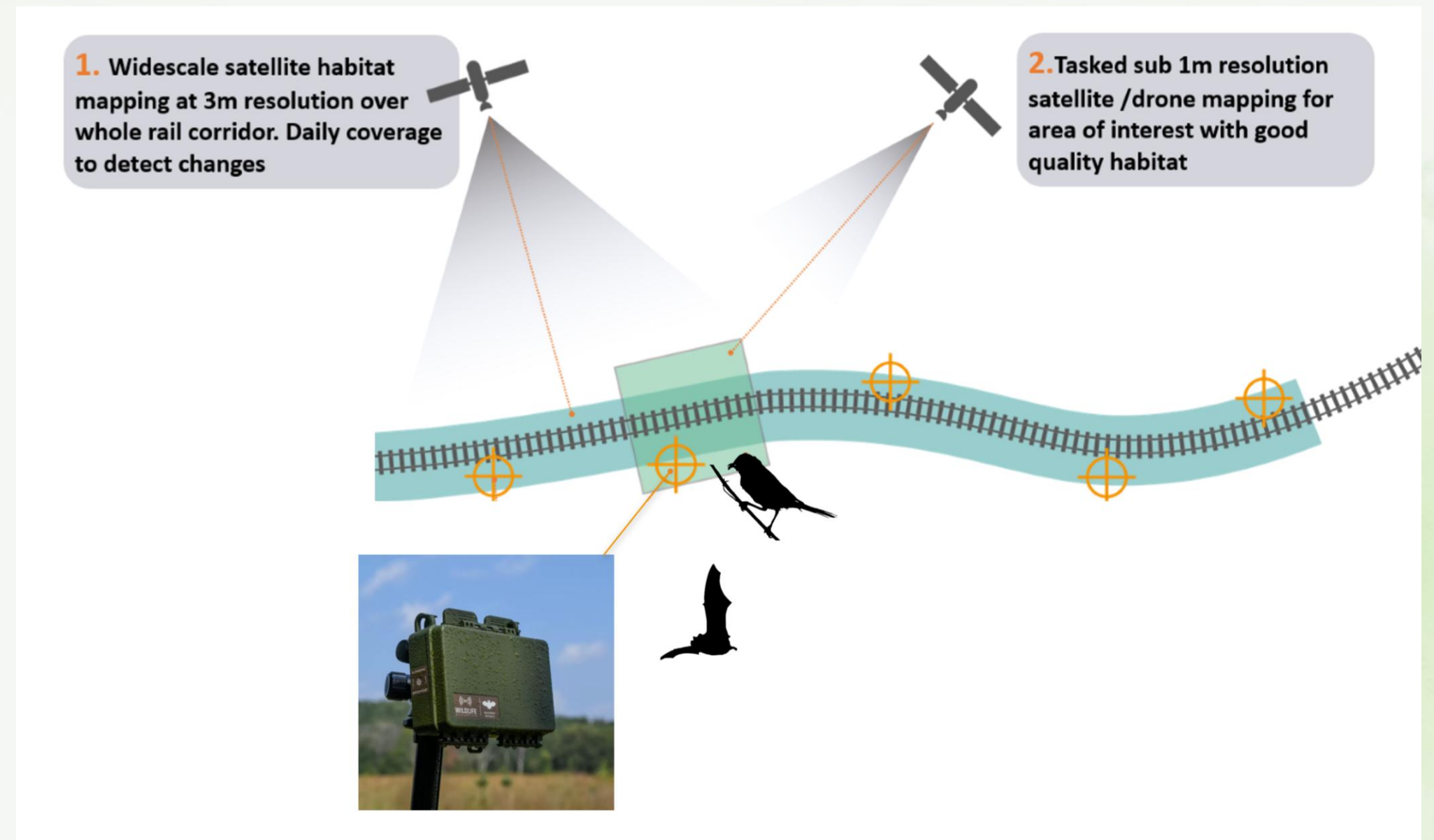
Potential

- Amphibians
- Small mammals



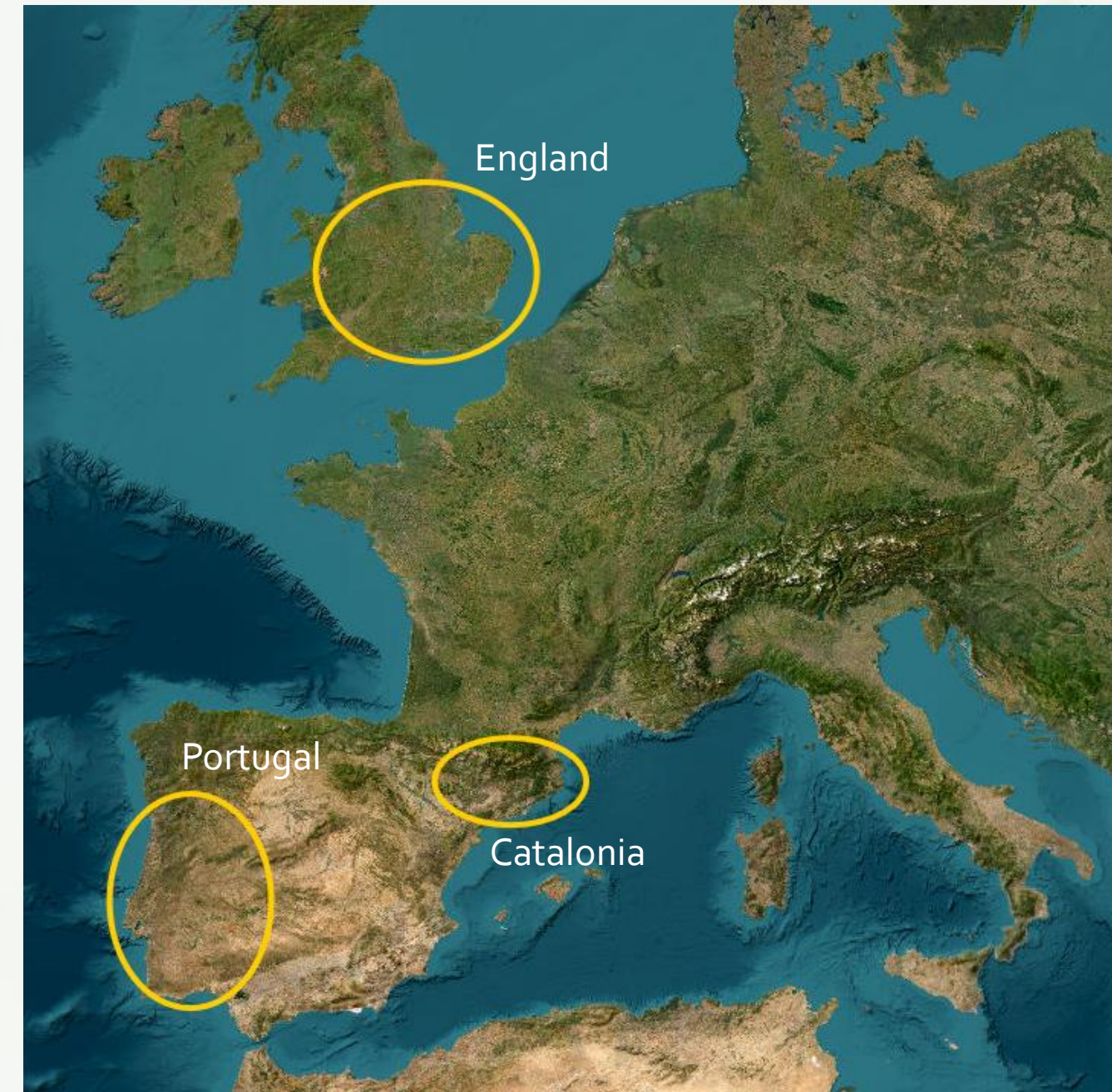
Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

- **Birds**
EU Nature Restoration Regulation
 - Upcoming member-state obligation to report on bird indicators (e.g. common/farmland & woodland bird indices).
- **Bats**
Legally protected across many regions
 - Presence & activity are key factors for planning, management, and infrastructure design.



Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

- 3 countries (UK, Portugal and Spain)
- 3 sites per country
- 9 Song Meter Mini (Bat) 2 in each country
- 2 acoustics (audible) & 1 ultrasonic per site
- 3 partners (UKCEH, Fciencias.ID and Minuartia)



Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

Withymead Nature Reserve



Holme Fen Nature Reserve



Church Farm (Regenerative farming)

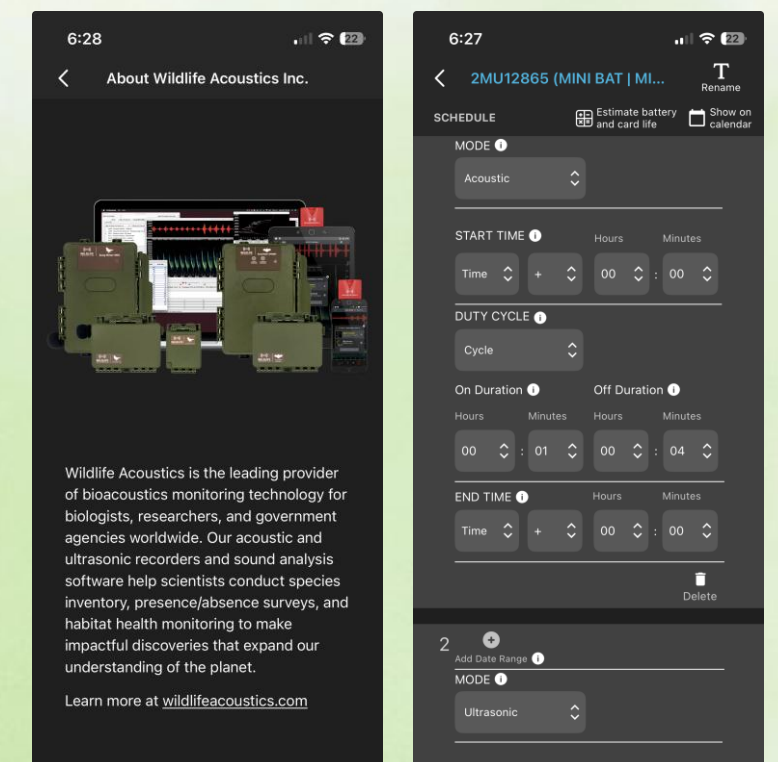


Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

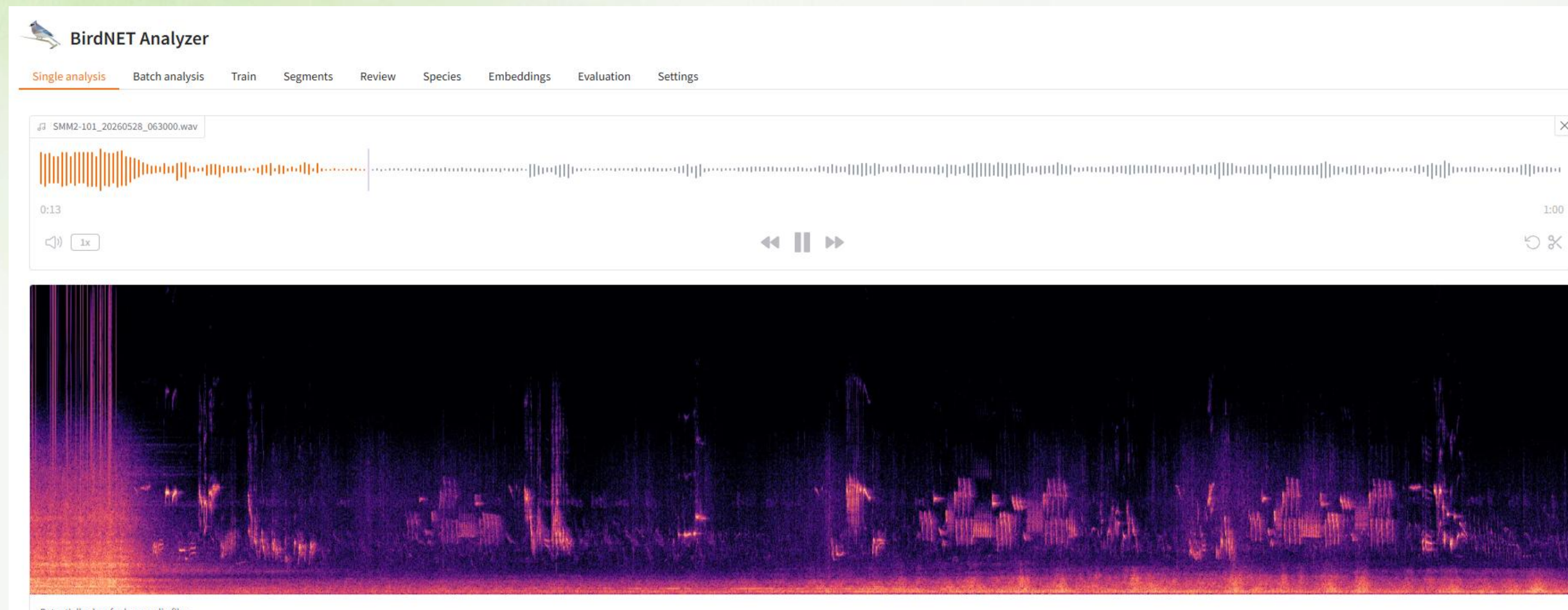
Acoustic	
Sample Rate	24000 Hz
Channel	Left (mono)
Custom Schedule	Record birds/frogs 24 hours a day
Duty cycle	Cycle
On duration	1 minute
Off duration	4 minutes
Ultrasonic	
Full spectrum sample rate	256 kHz
Non-triggered recording	off
Minimum trigger frequency	18 kHz
Custom schedule	Record bats 30 minutes before sunset to 30 minutes after sunrise (subject to trigger)
Mode	Ultrasonic
Duty cycle	Cycle
On duration	5 minutes
On duration	5 minutes

Song Meter Mini 2 and Song Meter Mini Bat 2

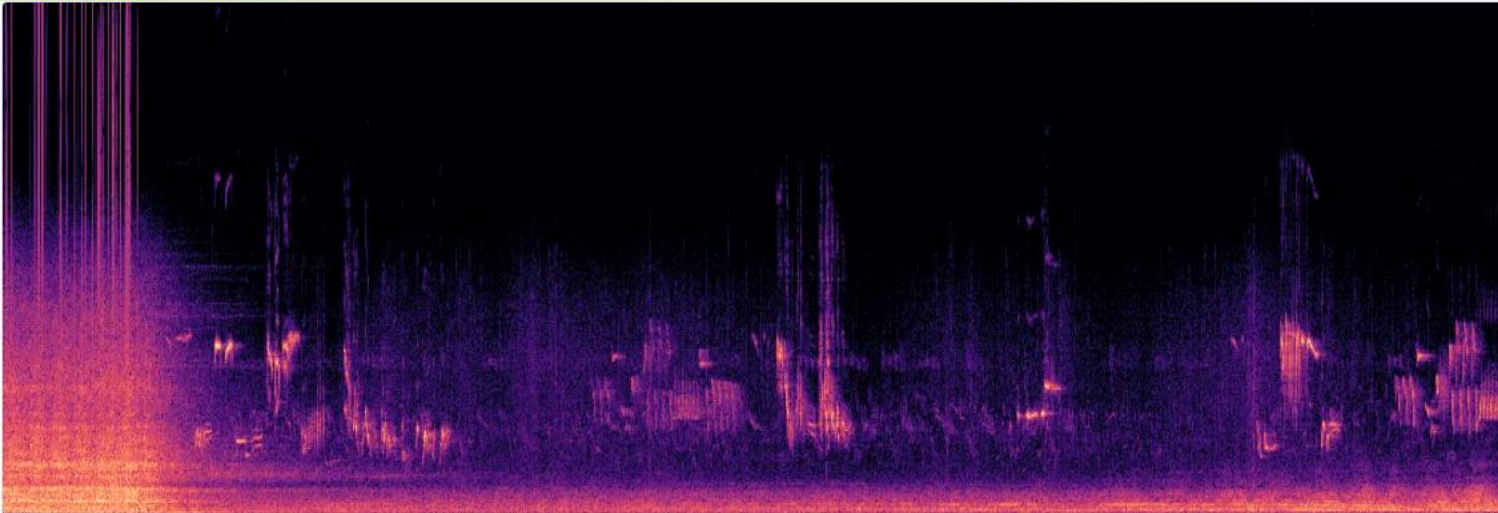

Recognised standard for passive acoustic monitoring



Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)



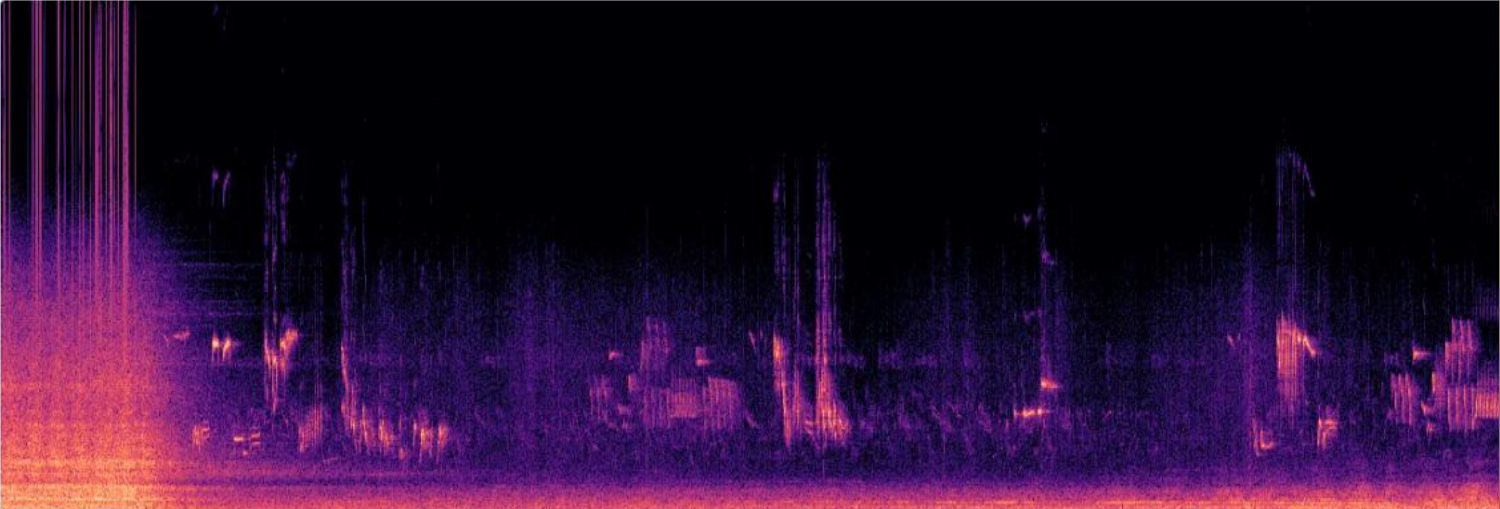
Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)


	Start	End	Scientific name		
▶	0:00:21	0:00:24	Spinus spinus		
▶	0:00:30	0:00:33	Erithacus rubecula	European Robin	0.9882
▶	0:00:33	0:00:36	Troglodytes troglodytes	Eurasian Wren	0.5521
▶	0:00:36	0:00:39	Troglodytes troglodytes	Eurasian Wren	0.9744
▶	0:00:36	0:00:39	Engine	Engine	0.2886
▶	0:00:39	0:00:42	Troglodytes troglodytes	Eurasian Wren	0.5093
▶	0:00:39	0:00:42	Prunella modularis	Dunnock	0.4125
▶	0:00:42	0:00:45	Prunella modularis	Dunnock	0.9441
▶	0:00:45	0:00:48	Erithacus rubecula	European Robin	0.9396
▶	0:00:48	0:00:51	Troglodytes troglodytes	Eurasian Wren	0.9859
▶	0:00:51	0:00:54	Troglodytes troglodytes	Eurasian Wren	0.9119
▶	0:00:54	0:00:57	Erithacus rubecula	European Robin	0.8815



Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)



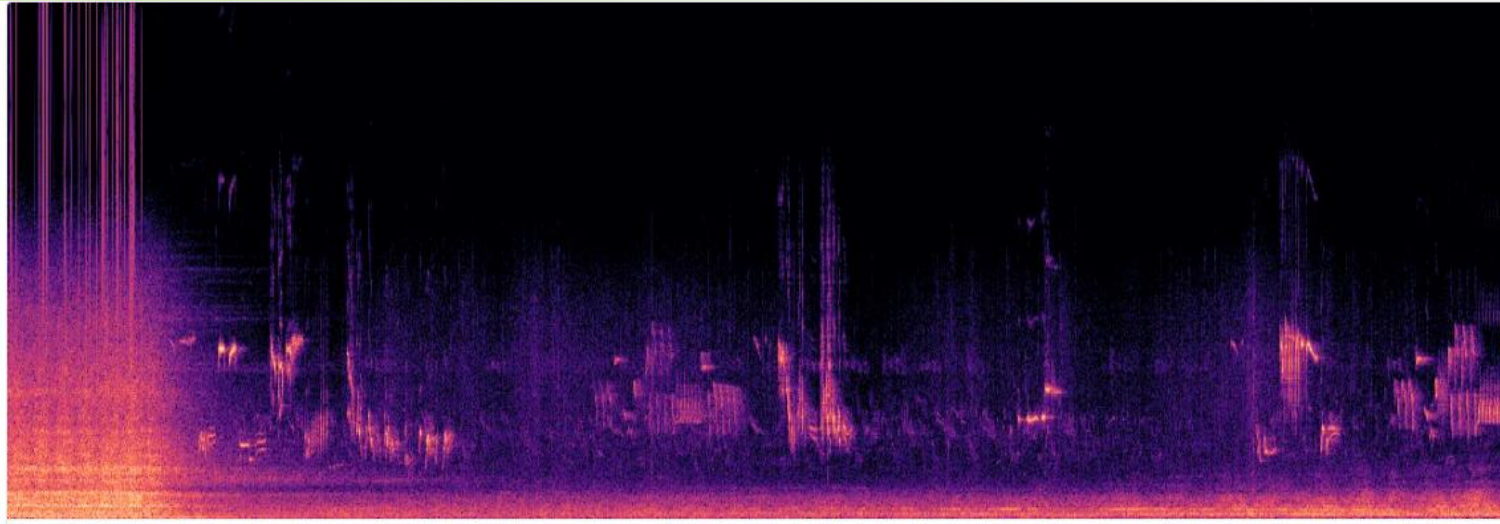

Wren



	Start	End	Scientific name		
▶	0:00:21	0:00:24	Spinus spinus		
▶	0:00:30	0:00:33	Erithacus rubecula	European Robin	0.9882
▶	0:00:33	0:00:36	Troglodytes troglodytes	Eurasian Wren	0.5521
▶	0:00:36	0:00:39	Troglodytes troglodytes	Eurasian Wren	0.9744
▶	0:00:36	0:00:39	Engine	Engine	0.2886
▶	0:00:39	0:00:42	Troglodytes troglodytes	Eurasian Wren	0.5093
▶	0:00:39	0:00:42	Prunella modularis	Dunnock	0.4125
▶	0:00:42	0:00:45	Prunella modularis	Dunnock	0.9441
▶	0:00:45	0:00:48	Erithacus rubecula	European Robin	0.9396
▶	0:00:48	0:00:51	Troglodytes troglodytes	Eurasian Wren	0.9859
▶	0:00:51	0:00:54	Troglodytes troglodytes	Eurasian Wren	0.9119
▶	0:00:54	0:00:57	Erithacus rubecula	European Robin	0.8815



Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)


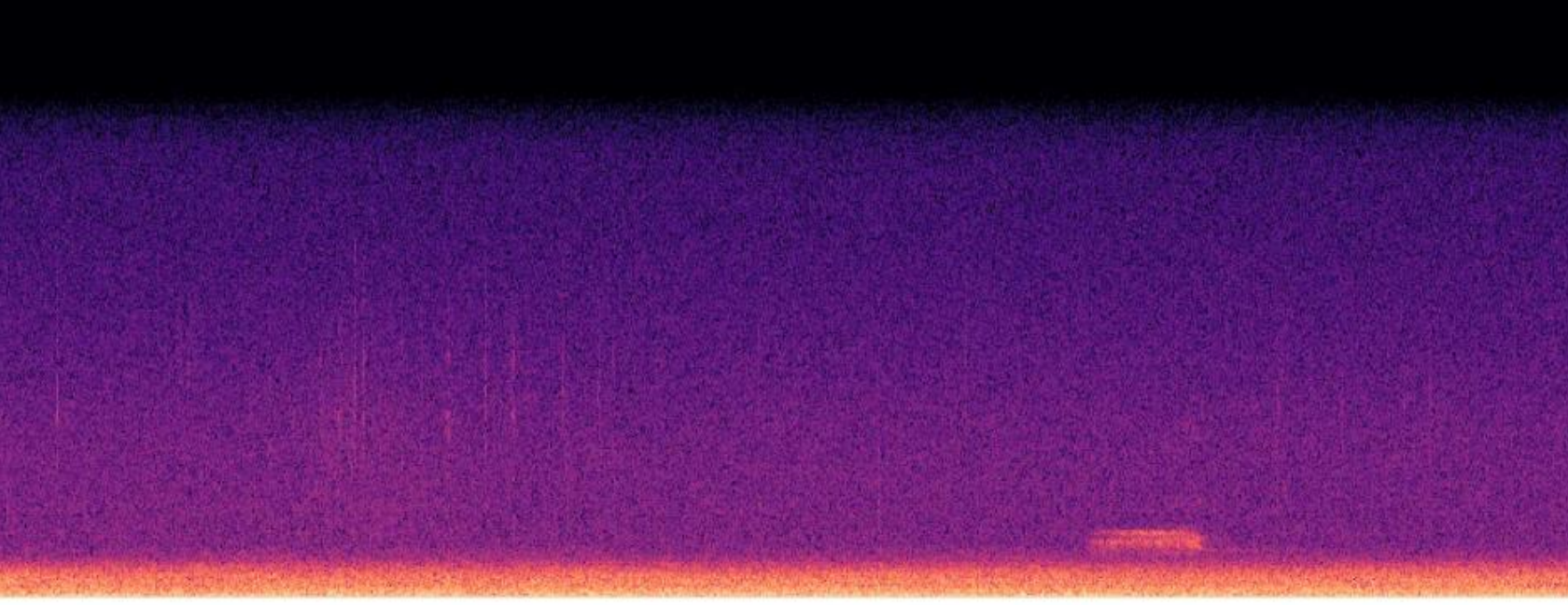



Dunnock

	Start	End	Scientific name		
▶	0:00:21	0:00:24	Spinus spinus		
▶	0:00:30	0:00:33	Erithacus rubecula	European Robin	0.9882
▶	0:00:33	0:00:36	Troglodytes troglodytes	Eurasian Wren	0.5521
▶	0:00:36	0:00:39	Troglodytes troglodytes	Eurasian Wren	0.9744
▶	0:00:36	0:00:39	Engine	Engine	0.2886
▶	0:00:39	0:00:42	Troglodytes troglodytes	Eurasian Wren	0.5093
▶	0:00:39	0:00:42	Prunella modularis	Dunnock	0.4125
▶	0:00:42	0:00:45	Prunella modularis	Dunnock	0.9441
▶	0:00:45	0:00:48	Erithacus rubecula	European Robin	0.9396
▶	0:00:48	0:00:51	Troglodytes troglodytes	Eurasian Wren	0.9859
▶	0:00:51	0:00:54	Troglodytes troglodytes	Eurasian Wren	0.9119
▶	0:00:54	0:00:57	Erithacus rubecula	European Robin	0.8815

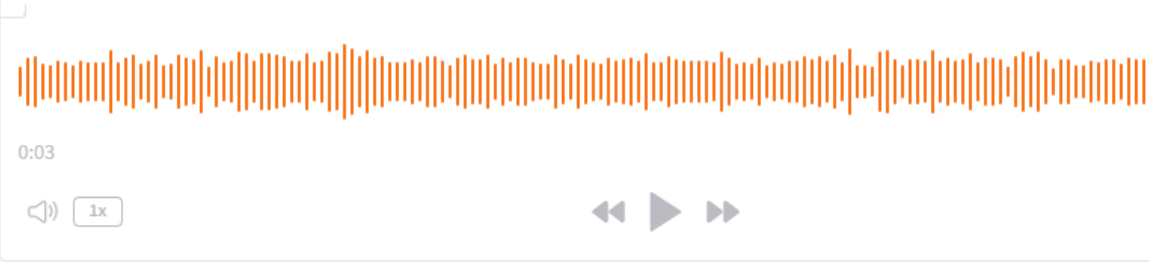


Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)



Barn owl


Download result table



0:03

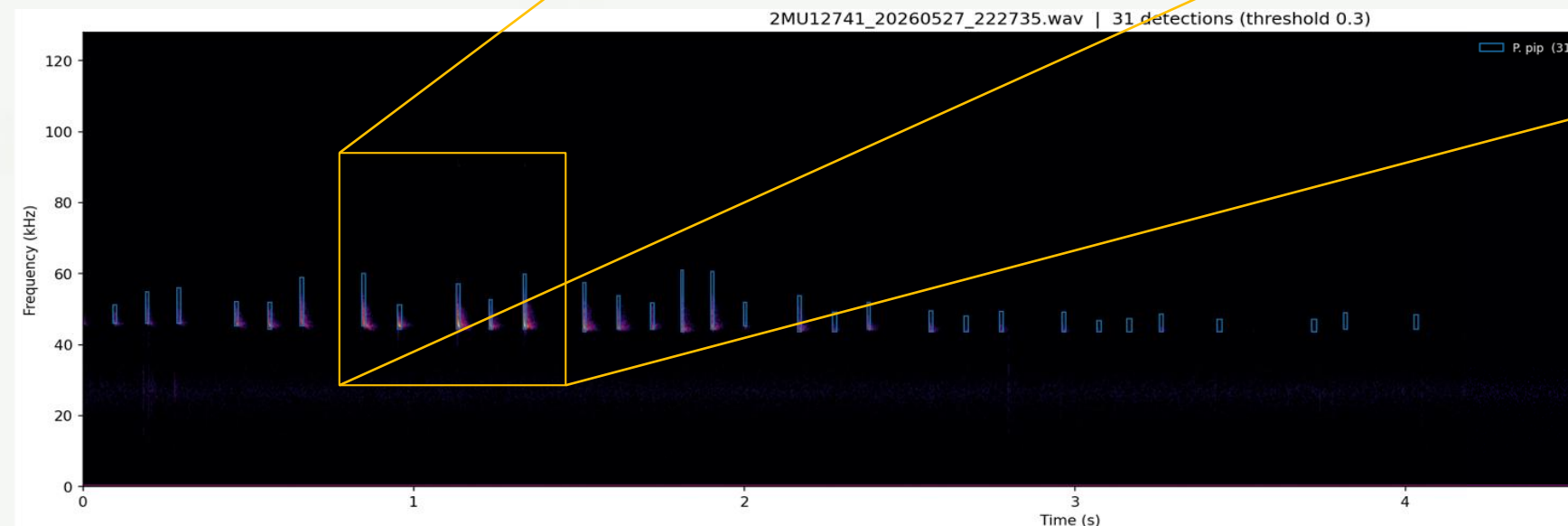
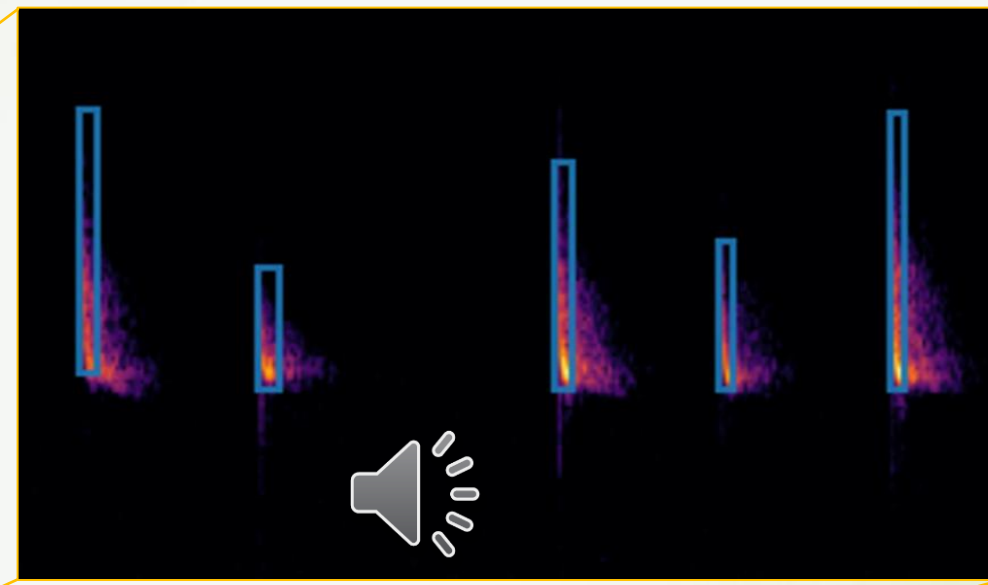
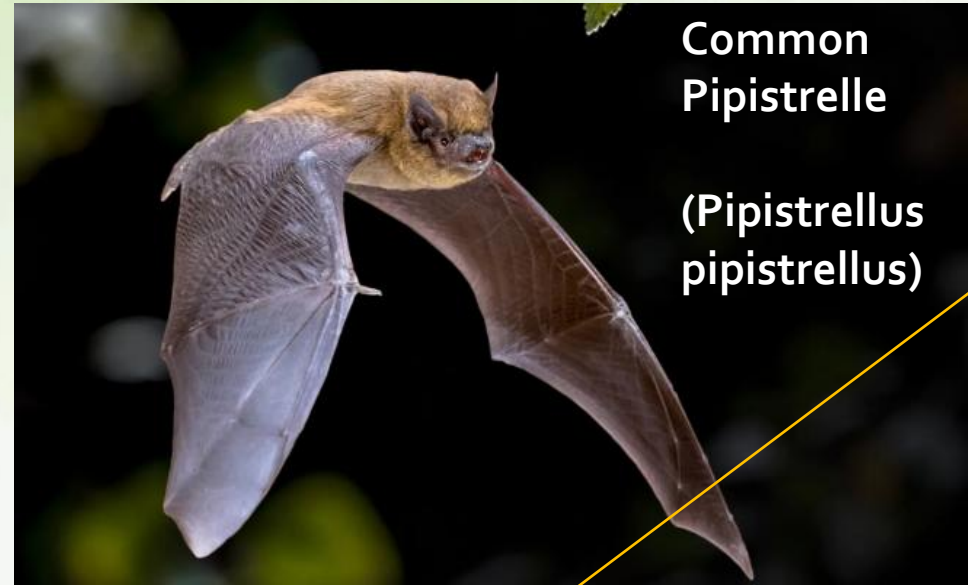
	Start	End	Scientific name	Common name	Confidence
▶	0:00:06	0:00:09	Tyto alba	Barn Owl	0.9917

2:00 am – 28 May 2026 (Church Farm)



Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

Ultrasonic (40kHz to 120 kHz)



Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

- Developing scalable data processing pipelines
 - Birds

The screenshot shows a Visual Studio Code editor with two main components: a README file and a terminal window.

Bird Acoustic Classification Pipeline

A workflow for detecting and classifying bird vocalisations in audio recordings using BirdNET via `birdnetlib`. It mirrors the sibling `Bat_workflow` (BatDetect2) so the two run the same way.

It takes a folder of audio recordings and produces:

- a single **CSV** with one row per detection, carrying full file, detection, and model metadata, and
- **spectrogram images** with detected vocalisations shown as species-coloured time bands.

CPU, not GPU. BirdNET runs on CPU via TensorFlow Lite. A GPU brings little benefit here — the opposite of the bat workflow. Scale with CPU cores.

Terminal Output:

```
(BIRD_WORKFLOW) (base)
retoschn@MILL-7172724 MINGW64 ~/OneDrive - UKCEH/SYMBIOSIS/SYMBIOSIS-UKCEH/implementation/task_4_2/Analyses/BIRD_WORKFLOW
$ .venv/Scripts/python.exe analyse_wav.py data\\SMB2_12741\\Data2\\2MU12741_20260527_160000.wav --min-conf 0.25 --lat 51.49 --lon -0.82 --date 2026-05-27
20
127 species loaded.

7 detections above confidence 0.25.

Detections per species:
common_name      6
European Robin
Eurasian Blue Tit 1

Mean confidence: 0.692

Saved:
results\2MU12741_20260527_160000.csv
results\2MU12741_20260527_160000.json
(BIRD_WORKFLOW) (base)
retoschn@MILL-7172724 MINGW64 ~/OneDrive - UKCEH/SYMBIOSIS/SYMBIOSIS-UKCEH/implementation/task_4_2/Analyses/BIRD_WORKFLOW
$
```

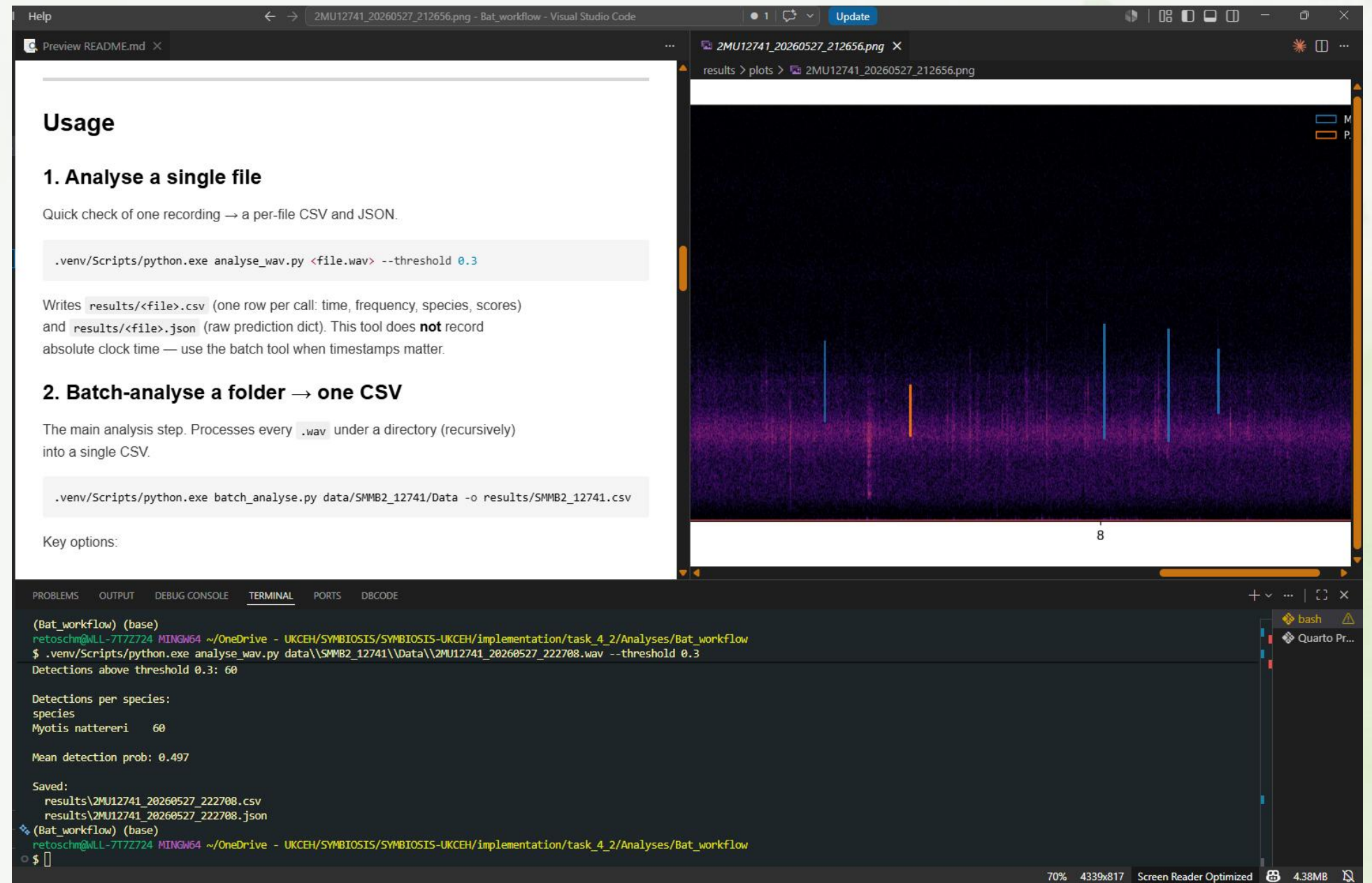
CSV Output:

file	start_time_s	end_time_s	scientific_name	common_name	confidence
2MU12741_20260527_160000.wav	0.0	3.0	Cyanistes caeruleus	Eurasian Blue Tit	0.2956
2MU12741_20260527_160000.wav	12.0	15.0	Erithacus rubecula	European Robin	0.3062
2MU12741_20260527_160000.wav	24.0	27.0	Erithacus rubecula	European Robin	0.9056
2MU12741_20260527_160000.wav	27.0	30.0	Erithacus rubecula	European Robin	0.8319
2MU12741_20260527_160000.wav	39.0	42.0	Erithacus rubecula	European Robin	0.8684
2MU12741_20260527_160000.wav	54.0	57.0	Erithacus rubecula	European Robin	0.6423
2MU12741_20260527_160000.wav	57.0	60.0	Erithacus rubecula	European Robin	0.9942



Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

- Developing scalable data processing pipelines
 - Birds
 - Bats



The screenshot displays the Visual Studio Code interface. On the left, a 'Preview README.md' window shows the following content:

Usage

1. Analyse a single file

Quick check of one recording → a per-file CSV and JSON.

```
.venv/Scripts/python.exe analyse_wav.py <file.wav> --threshold 0.3
```

Writes `results/<file>.csv` (one row per call: time, frequency, species, scores) and `results/<file>.json` (raw prediction dict). This tool does **not** record absolute clock time — use the batch tool when timestamps matter.

2. Batch-analyse a folder → one CSV

The main analysis step. Processes every `.wav` under a directory (recursively) into a single CSV.

```
.venv/Scripts/python.exe batch_analyse.py data/SMMB2_12741/Data -o results/SMMB2_12741.csv
```

Key options:

Below the README, the 'TERMINAL' window shows the execution of the single file analysis command:

```
(Bat_workflow) (base)
retoschm@MLL-7172724 MINGW64 ~/OneDrive - UKCEH/SYMBIOSIS/SYMBIOSIS-UKCEH/implementation/task_4_2/Analyses/Bat_workflow
$ .venv/Scripts/python.exe analyse_wav.py data\\SMMB2_12741\\Data\\2MU12741_20260527_222708.wav --threshold 0.3
Detections above threshold 0.3: 60

Detections per species:
species
Myotis nattereri 60

Mean detection prob: 0.497

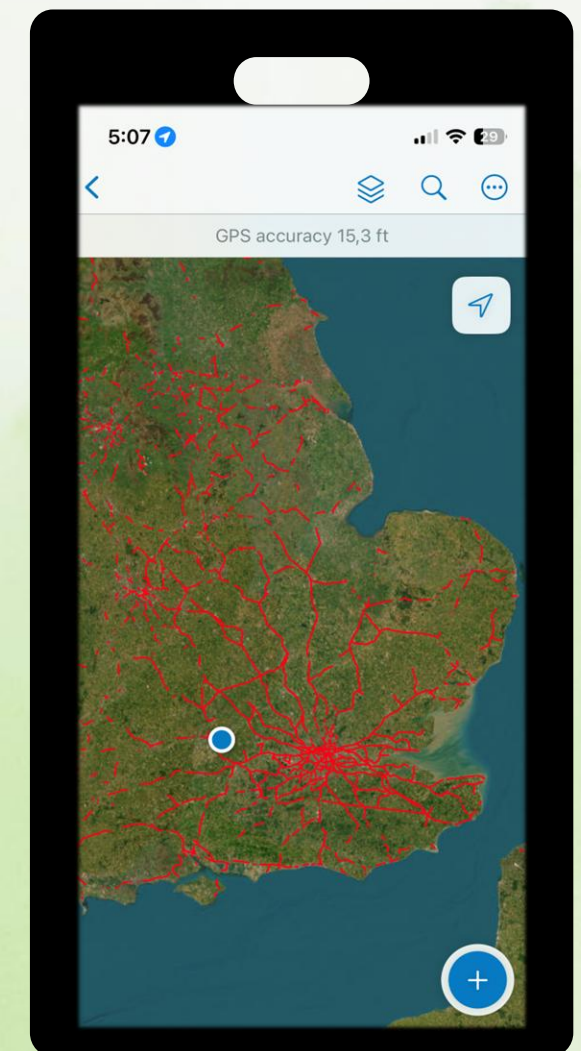
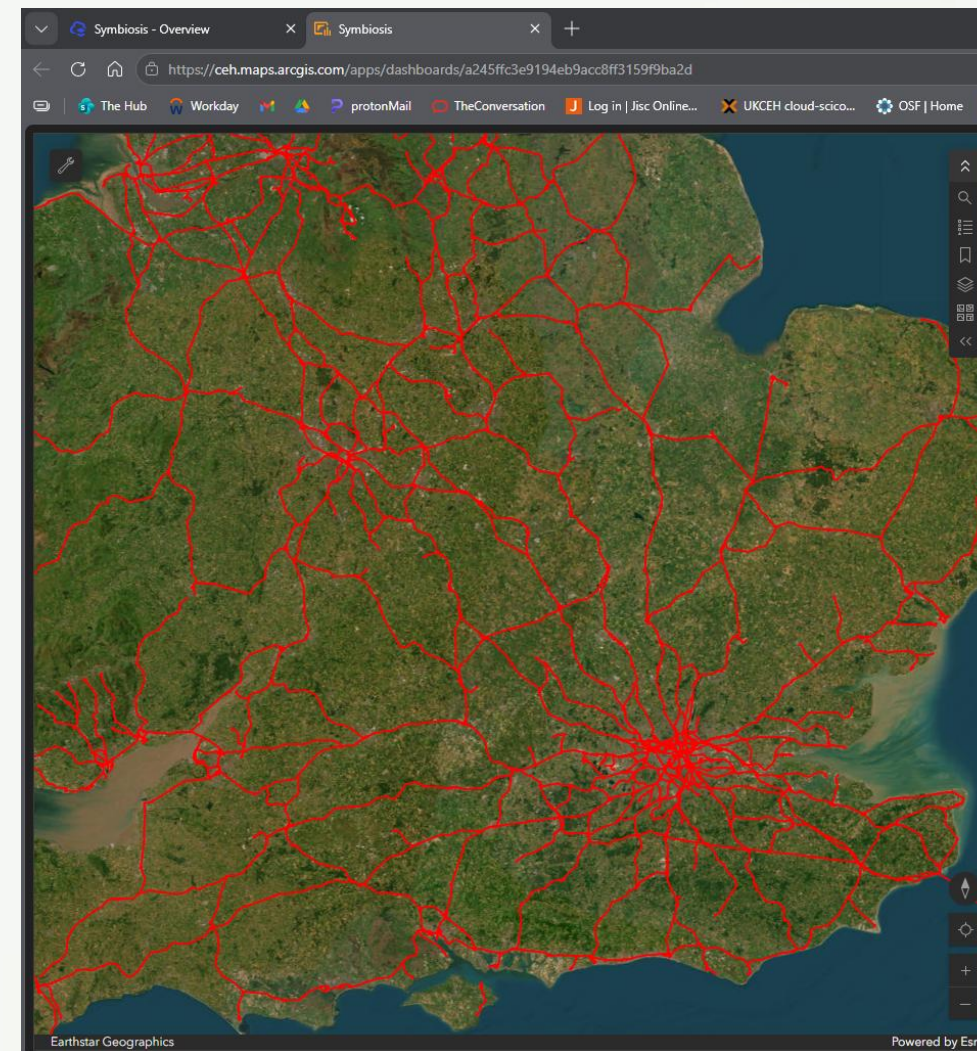
Saved:
results\2MU12741_20260527_222708.csv
results\2MU12741_20260527_222708.json
(Bat_workflow) (base)
retoschm@MLL-7172724 MINGW64 ~/OneDrive - UKCEH/SYMBIOSIS/SYMBIOSIS-UKCEH/implementation/task_4_2/Analyses/Bat_workflow
$
```

On the right, a spectrogram plot titled '2MU12741_20260527_212656.png' is displayed, showing frequency over time with several vertical lines indicating detected calls.



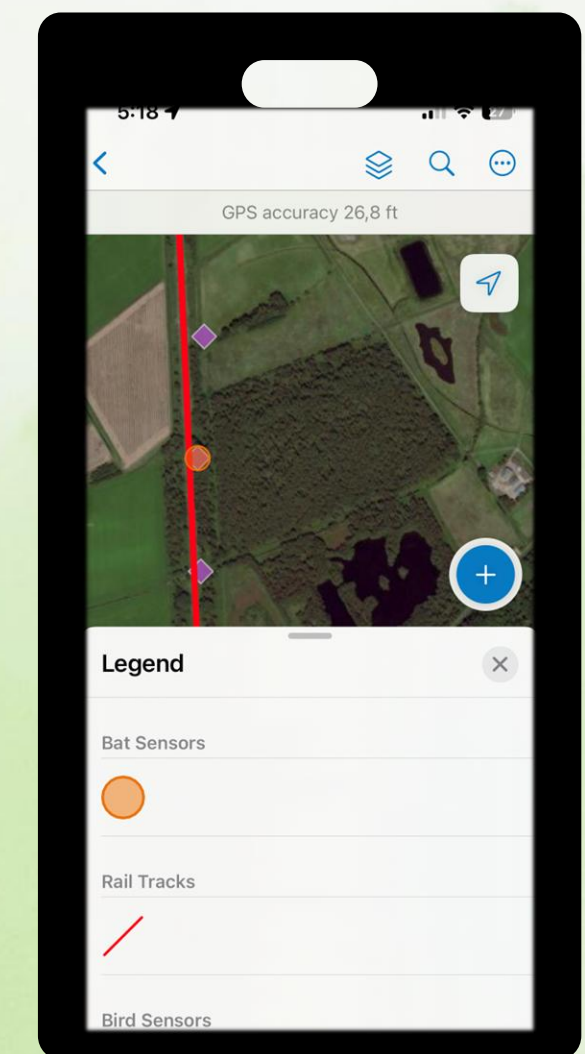
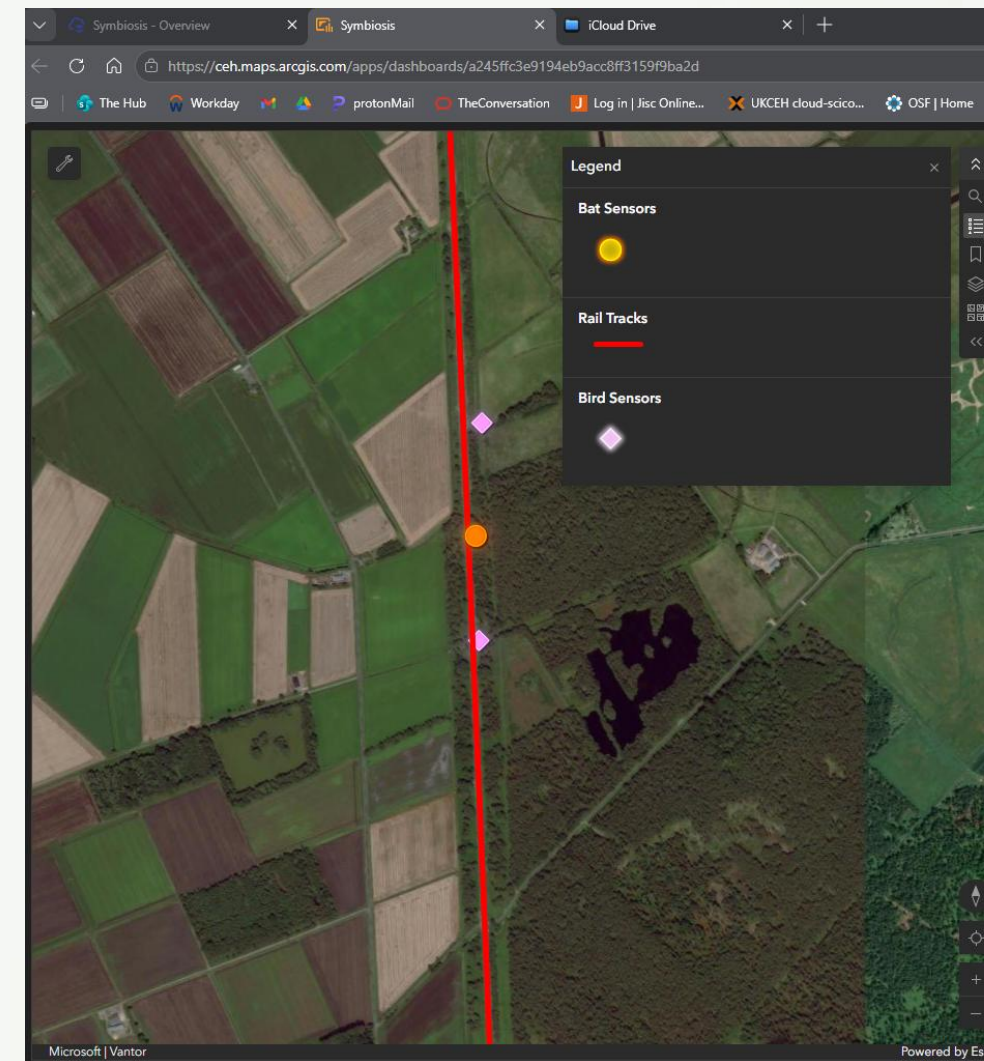
Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

- Developing an integrated monitoring data system
 - planning field deployment (office to field)



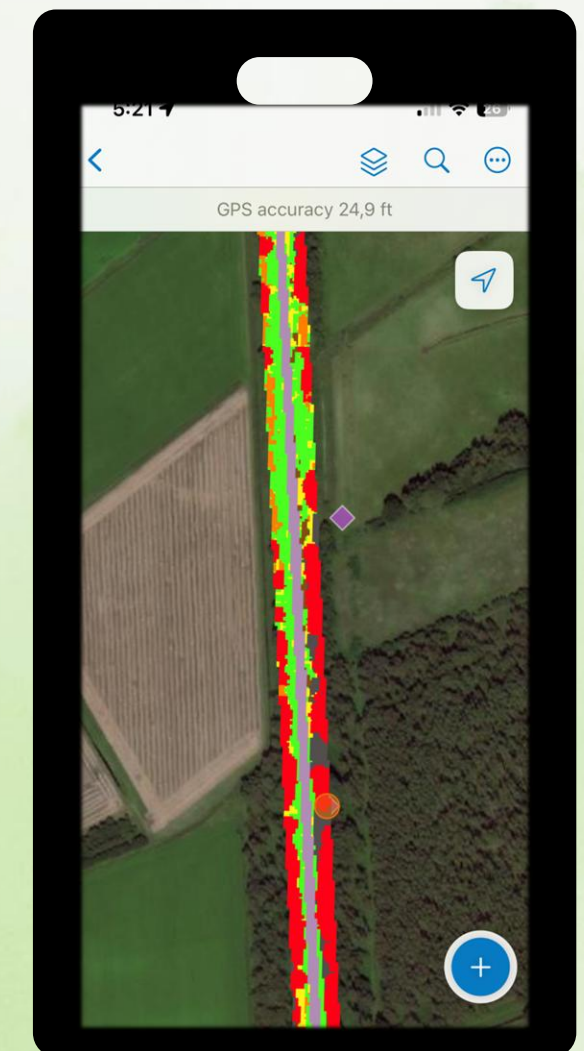
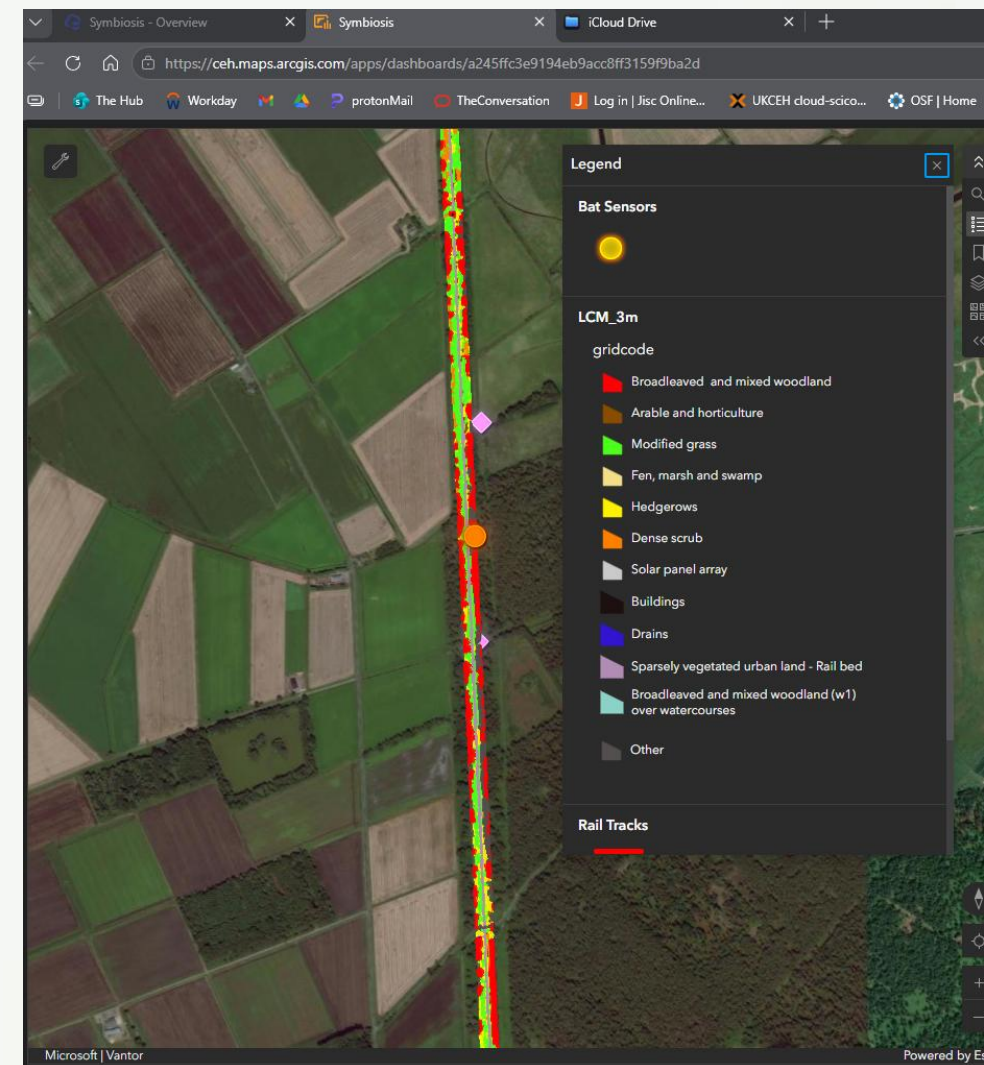
Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

- Developing an integrated monitoring data system
 - planning field deployment (office to field)
 - localise monitoring devices and data collection



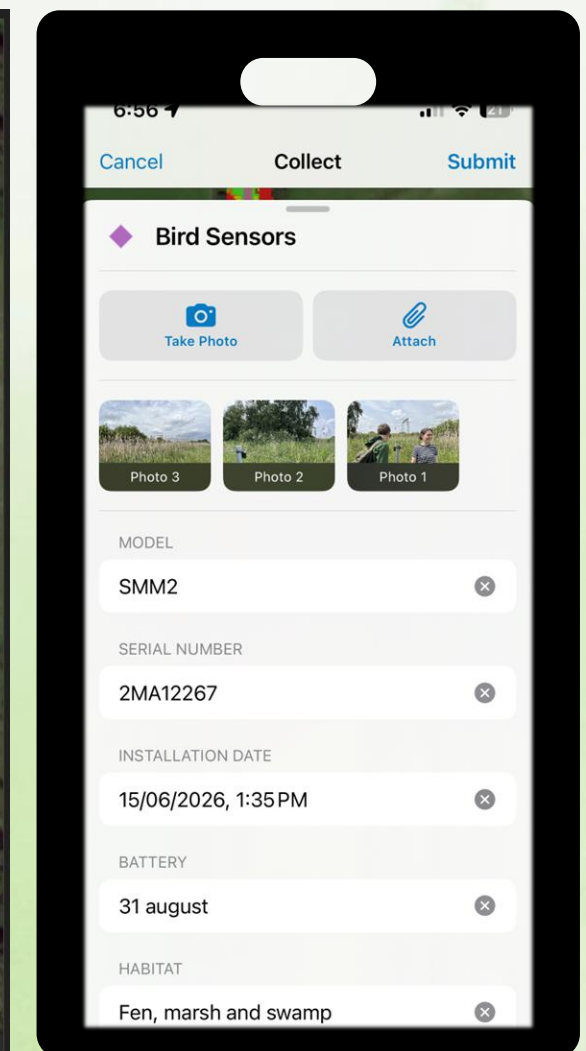
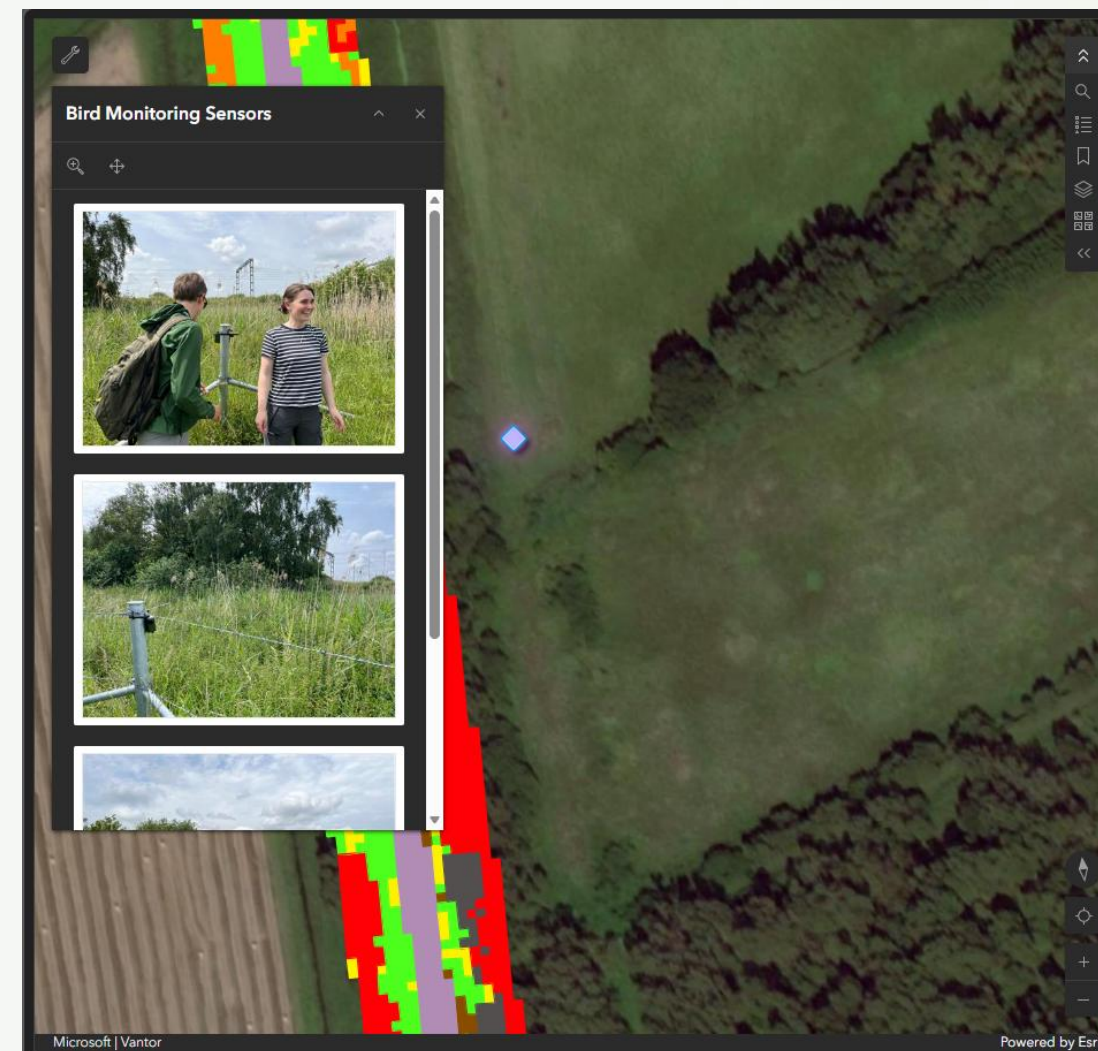
Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

- Developing an integrated monitoring data system
 - planning field deployment (office to field)
 - localise monitoring devices and data collection
 - integrate spatial information layers (habitat map, roads, elevation, infrastructure)



Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

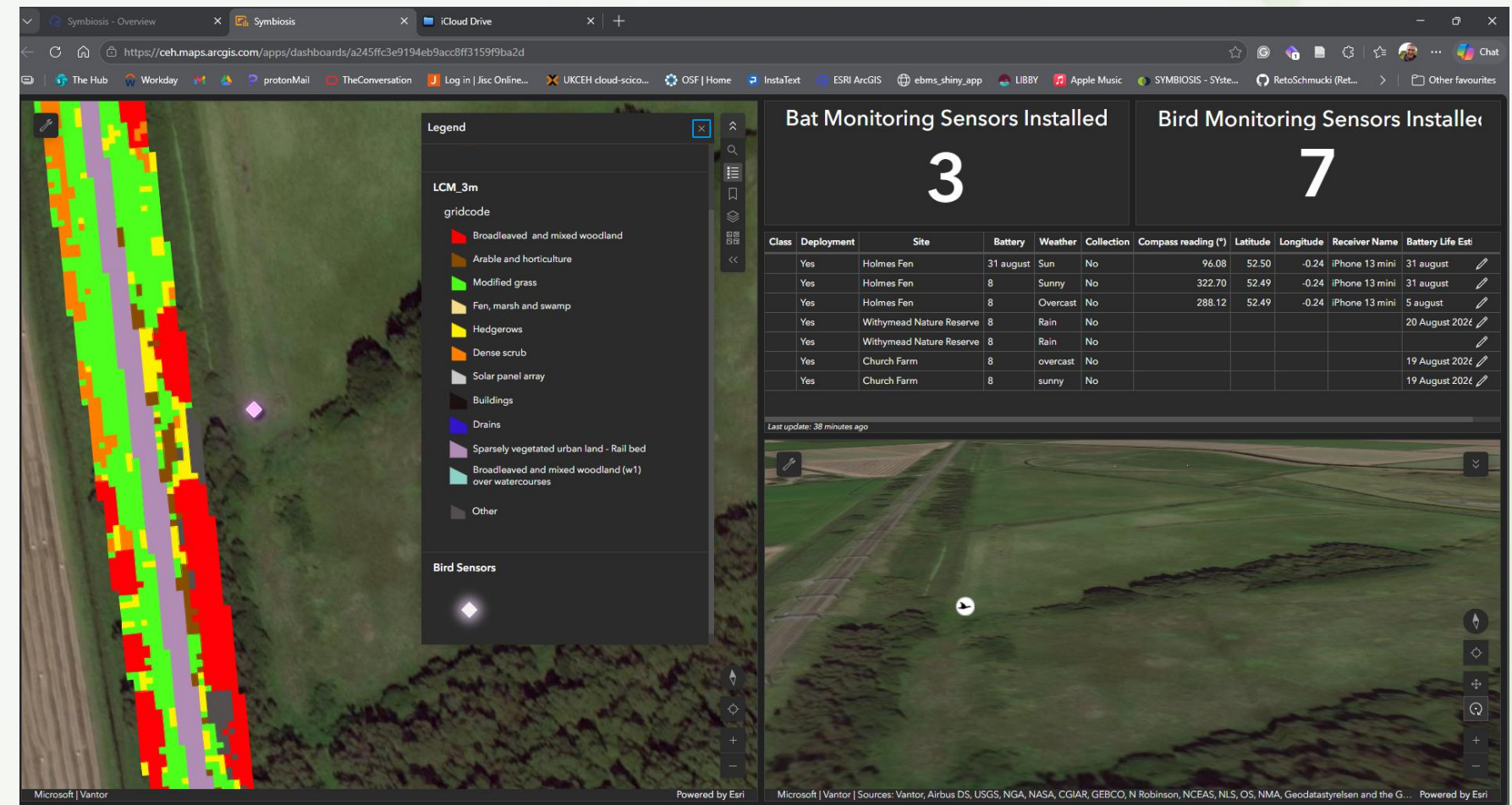
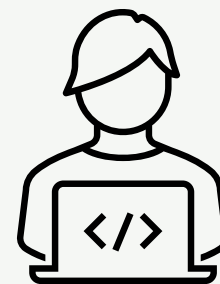
- Developing an integrated monitoring data system
 - planning field deployment (office to field)
 - localise monitoring devices and data collection
 - integrate spatial information layers (habitat map, roads, elevation, infrastructure)
 - capable of ingesting digital multimedia documents



Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

- Developing an integrated monitoring data system

- Planning deployment
- Monitoring and Validation
- Reporting
- Maintenance scheduling



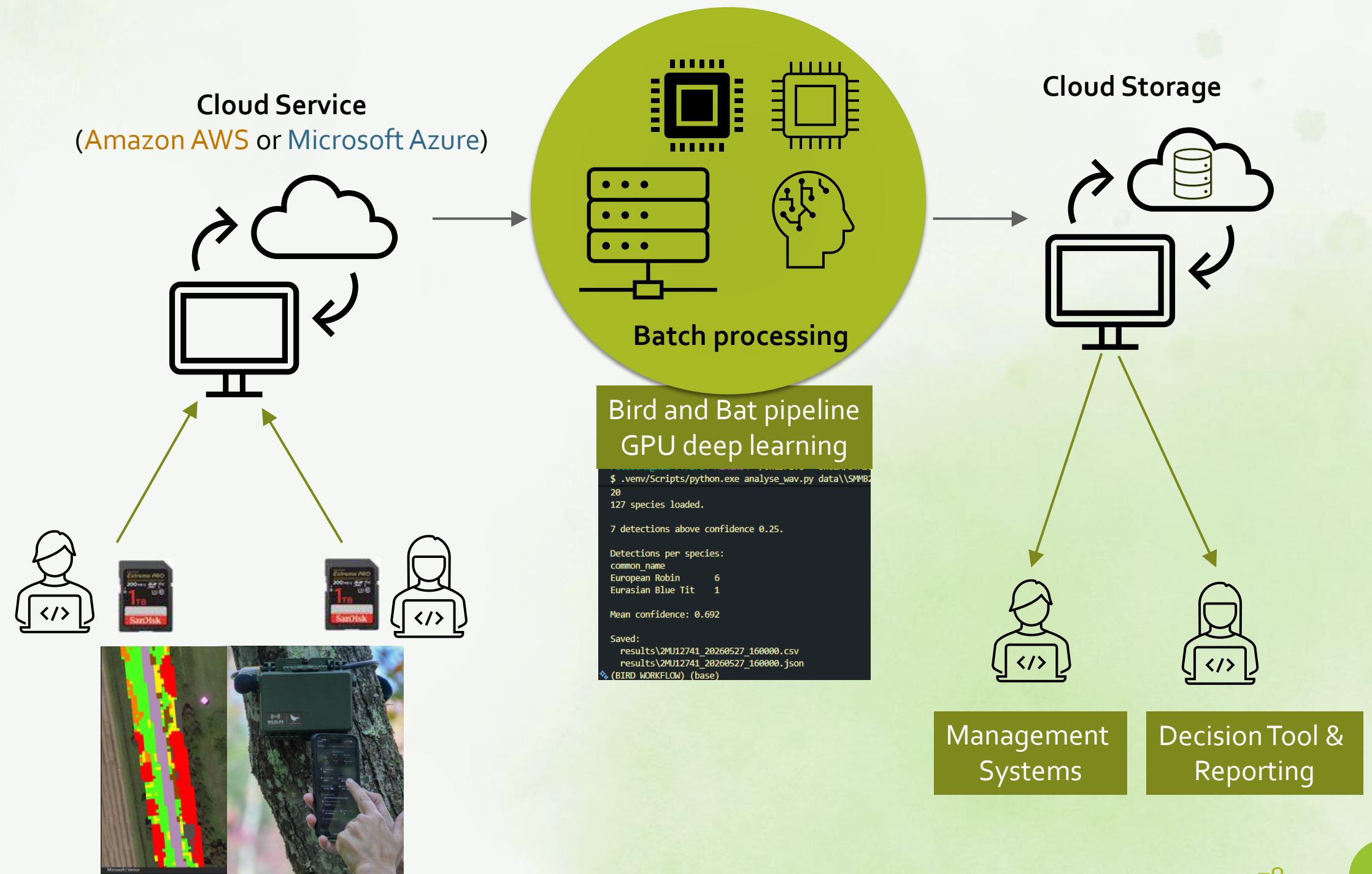
Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

- Developing an integrated monitoring data system
 - Standardised data collection
 - Centralised data storage
 - Real-time documentation
 - Bespoke layers (local information)



Task 4.2: Pilot testing automated monitoring along railway corridors (Passive Acoustics)

- Developing an integrated data pipeline
- Next steps
 - Validation of AI (human-in-the-loop).
 - data quality, trust, defensible outputs.



Conclusion (WP 4)

Designed and tested for railway — transferable to road, energy and the wider landscape.

Four integrated tasks

- 4.1 Review current practice — the baseline
- 4.2 Pilot automated sensor + AI approaches (today's focus)
- 4.3 Integrate data into asset management
- 4.4 Co-design the standardised best-practice framework

Next steps

- 1. The data streams developed in 4.2 feed Task 4.3 (CentraleSupélec)**
 - Digital Shadow of the asset's biodiversity (precursor to a Digital Twin)
 - RangeShifter dynamic modelling → biodiversity heatmaps & risk maps
 - GIS–BIM interoperability with SNCF; metrics aligned with WP3
- 2. Develop a narrative and strategies to enable transformative changes and leverage culture shift**
 - Monitoring seen as strategic knowledge, not just a compliance cost
 - Better integrated data → better planning → better decisions.



COFFEE BREAK





WORK PACKAGE 5:

ASSESSMENT OF SOCIETAL CHALLENGES IN SUSTAINABLE TRANSPORT DEVELOPMENT

- Key objectives
- Brief update on progress achieved, including reported milestones and deliverables
- Planned next steps with WP/task partners
- Required involvement from external stakeholders

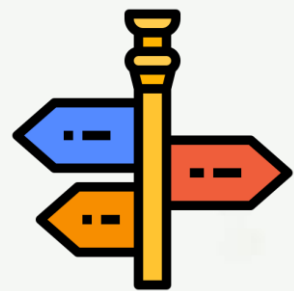
Assessment of Societal Challenges in Sustainable Transport Development



Investigate societal impacts of sustainable transportation, enhancing railway capacity and reducing infrastructure costs.



Assess alignment of Europe-wide policies with environmental goals, focusing on rail and energy impacts on biodiversity and climate change.



Establish guidance framework for seamless integration in rail and energy sectors by providing recommendations for holistic planning and inclusive land use management.



Formulate recommendations to enhance biodiversity and climate considerations in transport policies.

TASKS



5.1.

Assessment of societal challenges in sustainable transport development



5.2:

Regulation and Policy Assessment



5.3:

Sustainable environmental impact assessment and corporate sustainability reporting on transport



5.4:

Integrating biodiversity into company strategies, procurement processes and supply chain



KEY OBJECTIVES



Task 5.1. Assessment of societal challenges in sustainable transport development

- **To achieve and analyse a comprehensive understanding of societal impacts, thereby supporting well-informed decision-making in the field of sustainable transport development.**

This includes:

- **Assessing societal challenges and impacts** by identifying key challenges and evaluating their consequences for society and local communities.
- **Improving stakeholder participation in decision-making** by assessing and strengthening the involvement of relevant stakeholders in decision-making processes and transport policy formulation.

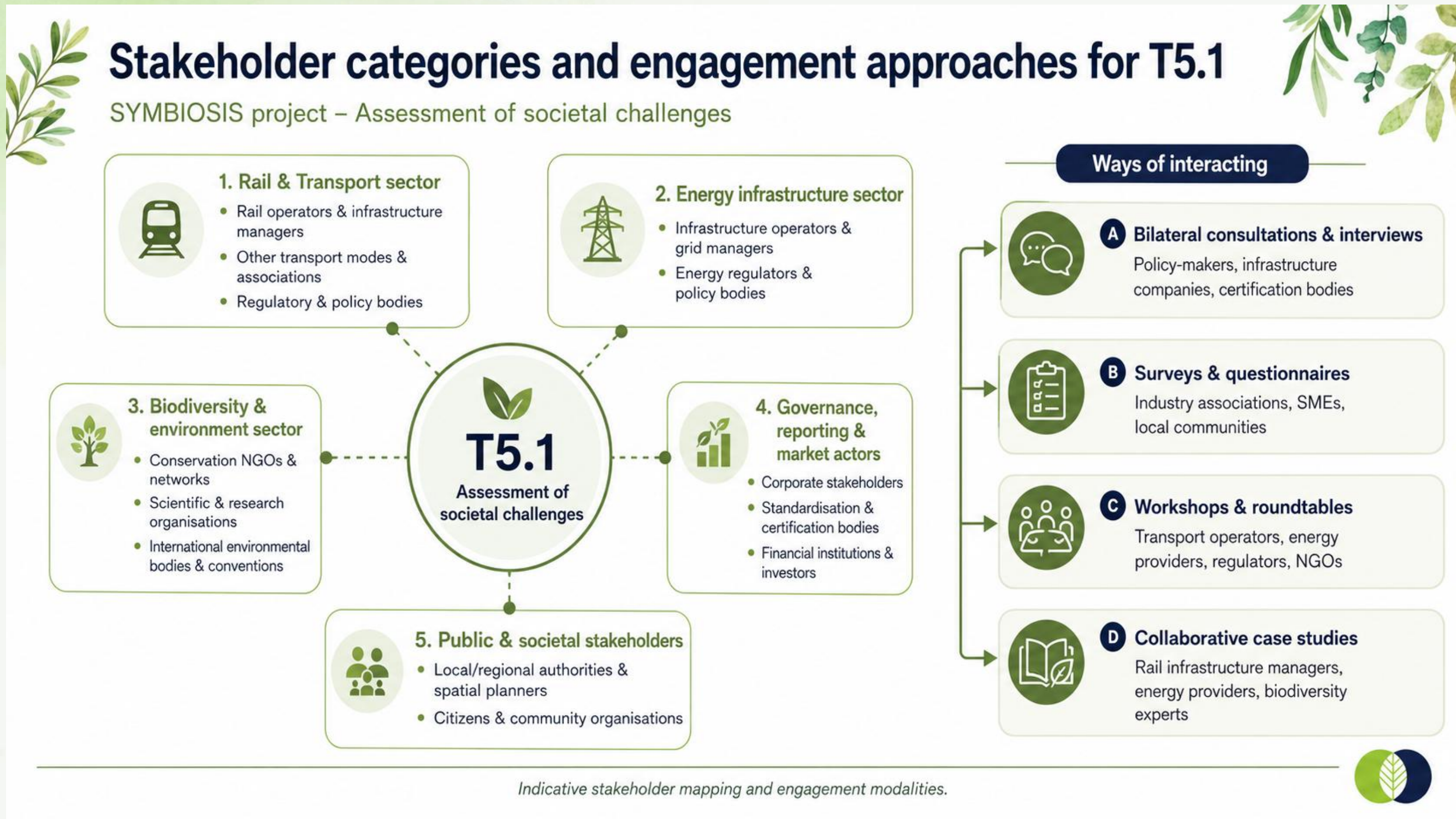


BRIEF UPDATE ON PROGRESS ACHIEVED



Task 5.1. Assessment of societal challenges in sustainable transport development

Stakeholder definition and engagement



Task 5.1. Assessment of societal challenges in sustainable transport development

Methodological actions taken

1 EVIDENCE GATHERING Extensive bibliographic review



75 reports and publications collected and reviewed.



Collected material categorised into three main groups:

- ✓ Policy and regulatory documents
- ✓ Scientific papers
- ✓ Case studies and practical examples



A common analysis template has been developed and shared.



Review responsibilities have been allocated among **T5.1 partners**.



2 STAKEHOLDER ENGAGEMENT & VALIDATION



Online expert workshop

- Held on **25 September 2025**
- Involving at least **10 external experts**



Aim:

- Validate preliminary findings
- Collect targeted stakeholder feedback



Interactive discussion supported through **Mentimeter questions**.

Inputs used to refine the initial analysis and guide next methodological steps.



Ongoing anonymous stakeholder survey on societal, environmental and biodiversity-related impacts of sustainable transport.

Survey integrates elements of the Societal Readiness Level (SRL) approach to explore societal acceptance, readiness, barriers and enabling conditions.



Overall aim:

Build robust evidence and engage stakeholders to assess societal and environmental challenges and inform sustainable transport development.



Extensive bibliographic review

- 75 reports and publications have been collected and reviewed. Collected material categorised into three main groups:
 - ✓ Policy and regulatory documents
 - ✓ Scientific papers
 - ✓ Case studies and practical examples
- A common analysis template has been developed and share
- Review responsibilities have been allocated among T5.1 partners



SWOT Analysis: Societal Challenges in Sustainable Transport Development

SWOT Analysis: Societal Challenges in Sustainable Transport Development



Strengths

- Improved territorial cohesion through rail and multimodal connectivity
- Better accessibility for persons with reduced mobility
- Social inclusion through fare schemes and integrated services
- Job creation, innovation and regional economic benefits
- Public health benefits from lower emissions



Weaknesses

- Service and infrastructure gaps in rural and disadvantaged areas
- Limited digital literacy among vulnerable groups
- Accessibility gaps in legacy transport systems
- Affordability challenges without long-term subsidies
- Fragmented governance and weak coordination



Opportunities

- Strong policy support through the EU Green Deal and Smart Mobility Strategy
- Innovation in digital and inclusive mobility services
- Public-private partnerships for socially inclusive solutions
- Just transition frameworks supporting equity
- Demand for greener and more inclusive urban/regional planning



Threats

- Digital divide and risk of exclusion
- Environmental pressures, including noise, emissions and biodiversity loss
- Disruption of traditional livelihoods and local practices
- Gentrification and displacement in newly connected areas
- Poor land-use planning and uncontrolled development



Key message: Sustainable transport development can generate major social benefits, but these depend on inclusive planning, affordability, accessibility, digital readiness and strong coordination.



Evaluation and enhancement of stakeholders' involvement in decision-making processes and transport policy formulation (MS6)

Key outcomes from MS6 – Evaluation and enhancement of stakeholder involvement

Stakeholder engagement should be treated as a strategic governance mechanism, not only as a formal consultation requirement.

Main findings:

- ✓ **Early and inclusive participation:** Engage stakeholders from the strategic planning stage, before key technical and financial decisions are fixed.
- ✓ **Comprehensive stakeholder mapping:** Include not only operators, regulators and infrastructure managers, but also local communities, environmental organisations, cross-border actors and underrepresented groups.
- ✓ **Structured dialogue and co-creation:** Use regular meetings, thematic working groups and structured forums to jointly identify challenges, trade-offs and practical solutions.
- ✓ **Link engagement to tangible community benefits:** Connect infrastructure development with visible local benefits, such as green spaces, improved access, social value and biodiversity-sensitive design.
- ✓ **Institutionalised feedback mechanisms:** Show how stakeholder input has been considered, integrated or rejected, using transparent monitoring and reporting processes.

Meaningful stakeholder engagement can strengthen trust, reduce conflicts and delays, improve policy and project quality, and support more sustainable and resilient rail systems



SYMBIOSIS Stakeholder Survey: Societal Challenges in Sustainable Transport Development

- Short, anonymous survey aims to gather insights on the societal, environmental, and biodiversity-related effects of transport developments.

Respondent Profile

SYMBIOSIS Stakeholder Survey: Societal Challenges in Sustainable Transport Development

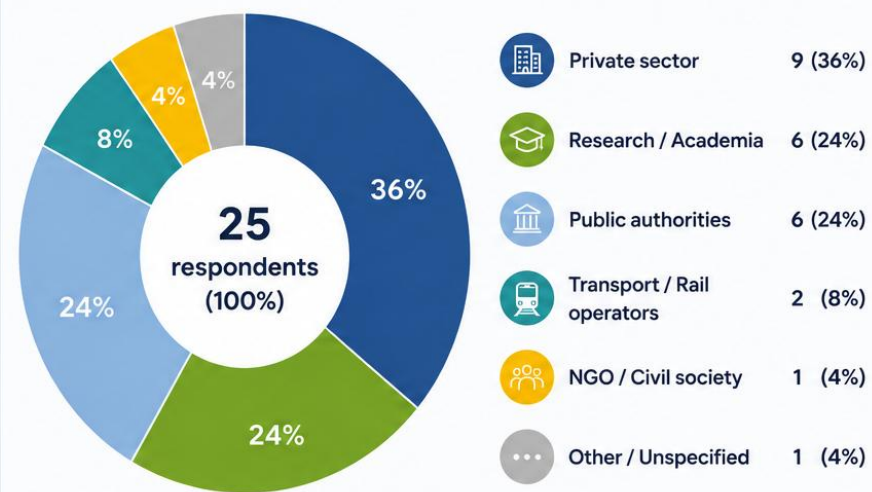
OVERVIEW

25
valid responses analysed

80% of respondents are directly connected with transport infrastructure

Strong representation from across the transport and research ecosystem

STAKEHOLDER TYPES



KEY MESSAGE

The survey gathered perspectives from a diverse group of stakeholders, with a strong majority directly connected to transport infrastructure.



Key message

Societal challenges in sustainable transport development

Social benefits

- Territorial cohesion
- Accessibility & inclusion
- Public health benefits
- Access to essential services



Sustainable transport development creates clear social benefits, but these can only be fully realised if accessibility, affordability, digital inclusion and biodiversity risks are addressed from the early planning stages.

Critical conditions to address early



Planning for sustainability also means planning for social inclusion and environmental responsibility.



SYMBIOSIS Stakeholder Survey: Societal Challenges in Sustainable Transport Development

- ❑ Respondents see transport projects as having **moderate to high societal and environmental relevance.**
- ❑ Respondents perceive **current assessment practices as incomplete, especially regarding social impacts and biodiversity.**
 - environmental impacts are often assessed more systematically than social impacts;
 - biodiversity is still not fully integrated into planning and evaluation;
 - assessments tend to focus mainly on construction-phase impacts, while long-term operational, social and ecological effects receive less attention;
 - economic growth, safety or technical feasibility may dominate over wider societal and biodiversity considerations.
- ❑ Ratings related to community engagement and monitoring mechanisms were relatively moderate: Respondents see room for improvement in:
 - informing and engaging local communities;
 - monitoring environmental & biodiversity impacts;
 - monitoring social impacts;
 - managing conflicts and communication gaps.

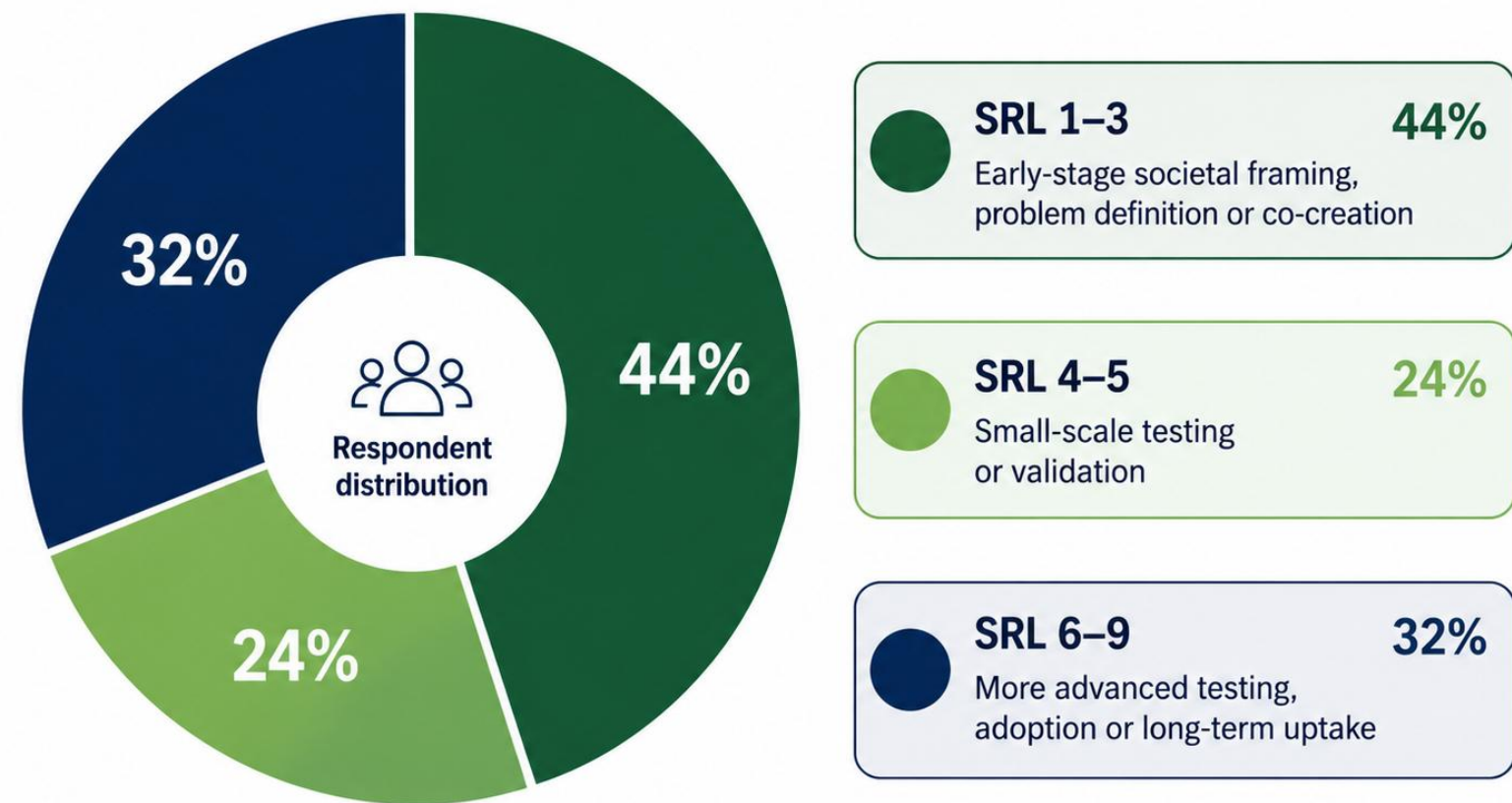


SYMBIOSIS Stakeholder Survey: Societal Challenges in Sustainable Transport Development

- ❑ Societal Readiness Level appears **relatively low to medium**
- ❑ Respondents recognise that transport projects do not affect all groups or territories equally. Groups or areas mentioned as **more vulnerable** include:
 - low-income groups;
 - people without access to private vehicles;
 - rural and peripheral areas;
 - communities near infrastructure corridors;
 - species and ecosystems affected by fragmentation;
 - birds, mammals, reptiles, amphibians and ecologically sensitive corridors.

Distribution of responses across Societal Readiness Levels (SRL)

Stakeholder assessment of project maturity



Most responses place projects either at early-stage societal framing (44%) or at advanced testing/adoption stages (32%).

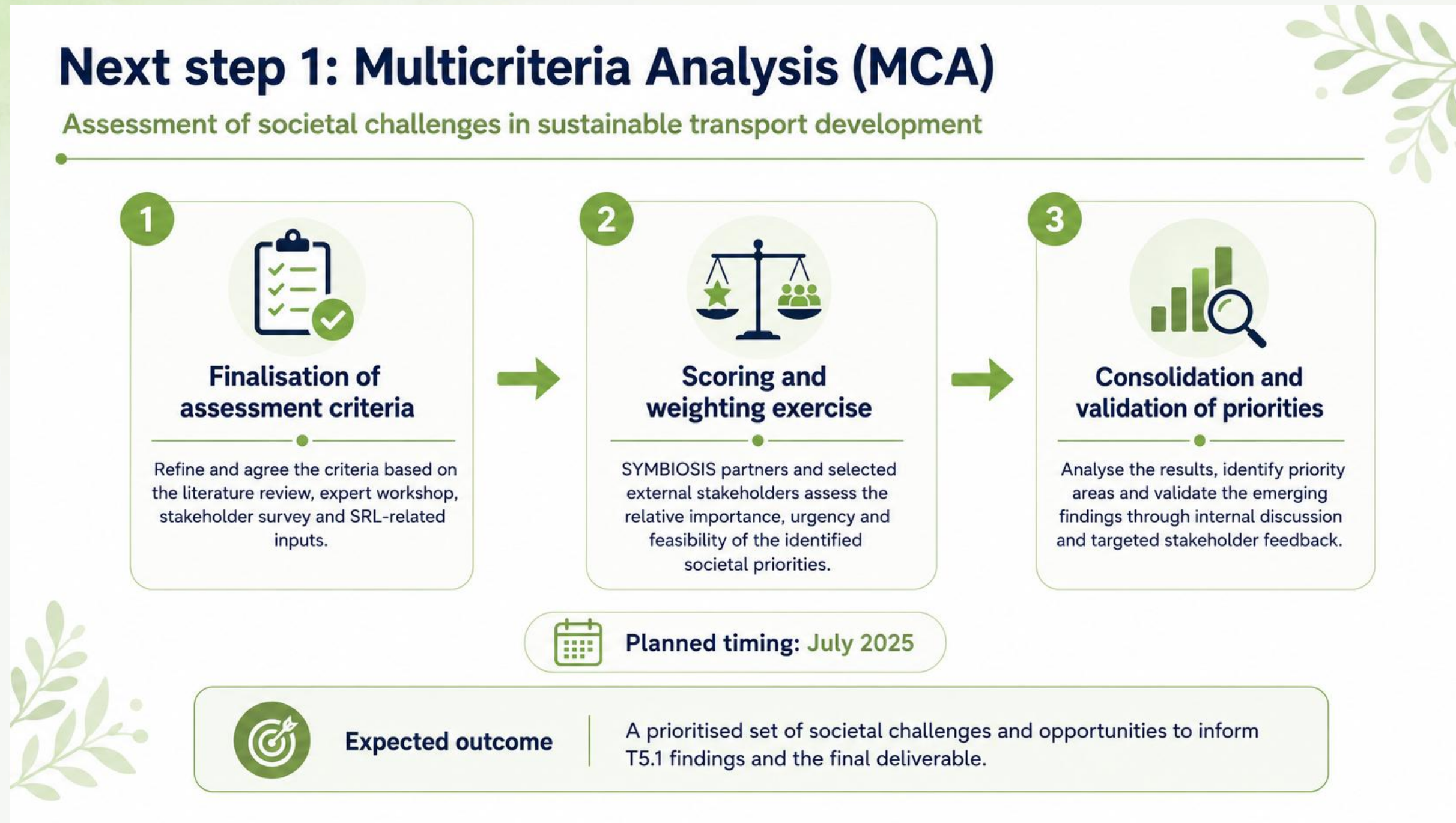


NEXT STEPS



Multicriteria Analysis – July 2026

- **Purpose:** To prioritise the most relevant societal challenges and opportunities linked to sustainable transport development.



Drafting of the T5.1 deliverable – July / August 2026

- The deliverable will consolidate the evidence collected through the bibliographic review, expert workshop, stakeholder survey and multicriteria analysis, providing a structured assessment of societal priorities, challenges and enabling conditions for sustainable transport development.

Next step 2: Drafting of Deliverable T5.1

Analysis report on assessing societal priorities on sustainable transport development

Draft deliverable structure

1



Introduction

- Purpose and scope
- Link with Task 5.1 and WP5

2



Methodological approach

- Bibliographic review
- Stakeholder engagement
- Survey, SRL and MCA

3



Evidence base and analytical inputs

- Reviewed sources
- Key societal and environmental challenges
- Stakeholder perspectives

4



Assessment of societal priorities

- Assessment criteria
- MCA results
- Priority areas

5



Discussion of key findings

- Main societal priorities
- Barriers, risks and enabling conditions
- Implications for planning and governance

6



Conclusions and recommendations

- Summary of findings
- Recommendations
- Inputs for next WP5 activities

7



References and annexes



Task 5.2: Regulation and policy assessment

Task description

- The aim of this task is to better understand and assess the interactions and impacts of rail infrastructure and transport (and its synergies with energy infrastructure) on biodiversity and climate change. The main objective of this task is focused on:
 - **Evaluate the existing frameworks.**
 - **Identify gaps.**
 - **Provide recommendations from a joint sectorial approach, considering rail and energy infrastructure, and its interactions with biodiversity and climate change**
- This task will base its work on the regulation and policy issues emerging from two sources:
 - **Energy infrastructure, biodiversity and climate change.**
 - **Rail infrastructure and operation.**

The work of task 5.2 will embrace the following points:

- **Evaluation of existing knowledge:** Identify the BISON project's findings concerning rail infrastructure development and biodiversity protection. Initially assess the readiness of these regulations.
- **Regulatory framework analysis and policy assessment:** Extend the analysis of current European regulations and policies. At this point, the regulatory frameworks and needs detected in WP3, WP4 and WP5 will be included for assessment.
- **Gap Analysis:** Identify gaps and inconsistencies in the regulatory and policy framework affecting the integration of biodiversity protection measures in rail infrastructure.



Task 5.2: Regulation and policy assessment

Work Completed

Needs assessment

- Survey among SYMBIOSIS partners to identify expectations, priority topics and key needs for the study.
- Integration of insights gathered during the Stakeholder Engagement Workshop (September).

Evidence review

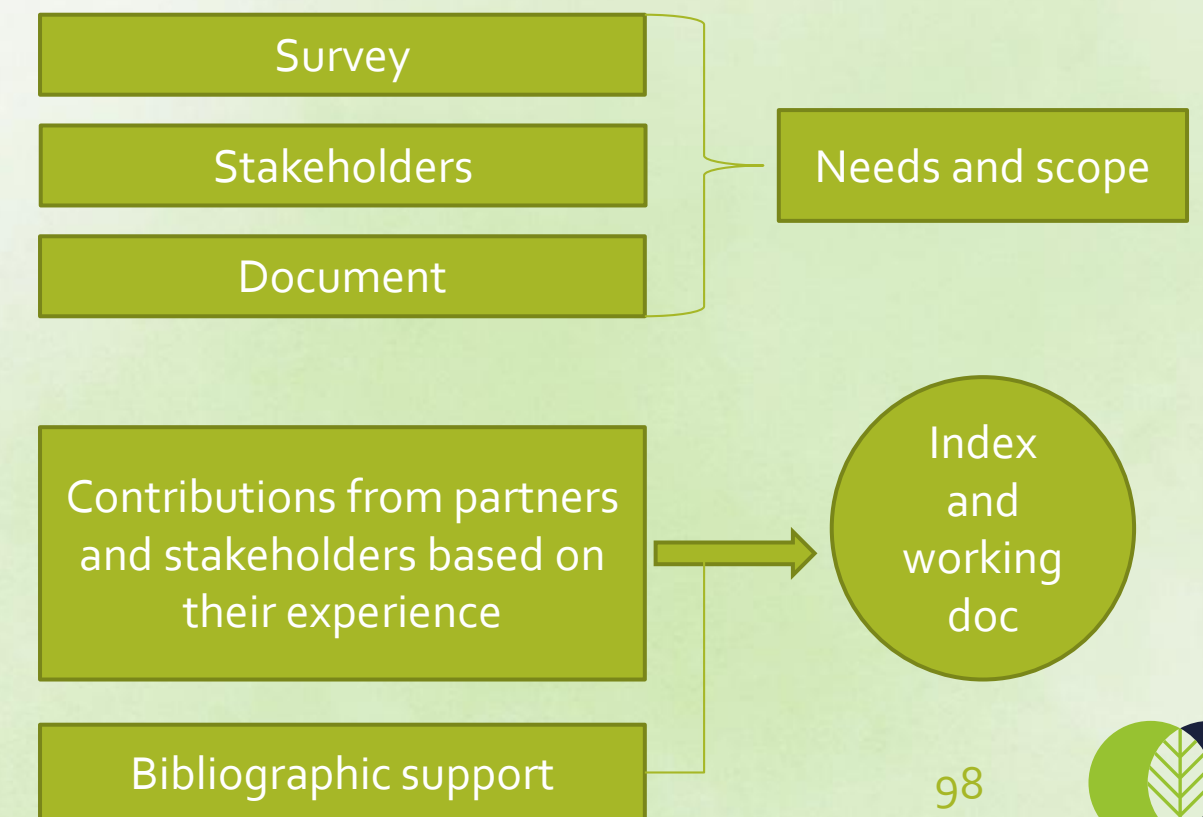
- Assessment of relevant international, European and national policy and regulatory frameworks.
- Review of previous initiatives and projects addressing biodiversity and climate integration in railway infrastructure.

Study Reorientation

- **Moving from a primarily document-based assessment to a collaborative, expert-led development process**, transitioning from a literature- and policy-review driven approach to a co-creation process involving project partners and stakeholders.
- **Survey results, stakeholder feedback and expert contributions are driving the definition of the study content and recommendations**, while policy and scientific evidence provide the supporting framework.
- **The resulting recommendations will combine policy relevance, practical expertise, implementation feasibility and stakeholder validation.**

Current Status

- Key needs identified through surveys, stakeholder engagement activities and document review.
- Needs and priorities grouped into thematic areas.
- Study structure and table of contents defined accordingly.
- Ongoing definition of section scope, key requirements and methodological approach.
- Collaborative drafting process launched with contributions from all relevant partner



Task 5.2: Regulation and policy assessment

Collaborative Development Process

The study is being developed through a collaborative process involving project partners and, where relevant, external stakeholders.

The objective is to combine:

- Expert knowledge and practical experience from the consortium.
- Evidence from policy, regulatory and scientific sources.
- Stakeholder perspectives and validation.
- Cross-sectoral insights on biodiversity and climate integration in railway infrastructure.

Selected stakeholders will contribute to specific sections and will be invited to review and validate the final recommendations.

INDEX

Executive Summary, Introduction and scope, and Methodology

Regulatory Framework

International Framework

Europeans transport and energy Infrastructure Frameworks

Europeans biodiversity and environmental frameworks

National-Level transposition and implementation of EU policies: Practical Experiences

Baseline Knowledge

Past initiatives enhancing cross-cutting biodiversity and climate policies on railway infrastructure: BISON project and others

SYMBIOSIS Project Surveys

Procedural Instruments and Cross-Sectoral Governance

Reporting and monitoring frameworks for rail infrastructure projects

Gaps and barriers to implementation: Policy, standards, governance and capacity-related barriers

Recommendations on Policy and Standards for Rail Infrastructure

Scientific Evidence and Added Value



Task 5.2: Regulation and policy assessment

Roadmap

Milestone	Timeline
Identification of needs and study structure	Completed
Definition of section scope, requirements and approach	Ongoing
Validation of scope and requirements	June 2026
First complete draft	October 2026
Final deliverable	December 2026
Final stakeholder consultation and validation	January 2027





Task 5.3. Sustainable environmental impact assessment and corporate sustainability reporting on transport (M6-M36)

- Key objectives
- Brief update on progress achieved, including reported milestones and deliverables
- Planned next steps with WP/task partners
- Required involvement from external stakeholders

Task 5.3. Sustainable environmental impact assessment and corporate sustainability reporting on transport (M6-M36)

Key objectives

Subtask A. Addressing cumulative effects of pairing infrastructure into environmental impact assessment of linear transport infrastructure development

D5.3. Recommendations on environmental impact assessment of the cumulative effects of pairing infrastructure development (Deadline: August 2027).

Subtask B. Mainstreaming biodiversity in corporate sustainability reporting

MS10. Analysis report on adapting the CSRD for the development of transport infrastructure networks in harmony with biodiversity conservation and ensuring ecological connectivity (Deadline: June 2026).

MS15. Analysis report on biodiversity data flow of different scale in the reporting processes and Follow up Framework on policies and strategic planning in connection with environmental impact assessment (Deadline: October 2026).



Task 5.3. Subtask A

➤ Brief progress update

➤ Established working meetings (WM) in trimester basis:

- Subtask A 4th WM took place on 4th of June.

➤ Literature search and review of publications is on going

➤ Stakeholders' involvement in progress:

- Presentations in TRA (Budapest, 18-21 May):

- **“Towards Nature-Positive Transport: Embedding Biodiversity and Societal Considerations in Railways Infrastructure Planning and Policy”** (WP5) - (*Matina Loukea, Lazaros Georgiadis*, Eduardo Prieto, Manuel Luis Campos Molina, Martina Busti, Almona Tani, Lorenzo Franzoni, Pinar Yilmazer*).
Technical Session 4/Special session 3: Infrastructure for circular economy (19 May)
- **“Mainstreaming Biodiversity in the UN Decade of Sustainable Transport 2026-2035”**: Input of WP5 and SYMBIOSIS in Technical Session 7/Special session 17: Biodiversity in transport (21 May).



Task 5.3. Subtask A

➤ Brief progress update

Four groups of challenges on assessment of cumulative impact of bundling linear infrastructure, as derived from:

- The questionnaire
- SYMBIOSIS Stakeholder Workshop in September 2025
- The interactive session at ATEF organized with CATS and CMS (October 2025)

A. Ecological and Biological Challenges

Challenges related to understanding, measuring, and predicting ecological effects.

B. Conceptual and Methodological Challenges

Challenges concerning underlying assumptions, analytical frameworks, and data limitations.

C. Spatial and Technical Planning Challenges

Challenges related to infrastructure design, spatial configuration, and assessment methods.

D. Governance and Stakeholder Challenges

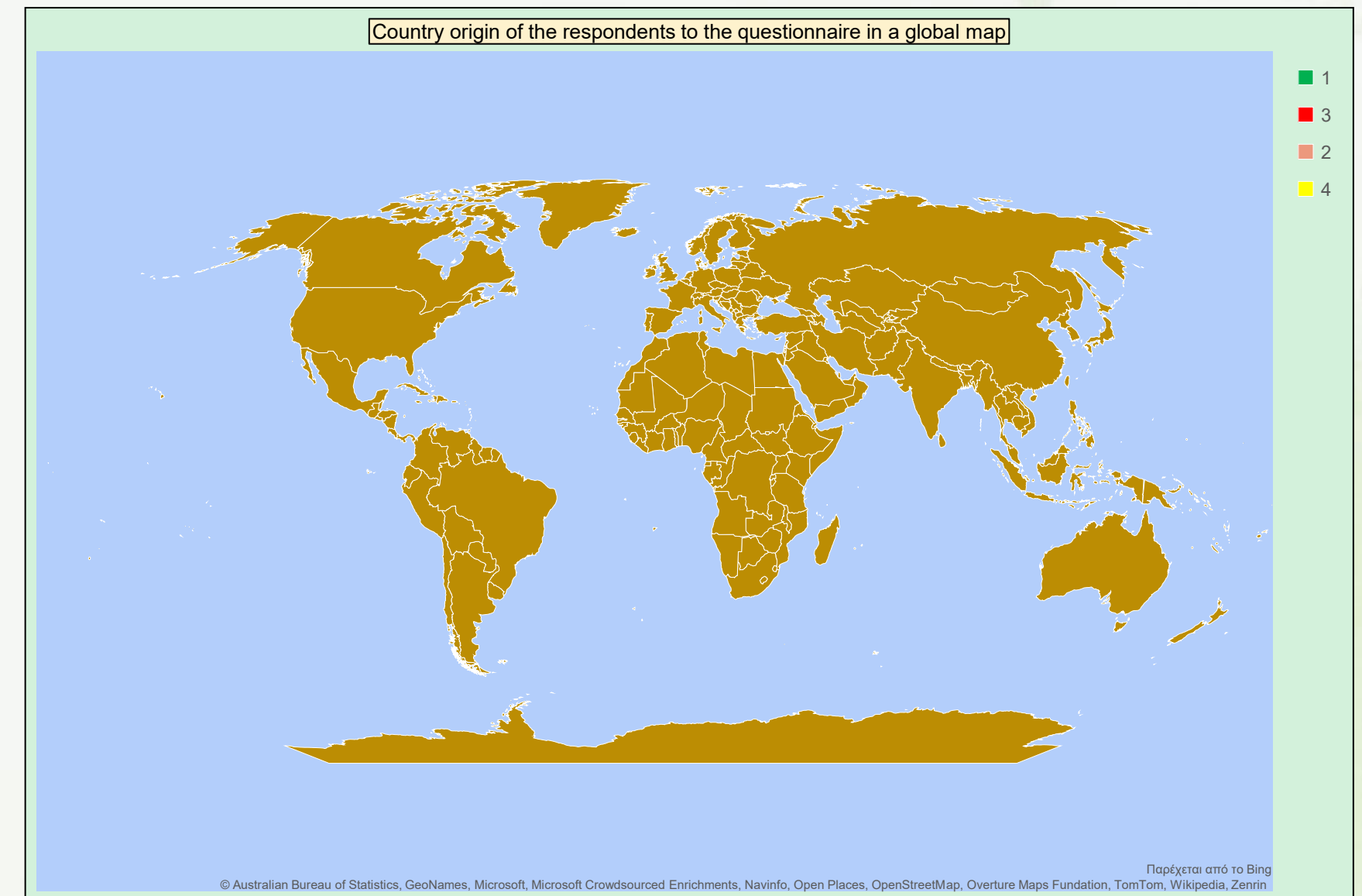
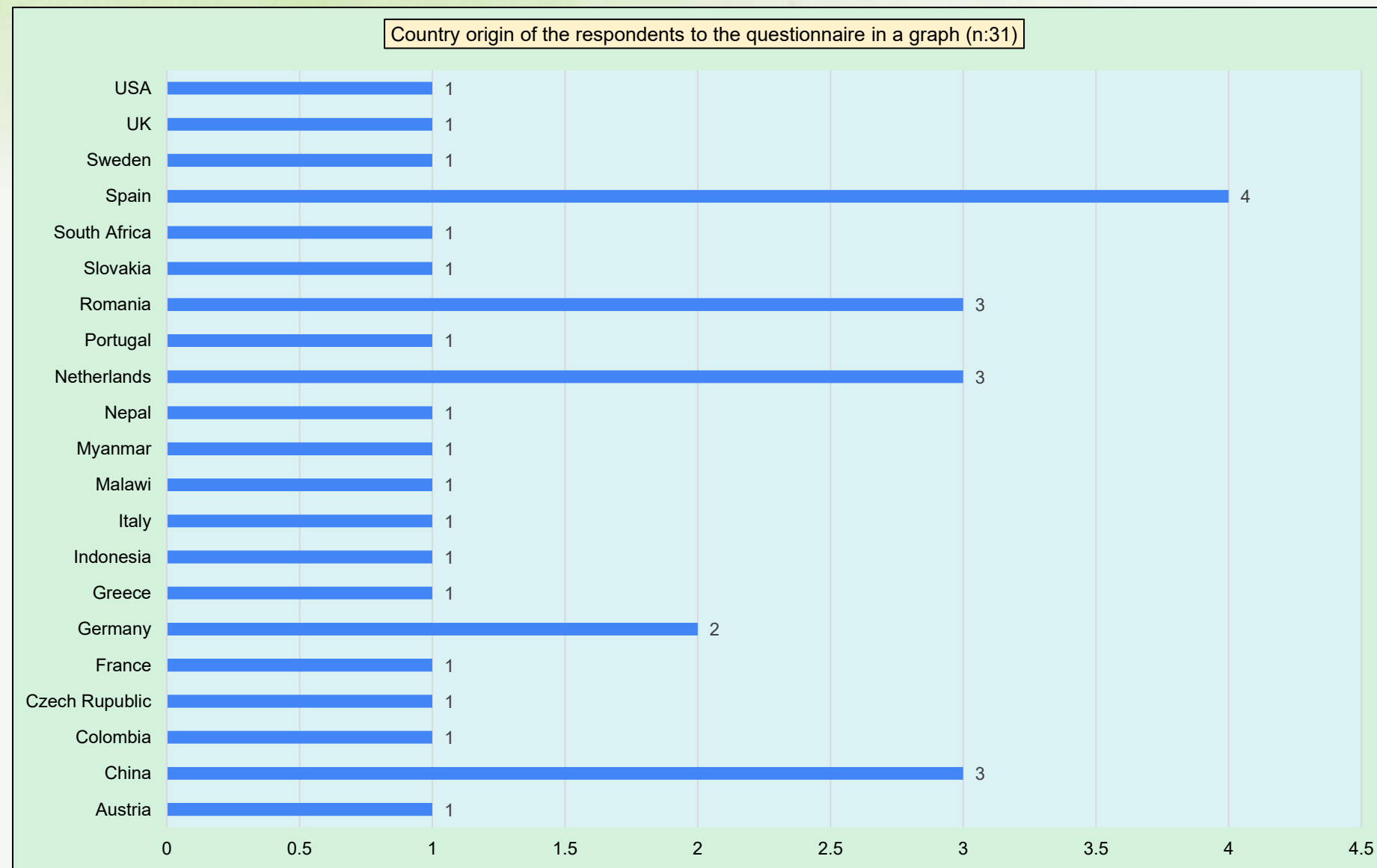
Challenges involving management, coordination, and participation.



Task 5.3. Subtask A

➤ Brief progress update

Background of 31 responders



Task 5.3. Subtask A

➤ Required involvement from external stakeholders

Interactive session at IENE 2026 conference

➤ The session will consist of two 45-minute parts.

- **The first part** will include a presentation as an introduction and discussion with Q&A
- **The second part will involve group work, during which participants will identify key biodiversity challenges on CIA approaches during different combinations of “pairs” of linear transport infrastructure (LTI):**
 - Railway* – Road
 - Railway – Powerlines**
 - Railway – Railway
 - Road – Road (e.g., Motorway – parallel regional road)
 - Road - Powerlines
 - Bundling more than two LTI (Railway – Road – Powerlines)

This interactive exercise will be conducted to explore specific challenges for each pair focusing on:

- Biodiversity impact aspects,



Task 5.3. Subtask B

- **Brief progress update and required involvement from external stakeholders**
- **Established working meetings (WM) in trimester basis:**
 - Subtask B 6th WM took place on 9th July.
- **MS10 development has been completed (with 6 Case Studies) and is in the final review process.**
- **The development of the dashboard will start after delivery of the MS10 in July.**
- **Stakeholders' involvement in progress:**

Interactive session at IENE 2026 conference

- An abstract has been submitted for an interactive session on which will consist of two 45-minute parts.
 - The first part will include a presentation as an introduction and discussion with Q&A
 - The second part will involve group work, during which participants will identify key biodiversity challenges on biodiversity KPIs in corporate sustainability and national reporting.
- **MS15 will be completed in October after the integration of the feedback of the IENE interactive session in the final results.**



Task 5.3. Subtask B

➤ Brief progress update

➤ The final framework of recommendations of MS10 have been grouped in four pillars:

- A. Governance, Policy Alignment & Accountability Reform
- B. Measurement, Data, and Reporting Systems
- C. Operational Integration, Risk Management & Innovation
- D. Capacity Building, Stakeholder Engagement & Cultural Change

➤ Cross-cutting enabling conditions across all four pillars:

- 1) Political and corporate will to prioritize biodiversity alongside climate
- 2) Integration of biodiversity–climate nexus (win–win approach)
- 3) Shift from global ambition to local implementation
- 4) Permanent monitoring and long-life adaptive management
- 5) Focus on ecological connectivity (structural & functional) and ecosystem valuation including:
 - *species impact assessment on wildlife mortality and safety, disturbance, and alien invasive species dispersal.*
 - *management of green assets as infrastructure related habitats*
 - *cumulative impact assessment in a framework of transport network large scale and not only as a solitary linear transport infrastructure.*
- 6) Alignment with the United Nations Decade of Sustainable Transport 2026-2035 principles



Task 5.3. Subtask B

➤ **Brief progress update:** MS10 Recommendations

Pillar A: Governance, Policy Alignment & Accountability Reform

A.1. Strengthen regulatory alignment and compliance with institutional reforming

- a. Fully integrate biodiversity into reporting under Corporate Sustainability Reporting Directive and ESRS E4.
- b. Align corporate strategies with Kunming-Montreal Global Biodiversity Framework, European Green Deal and Sustainable Development Goals.

A.2. Establish mandatory and standardized disclosure systems

- a. Promote science-based, comparable biodiversity indicators (**Table 8**).
- b. Support harmonization across frameworks (GRI, TNFD, ESRS).

A. 3. Reinforce corporate accountability



Task 5.3. Subtask B

➤ Brief progress update: MS10 Recommendations

Pillar B: Measurement, Data, and Reporting Systems

B.1. Develop standardized metrics and indicators

- a. Build consensus on biodiversity KPIs linked to ecosystem extent, condition, and connectivity. .
- b. Ensure time-series data for long-term monitoring.

B.2. Improve data availability and quality

- a. Use tools such as IBAT and International Union for Conservation of Nature Red List databases.
- b. Establish baseline inventories of species and habitats early in projects.



Task 5.3. Subtask B

➤ **Brief progress update:** MS10 Recommendations

Pillar C: Operational Integration, Risk Management & Innovation

C.1. Treat biodiversity as a strategic risk

- a. Integrate biodiversity into enterprise risk management (legal, operational, reputational) .
- b. Align with Taskforce on Nature-related Financial Disclosures recommendations.

C.2. Embed biodiversity into operations

- a. Incorporate biodiversity considerations across the full project lifecycle:
Planning → Design → Construction → Operation .
- b. Promote ecological connectivity solutions (corridors, wildlife crossings, habitat restoration).

C. 3. Drive efficiency and co-benefits.



Task 5.3. Subtask B

➤ Brief progress update: MS10 Recommendations

Pillar D: Capacity Building, Stakeholder Engagement & Cultural Change

D.1. Strengthen internal capacity.

- a. Develop continuous training programs for staff on: i) Biodiversity monitoring, ii) Impact mitigation and iii) Reporting standards. .
- b. Create dedicated and supported biodiversity roles within companies.

D.2. Enhance stakeholder engagement

- a. Define clear roles, responsibilities, and financing mechanisms in effective timeline.
- b. Engage supply chains, especially Small and Medium Enterprises (SMEs) facing reporting pressure.

D.3. Improve communication and transparency

- a. Use accessible language and visualization tools in CSR reports.
- b. Communicate both positive and negative impacts.
- c. Use more illustrations in biodiversity reporting and benchmarks from other sectors/ companies.
- d. When reporting measures the negative impacts should also be measurable (quantitative KPIs).

D.4. Foster collaboration and knowledge exchange.

- a. Partner with scientists, NGOs, and technology providers.
- b. Share best practices across sectors.
- c. Build on collaborative initiatives (e.g., BISON, SYMBIOSIS-type projects).

D. 5. Promote societal awareness and legitimacy

- a. Position biodiversity as a core business issue, not peripheral.
- b. Strengthen trust through transparency and demonstrated action.



Task 5.3. Sustainable environmental impact assessment and corporate sustainability reporting on transport (M6-M36)

Planned next steps with WP/task partners

Subtask A. Addressing cumulative effects of pairing infrastructure into environmental impact assessment of linear transport infrastructure development

- Organize the interactive session in IENE 2026 conference in September
- Continue to organize the working meetings and develop the D5.3
- Developing of the dashboard using data and elements from D5.3

Subtask B. Mainstreaming biodiversity in corporate sustainability reporting

- Finalizing and deliver MS10 in June.
- Organize the interactive session in IENE 2026 conference in September
- Organize the final working meeting early of October and finalizing and deliver MS15 until the end of October.
- Developing of the dashboard using data and elements from MS10 and MS15



5.4 Integrating biodiversity into company strategies, procurement processes and supply chain (M8-36)

Key objectives

- Analyse the **state of the art** in order to identify **biodiversity data gaps in procurement activities and sustainability reporting** in the supply chain
- Identify **good practices, existing indicators and criteria**, for the inclusion of biodiversity in sustainability reporting and procurement contracts
- Define **recommendations** on how to seamlessly integrate biodiversity considerations into **procurement processes and overarching corporate strategies**.



5.4 Integrating biodiversity into company strategies, procurement processes and supply chain (M8-36)

Progress



State of the art

Literature review, stakeholder mapping in related sector companies' governance and supply chain structure, identification of data gaps for improving information disclosure for Sustainability Reporting and collection of the last updates coming from regulation and distinctive, voluntary, efforts



Completed
→ *Dissemination opportunities*

[Home](#) > [Calls for papers](#) > Call for papers: Contemporary biodiversity challenges and economic responses

Call for papers: Contemporary biodiversity challenges and economic responses

Deadline 01 July '26

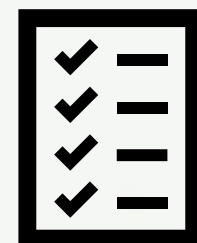


Benchmark analysis

Collect and review published sustainability reports from a relevant sample of infrastructure companies to build a benchmark, fill the gaps in desk analysis building a questionnaire and conducting interviews with relevant stakeholders



Ongoing
→ *Stakeholder engagement and case studies collection*



KPI e criteria identification

Identify good practices (existing indicators and criteria) for the inclusion of sustainability criteria in sustainability reporting and procurement contracts



5.4 Integrating biodiversity into company strategies, procurement processes and supply chain (M8-36)

Milestone 13 Table of contents:

1. Introduction

2. Methodology

3. Theoretical background/State of the art

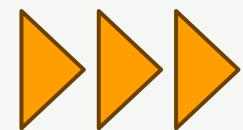
4. Innovative aspects regarding sustainability reporting: the new CSRD
 - Supply chain biodiversity in the sustainability reports of the case studies

5. Supply chain structure of the infrastructural sector
 - Supply chain structure of the case studies (RFI, SNCF Résau, PGE Energetyka, NetworkRail, etc.)

6. Sustainability/Biodiversity criteria in the procurement process
 - Sustainable procurement practices and criteria identified in the case studies

7. Results
 - Gaps, best practices, criteria and indicators

8. Conclusions



5.4 Integrating biodiversity into company strategies, procurement processes and supply chain (M8-36)

Roadmap to MS13

June 2026 Complete the **analysis of the case studies** and submit paper to journal (deadline 1Jul);



July 2026 **Online workshop** with Symbiosis partners and external stakeholders to present preliminary results and facilitate networking (**9 July**);



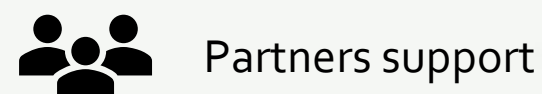
September 2026 Draft chapters 5, 6 and 7 of Milestone 13;



November 2026 **Finalise MS13** and circulate it among partners;



End of December 2026 **MS13 DEADLINE**



Partners support



Stakeholders support





COMMUNICATION, DISSEMINATION & EXPLOITATION OF RESULTS

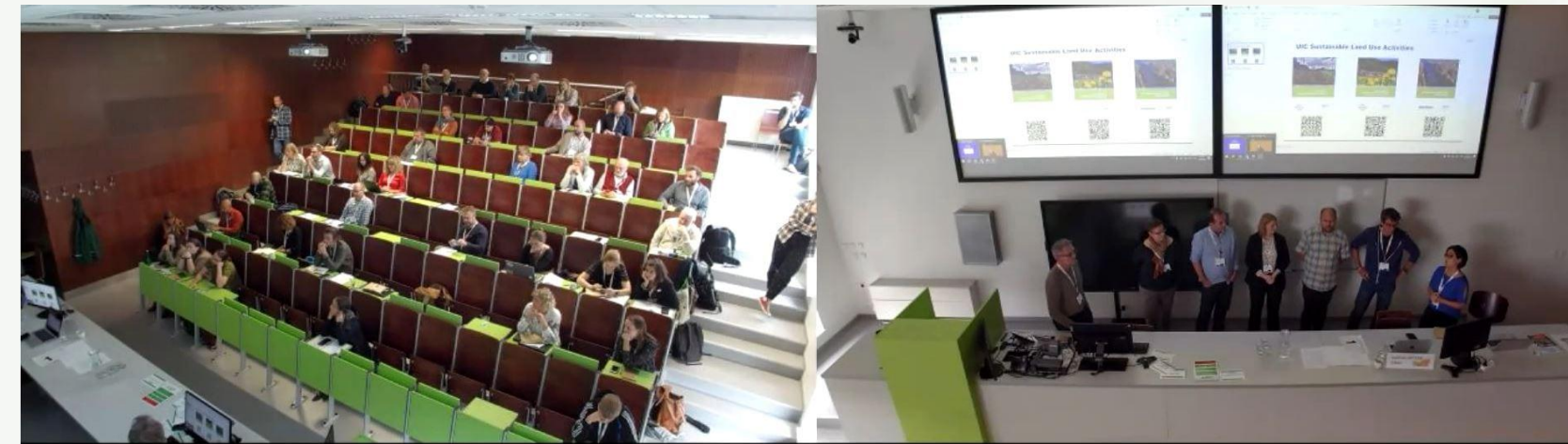
Opportunities to Connect with the
SYMBIOSIS Community



Dissemination activities conducted

Year 1 (2024)

- Keynote lecture, Scandinavian Association for Pollination Ecology annual meeting, Norway (Oct 2024)
- SYMBIOSIS session at IENE 2024 International Conference on Ecology and Transportation, Prague (Sep 2024)
- EU-Rail IAM4RAIL Mid-Term Conference – panel on Environmentally Friendly Asset Production (Nov 2024)



IENE 2024 International Conference

Year 2 (2025)

- UIC Sustainability Action Week; UIC RERA Project meeting; PIARC TC3.4 Workshop (Mar 2025)
- Applied Economics and Sustainability Conference; Living Data 2025, Bogotá; R&D Biodiversity and Innovation Conference, Pisa (Apr–Jun 2025)
- FIRM 2025, Brussels – presentation by UIC & Minuartia (May 2025)
- SYMBIOSIS Stakeholders Engagement Workshop (Sep 2025)
- IRF Congress Sofia; Rail Net Zero Summit, London; Asia Transport Ecology Forum, Beijing (Oct 2025)
- BIONEXT Project Workshop; IRF R2T Conference, Los Angeles (Dec 2025)



FIRM 2025



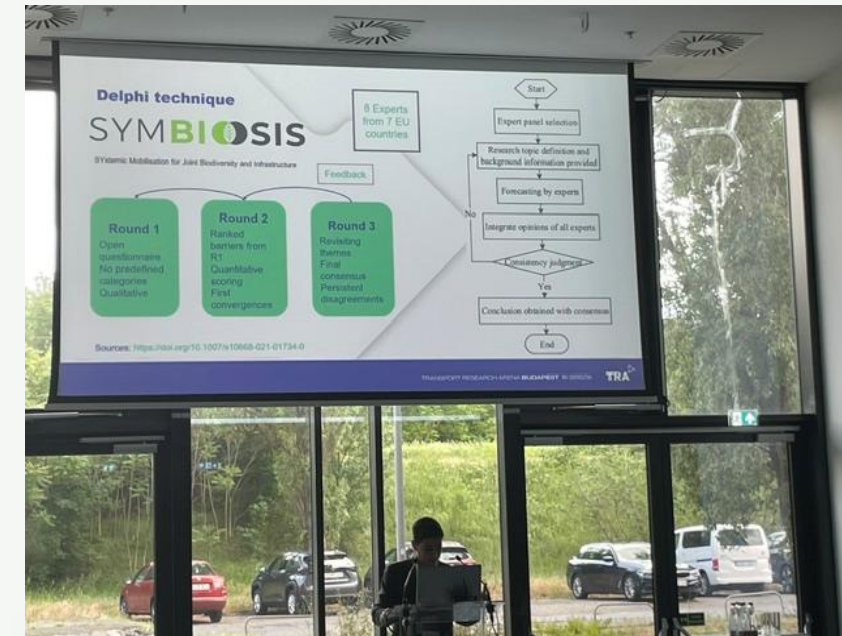
UIC Sustainability Action Week



Dissemination activities conducted

Year 3 (2026)

- Free Sky for Birds Conference, Bratislava (Mar 2026); Internal training on Sustainable Infrastructures for FS Engineering (Mar 2026)
- TRA 2026, Budapest – 5 contributions & FEHRL stand with project video (May 2026)
 - **Poster** – *SYMBIOSIS: Integrating Biodiversity into the Future of Linear Infrastructure in Europe* (Yilmazer, Franzoni, Loukea, Georgiadis et al.) – presented by FEHRL (Adewole Adesiyun)
 - **Poster** – *Sustainable transport infrastructure: Climate adaptation through Nature-based Solutions* (Fernández, Marull, Álvarez, Yilmazer, Franzoni, Rosell) – presented by FEHRL (Julie)
 - **Session** (19 May 14:00–15:30) – *Managing disruptions and wildlife in transport systems* – Oral: *Barriers to Biodiversity Integration in European Railway Operations: A Multi-Round Assessment* (Gil Llorente, Morillas, Álvarez Gallego, Romero Morales, Yilmazer, Berrocal, Franzoni, Martinez)
 - **Session** (19 May 16:00–17:30) – *Infrastructure for circular economy* – Oral: *Towards Nature-Positive Transport: Embedding Biodiversity and Climate Considerations in Infrastructure Planning and Policy* (Georgiadis, Loukea, Prieto, Campos Molina, Busti, Tani, Franzoni, Yilmazer)
 - **Session** (20 May 16:00–17:30) – *Life cycle assessment tools and methods* – Oral: *Operational Tools for Assessing Environmental Impacts and Benefits in Linear Infrastructure: A Systematic Review* (Morillas, Gil Llorente, Álvarez Gallego, Martinez, Yilmazer, Franzoni)



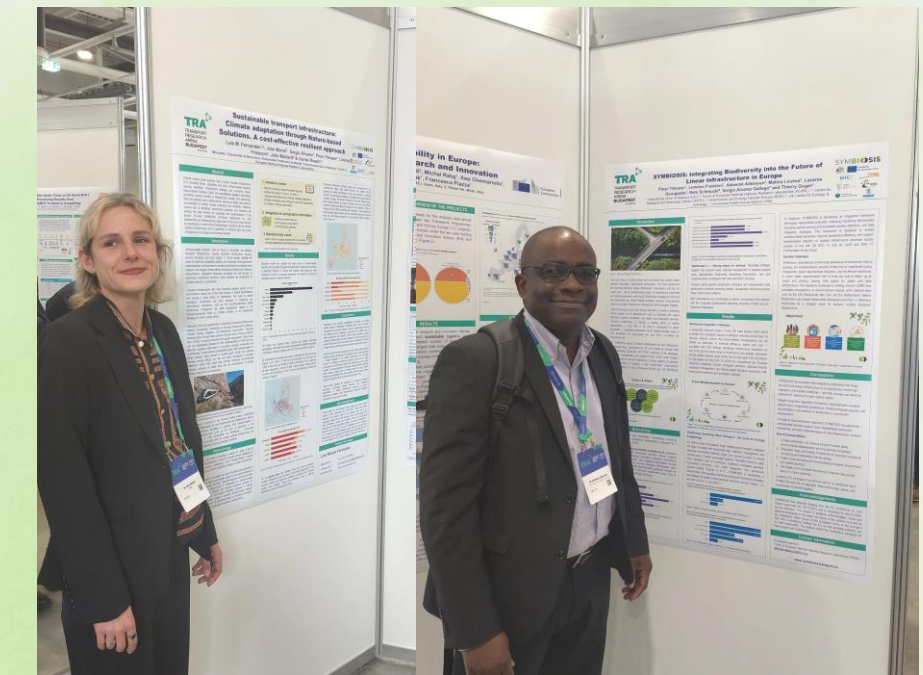
TRA 2026 - Session: *Managing disruptions and wildlife in transport systems*



TRA 2026 - Session: *Infrastructure for circular economy*



TRA 2026 - Session: *Life cycle assessment tools and methods*



TRA 2026 - posters presentation



ERJU Newsletters

Year 1 (Oct 2024 – Jun 2025)

- **Oct 2024** – *Symbiosis Project Kick-off Meeting*
- **Nov 2024** – *SYMBIOSIS at IAM4RAIL Mid-term Conference*
- **Jan 2025** – *Symbiosis Project Website Rolled Out*
- **Feb 2025** – *Meet the SYMBIOSIS Project at the UIC Sustainability Action Week (announcement)*
- **Mar 2025** – *SYMBIOSIS at UIC Sustainability Action Week (summary)*
- **Apr 2025** – *Insights from a Europe-wide literature review on Environmental Impact Assessment Tools (LinkedIn)*
- **May 2025** – *Insights from a Europe-wide literature review on Environmental Impact Assessment Tools*
- **Jun 2025** – *FIRM 25 & survey to assess current practice for habitat and biodiversity data collection and reporting across European transport infrastructure*



Symbiosis Project Kick-off Meeting

The new Europe's Rail **SYMBIOSIS** project is leading a new path towards sustainable infrastructure with its launch at the kick-off meeting in Paris on 4-5 September. This initiative fosters biodiversity and transport integration by bringing together energy, transport, and environmental sectors.

SYMBIOSIS also took center stage at the IENE 2024 conference in Prague, engaging stakeholders in discussions on harmonising rail infrastructure with biodiversity conservation. The project aims to establish a standardised approach to infrastructure impact assessment and biodiversity monitoring, paving the way for a greener, more resilient future. Stay tuned for further updates on this transformative project!

[Read more](#)



SYMBIOSIS at UIC Sustainability Action Week

Over 60 participants attended the session **"The Tracks of Harmony: Nature & Rail – Sustainable Land Use Day"** at UIC Sustainability Action Week, which focused on rail and biodiversity. **UIC** provided updates on the **EU-RAIL SYMBIOSIS project** across key Work Packages. Participants also learned about the ongoing biodiversity monitoring survey and the setup of an automated biodiversity data collection tool using train-mounted cameras. Key takeaways highlighted the need for collaboration, a shared understanding among experts on biodiversity challenges and the vital role rail infrastructure plays in supporting nature's recovery.

[Read more](#)



Updates from SYMBIOSIS Project

Our **EU-Rail project SYMBIOSIS** has completed a review of over 80 case studies (2021-2024) on **environmental impact assessments (EIA)** across road and railway infrastructures, identifying critical gaps.

Some of the key findings:

- Tools are fragmented and not standardised
- Maintenance and end-of-life stages are often overlooked
- Authorities are the primary audience, with little input from local stakeholders or infrastructure operators

These insights will inform the development of a **biodiversity-smart SYMBIOSIS impact assessment toolbox**, aligned with the EU Biodiversity Strategy.

On 6 May, the project was featured at the **FIRM25 Conference** during the session "Mainstreaming Biodiversity & Infrastructure Symbiosis," organised by **FEHRL**. Key takeaways included the need for cooperation, standardised tools and long-term strategies to align infrastructure with environmental goals. SYMBIOSIS is actively addressing these needs with practical tools for biodiversity assessment, resilience mapping and carbon impact analysis.

[Read more](#)



ERJU Newsletters

Year 2 (Sep 2025 – May 2026)

- **Sep 2025** – *Assessment of Biodiversity Monitoring in European Railways*
- **Oct 2025** – *Stakeholder workshop gathers more than 60 experts*
- **Nov 2025** – *Driving Sustainability and Biodiversity-Aligned Mobility: SYMBIOSIS in Key Global Forums (COP30 + IRF)*
- **Jan 2026** – *Learning Needs Assessment Survey + Strengthening Stakeholder Engagement for Sustainable Transport Solutions (LinkedIn)*
- **Feb 2026** – *FIRM Magazine – SYMBIOSIS project is mainstreaming biodiversity in transport infrastructure*
- **Mar 2026** – *Deliverable 4.1: Understanding Biodiversity Monitoring in European Railways*
- **Apr 2026** – *SYMBIOSIS at Mid-Term: Advancing Biodiversity Integration in Transport Infrastructure*
- **May 2026** – *Symbiosis Stakeholder survey & Open Plenary Meeting announcement*

Stakeholder workshop gathers more than 60 experts



On 25 September 2025, our EU-Rail **SYMBIOSIS** project held its **first online Stakeholder Engagement Workshop**, bringing together **over 60 participants** from across sectors to explore how biodiversity can be better integrated into transport and energy infrastructure. With 22 partners from 13 countries, SYMBIOSIS is focused on three strategic objectives:

- Underline key enablers in policy, finance and reporting
- Deliver practical tools that embed biodiversity into infrastructure planning
- Convene communities of practice to harmonise data and share knowledge

The workshop reaffirmed the importance of **broad stakeholder collaboration** to make transport infrastructure sustainable and biodiversity-friendly.

[WATCH THE PROJECT OVERVIEW VIDEO](#)

Driving Sustainability and Biodiversity-Aligned Mobility: SYMBIOSIS in Key Global Forums



On 14-16 October, our EU-Rail **SYMBIOSIS** project gained strong visibility during the **IRF Europe & Central Asia Regional Congress and Bulgarian National Transport Infrastructure Conference** in Sofia, Bulgaria.

Dr. Thierry Goger (Secretary General, FEHRL), highlighted the project during the “*Digital Corridors - Infrastructure for Intelligent Mobility*” panel, emphasising SYMBIOSIS as a **key European initiative** embedding biodiversity considerations into digitalised, future-ready transport corridors.

In the session “*Sustainable Infrastructure: Policy, Practice, and Environmental Alignment*”, Dr. **Lazaros Georgiadis** (CERth) presented technical insights from SYMBIOSIS, with a focus on **cumulative environmental impact assessment of pairing linear transport infrastructure**. His intervention outlined the methodology and objectives for evaluating combined ecological pressures arising from co-located transport assets, supporting better environmental decision-making and nature-positive design.

Furthermore, this month, at **COP30** in Belém, Brazil, the **International Coalition for Sustainable Infrastructure (ICSI)** and the **International Union of Railways (UIC)** stressed that nature-positive, people-centric transport is now a practical and cost-effective strategy for long-term resilience. Discussions focused on **standards, digital tools, community knowledge, and nature-based solutions**—such as green corridors, mangrove buffers, and urban wetlands—to protect vulnerable corridors and cities. These insights and collaborations will directly support upcoming SYMBIOSIS capacity-building work.

Stakeholders are invited to contribute to the ongoing assessment through the **SYMBIOSIS questionnaire**.

[READ MORE](#)

Total: 20 newsletter contributions across Years 1 & 2

Website



Visit the SYMBIOSIS website for the latest project news & updates

The SYMBIOSIS website is the central hub for all project information — from research outputs and publications to event reports and partner news.

What you will find:

- Latest news articles and project updates

The screenshot shows a navigation bar with the following categories: News, Press release, Events, Capacity Building, Social media, Videos, and Other materials. Below the navigation bar, there are three news articles displayed in a grid. The first article is titled 'SYMBIOSIS Open Plenary meeting' and is dated 18 June 2026, from 9:30am to 12:30pm CEST, online. The second article is titled 'Earth Day 2026: Reconnecting Infrastructure with Nature' and features a 'celebrate EARTH DAY' sign. The third article is titled 'SYMBIOSIS at Mid-Term: Advancing Biodiversity Integration in Transport Infrastructure' and features a photo of a train track in a field. Each article has a 'read more' link. At the bottom left of the news section, there is a link for '< Older Entries'. At the bottom right of the page, there is a page number '123' and a logo consisting of a green circle with a white leaf and a dark blue circle.



Website

- Deliverables and publications as they are released



DELIVERABLES

- [D1.1: Project Management and Quality Assurance Plan](#)
- [D1.2: Data Management Plan](#)
- D1.3: Data Management Report
- [D2.1: Communication, dissemination & Exploitation plan](#)
- D2.2: Knowledge Transfer and Capacity Building Strategy
- D2.3: Stakeholder analysis and recommendations
- D2.4: Communication, dissemination & exploitation report
- D2.5: Report on the R&I strategic recommendations
- D2.6: Knowledge & Learning Hub

- D3.1: Impact Assessment Tools for Linear Infrastructures
- D3.2: Harmonised methodology to prioritise NbS for Climate-Resilient Infrastructure
- D3.3: Decision support Guidelines to reinforce Blue and Green Infrastructure on transport and energy infrastructure
- D3.4: Biodiversity-CO2 calculator for the railway sector. Methodology, case studies and its evaluation.
- D4.1: Report on 'Transformative Insights and Strategies for Biodiversity Monitoring in European Railway'
- D4.2: Advancements in Automated Biodiversity Monitoring for European Railways
- D4.3: Assessment of the benefits and challenges to integrating real-time biodiversity data into rail infrastructure GIS and BIM alongside data on economic performance and carbon emissions

- D4.4: Recommendations for new approaches for standardised biodiversity monitoring.
- D5.1: Analysis report on assessing societal priorities on sustainable transport development.
- D5.2: Recommendations for enhancing cross-cutting biodiversity and climate policies on railway infrastructure.
- D5.3: Recommendations on environmental impact assessment of the cumulative effects of pairing infrastructure development.
- D5.4: Recommendations for mainstreaming biodiversity within the procurement process, as well as for improving the disclosure regarding biodiversity in the supply chain in compliance with the new standards

- Upcoming events and training activities
- Partner information and project background



Upcoming Events & Training Activities

- IENE Conference 2026, 21-25 September 2026, Bristol UK (TBC)
 - 4 abstracts submitted included a proposal of a 90-minute interactive session about "Integrating Biodiversity into Climate-Resilient Infrastructure: Insights from the SYMBIOSIS Project"
- Online Workshop related to task 5.4 "Integrating biodiversity into company strategies, procurement processes and supply chain" research activities
Thursday, 9 July, 14:30 – 16:30 CET



Identifying Training Priorities:

Learning Needs Assessment And Stakeholder Consultation

Results of the online survey and expert interviews, conducted by ICSI, as part of T2.3

- Biodiversity knowledge is uneven → engineers and decision-makers often lack foundational understanding, while technical specialists are developing growing expertise
- Biodiversity is introduced late or treated as a compliance requirement → lifecycle integration — from early planning through construction, monitoring, and reassessment — is critical
- **Priority areas for learning:** biodiversity monitoring and reporting standards, policy and regulatory frameworks, and financing biodiversity-positive infrastructure development
- **Preferred training format:** peer-to-peer learning webinars with case studies and practical, implementation-oriented resources that support real-world application



SYMBIOSIS Online Training Series

Key audience groups

- Infrastructure practitioners with no prior ecology training (engineers, planners, consultants, asset managers)
- Environmental specialists and ecologists within infrastructure owner/operator organisations
- Policymakers and regulators

Delivery model: Infrastructure Sustainability Learning (ISLe) Initiative

- peer-to-peer learning
- virtual community of practice

ISLe partners: International Coalition for Sustainable Infrastructure (ICSI), Nicholas Institute for Energy, Environment & Sustainability at Duke University and the UN Environment Programme (UNEP)



SYMBIOSIS Online Training Series

3 webinar series - 3 sessions each - by August 2027

Delivered by ICSI and SYMBIOSIS partners, supported by ISLe partners

1. Integrating Biodiversity into Climate-Resilient Infrastructure – Europe

- Audience: infrastructure practitioners, ecologists from Europe

2. Integrating Biodiversity into Climate-Resilient Infrastructure – Africa

SYMBIOSIS learning materials adapted to the African context using local case studies

- Audience: infrastructure practitioners, ecologists from Africa

3. Integrating Biodiversity into Climate-Resilient Infrastructure – Policy Pathways

- Audience: policymakers and regulators from around the world



Training Session at IENE 2026

Introductory Session to the Online Training Series

Integrating Biodiversity into Climate-Resilient Infrastructure: Insights from the SYMBIOSIS Project

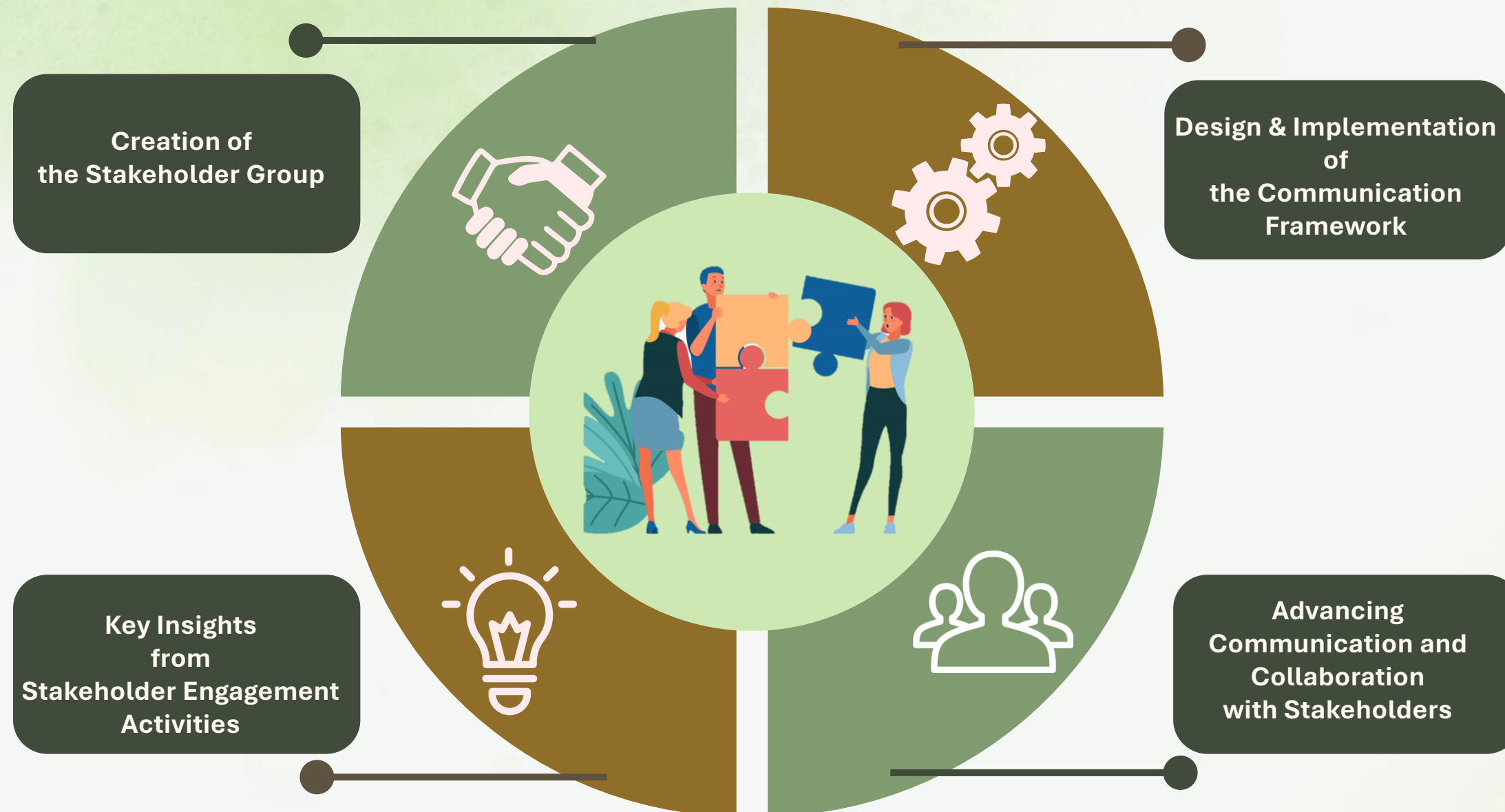
- Aim: Presenting recent progress from the project while creating space for participants to share their own experiences and perspectives.
- Format: Hybrid, interactive

Three themes:

1. Mapping railway resilience to climate change and identifying priority areas for nature-based solutions that strengthen infrastructure while enhancing biodiversity and ecosystem services
2. Biodiversity monitoring and reporting practices, highlighting gaps and opportunities from emerging sensor technologies and AI-based classification tools
3. Societal and governance challenges in sustainable transport development, including stakeholder engagement, infrastructure planning integration, cumulative impact assessment, and corporate sustainability reporting



Be part of the SYMBIOSIS community: stakeholders



Advisory Board

- *Strategic Planning*
- *Policy Guidance*
- *Technical Guidance*

Technical Stakeholder Group

- Technical knowledge and research
- Editing/Reviewing deliverables
- Provide data/information

Why Join the Stakeholder Group?

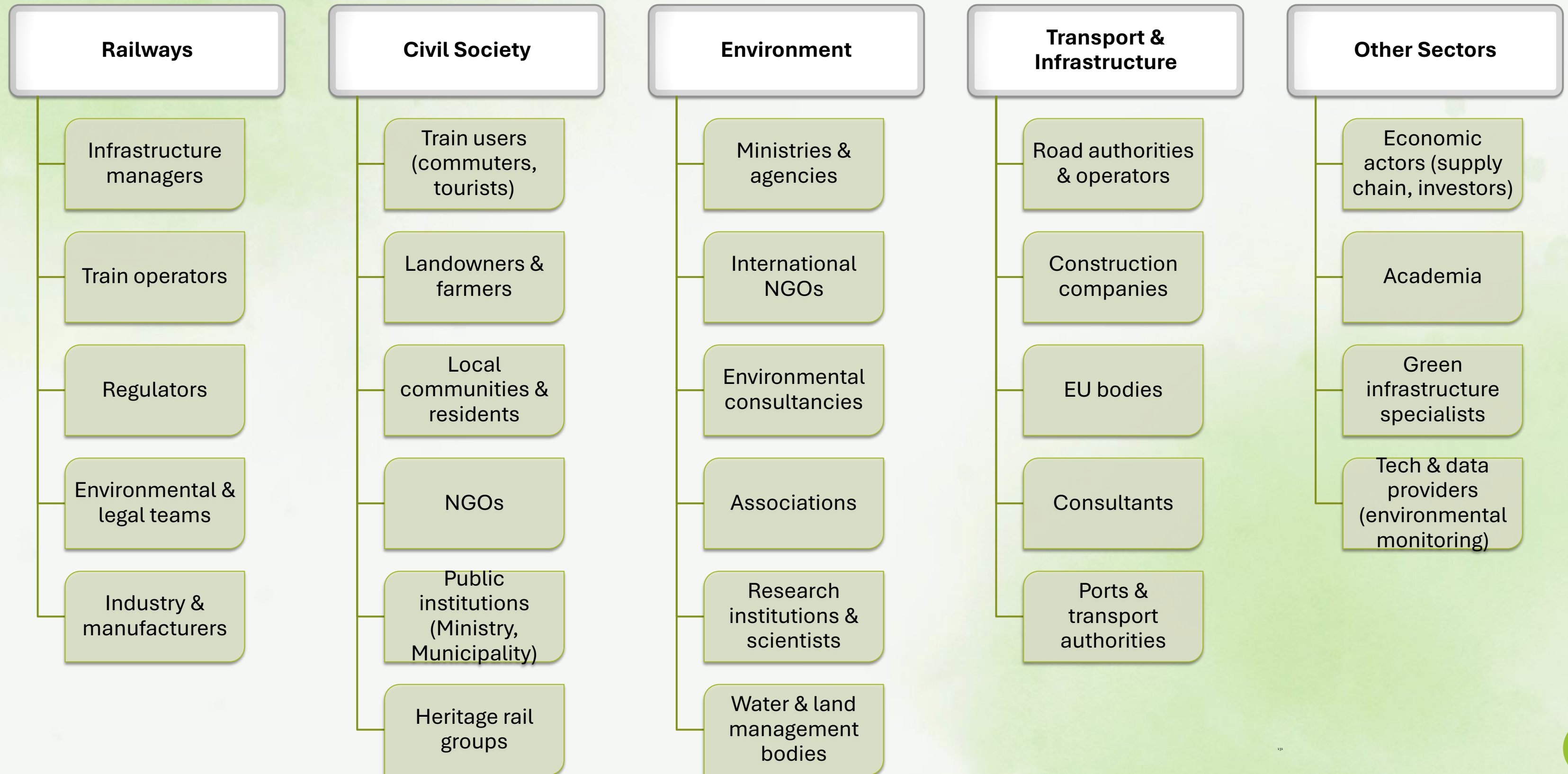
- Visibility and positioning within a network of experts.
- Participation in the validation of real-world solutions for the sector.
- Access to and exchange of knowledge and best practices.

Interested in joining our stakeholder group? Contact us at manuel.campos@ffe.es





Be part of the SYMBIOSIS community: Technical group profiles...

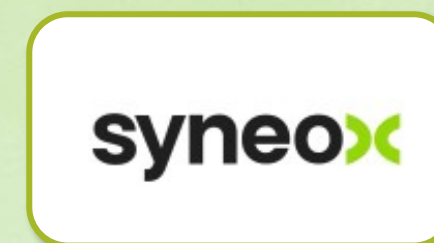


Advisory Board



Individual Members of the AB: Rowan Palmer , Suneetha Subramanian

Technical Stakeholder Group



25 stakeholders + other external collaborating organizations





Thank You

SYMBIO^{IS}  SIS