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Research and Innovation

CORDIS Results Pack on

innovative solutions for biodiversity monitoring

New monitoring technologies and solutions help conserve ecosystems and species

A thematic collection of innovative EU-funded research results

April 2026

Contents

Editorial

Biodiversity and ecosystems underpin life on Earth, and we depend on nature for food, medicine, energy, clean air and water, as well as security from natural disasters. The provision of ecosystem services not only sustains our quality of life and our economy, but it is also essential for our prosperity and our competitiveness. Accurate information on ecosystem condition through efficient monitoring is key to support effective conservation and restoration policy actions. This CORDIS Results Pack showcases 12 EU-funded projects that support the development of cutting-edge technologies and innovative approaches to improve biodiversity monitoring and assessment.

Essential ecosystem services such as pollination, water purification, soil fertility, disease control and climate regulation are dependent on healthy ecosystems. However, Europe's rich array of biodiversity, habitats and species is under threat due to human activities and climate change. This degradation affects our well-being and economy, as evidenced by Europe's environment 2025 (European Environment Agency - EEA).

The EU has taken action to protect and restore biodiversity and ecosystem services, with goals and targets defined in the EU biodiversity strategy for 2030. Also at global level, the COP15 under the Convention on Biological Diversity adopted the Kunming-Montreal Global Biodiversity Framework that established targets to be regularly monitored.

Concrete steps have been taken at the EU level with the implementation of the Green Deal agenda, particularly with the adoption of the EU Nature Restoration Regulation in 2024, which is now at the stage of implementation. Other important relevant EU policies and legislations include the Birds and Habitats Directives, the Water Framework Directive, the Marine Strategy Framework Directive and the EU Regulation on Invasive Alien Species. Nature credits are expected to contribute to boosting private investments in nature-positive actions in the future.

Accurate biodiversity monitoring is key to evaluating the effectiveness of biodiversity policies and measures, but it can be relatively costly if done with traditional methods. Alternative effective and affordable methods based on new technologies are therefore expected to greatly support biodiversity policies and nature-positive actions.

This Results Pack features 12 selected projects funded under the EU's Horizon Europe research programme that help to address current challenges to the protection and restoration of ecosystems. They involve designing and developing innovative technologies and approaches for monitoring, assessing, conserving and enhancing biodiversity and ecosystems at the European level.

The projects identified for this Results Pack support data collection and monitoring changes in biodiversity through the application of genomic science and other advanced technologies. They include environmental DNA analysis, which can detect endangered wildlife that is otherwise unobserved.

Other technologies involve the development of digital platforms and tools, the use of artificial intelligence and Earth observation. Some projects also provide a first assessment of the cost-effectiveness and of the potential of these new technologies and approaches to ease EU biodiversity monitoring for policies.

By providing crucial insights into the drivers of ecosystem degradation, these initiatives can revolutionise the way biodiversity is studied and understood, contributing to informed policymaking for the protection, restoration and sustainable use of biodiversity and ecosystems.

Accelerating the inventory of life on Earth through genomics

Genomic technologies are transforming our understanding of biodiversity, unlocking hidden species diversity and laying new foundations for conservation efforts.

An estimated 25 % of known species are threatened with extinction, according to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). To prevent this loss, not only must we protect habitats but also gain a far deeper understanding of what species exist, how they function and how they respond to rapid environmental change. However, biodiversity information remains fragmented, limiting the effectiveness of conservation and restoration efforts.

A genomic step change for biodiversity knowledge

The EU-funded BGE project was launched to close this gap by accelerating the application of genomic science to biodiversity research, monitoring and management. The project brings together

33 partners from 20 countries, uniting research institutes, museums, sequencing centres and biodiversity experts. BGE employs complementary genomic approaches, DNA barcoding and full reference genome sequencing into a single coordinated European effort.

DNA barcoding enables rapid species identification using short DNA sequences, while reference genome sequencing decodes entire genomes, revealing how species function and adapt. By aligning these approaches, BGE opens the door to a major shift in how biodiversity is characterised, monitored and protected across Europe.

Scaling up data generation across Europe

From the DNA barcoding perspective, the project has focused strongly on building a pan-European community of practice for DNA barcoding, enabling the sharing of samples, expertise and data through initiatives such as iBOL Europe. This collaboration is essential given the urgency and scale of biodiversity loss. BGE's barcoding stream has also had a major focus on upscaling the generation of DNA sequencing of museum specimens.

"BGE efforts in this area capitalise on the hundreds of millions of specimens held in European museums," explains Peter Hollingsworth, leader of the DNA barcoding stream. "It is a major step forward in building a DNA-based reference library of European biodiversity to support rapid species identification."

"By fostering knowledge exchange among sequencing centres and implementing a collaborative 'buddy system' for genome assembly review, BGE has improved problem-solving and ensured that genome assemblies meet global standards," outlines Camila Mazzoni, leader of the genome sequencing stream.

From genomic data to real-world applications

While many barcoding datasets have only recently been completed, their future impact is already clear. Curated genomic resources for European pollinators will serve to underpin monitoring of insect health in Europe.

Reference genome data are already informing more immediate management decisions. Genomes generated for species such as Atlantic mackerel and Culex mosquitoes allow the identification of single nucleotide polymorphisms (a form of DNA variation) that can be used for example to improve fisheries management or track insecticide resistance respectively.

A model for coordinated European action

The most significant achievement of BGE is demonstrating that genomic research for biodiversity can be scaled through coordinated European action.

BGE is building a model for scaling genomic knowledge production while ensuring that data and infrastructure are shared efficiently.

"BGE is building a model for scaling genomic knowledge production while ensuring that data and infrastructure are shared efficiently," highlights Dimitris Koureas, BGE director and scientific coordinator.

As BGE concludes, the plan is to continue its legacy through sustainable mechanisms for cross-border collaboration, innovation and policy alignment. Together, these efforts aim to lay the foundations for a future European research infrastructure in biodiversity genomics that will contribute to biodiversity restoration and conservation.

PROJECT
BGE – Biodiversity Genomics Europe

COORDINATED BY
Stichting Naturalis Biodiversity Center in the Netherlands

FUNDED UNDER
Horizon Europe – Food, Bioeconomy, Natural Resources, Agriculture and Environment

CORDIS FACTSHEET
cordis.europa.eu/project/id/101059492

PROJECT WEBSITE
biodiversitygenomics.eu/

Filling the knowledge gap in marine biodiversity

An extensive sampling expedition coupled with data harmonisation and outreach efforts provides actionable information on the health of marine ecosystems throughout Europe and beyond.

This is a time of extraordinary environmental change all around the world. Scientists estimate that only 13 % of the world's oceans are unaffected by human activity. To preserve and protect these natural resources, local residents, scientists and policymakers need to understand what is happening in marine environments.

The EU-funded BIOcean5D project sought to understand how space, time and human activity impact marine life. The project brought together a diverse team of experts from 11 countries to collect information, harmonise multi-method data streams, and provide indicators and theoretical frameworks to guide governance.

The sampling strategy was designed to encompass various habitats and geomorphologies, including areas impacted by human activity, as well as pristine environments and sharp climate gradients – ranging from brackish waters in the Baltic Sea to hyper-saline warm waters in the Mediterranean.

Sampling and the TREC/Tara Europa expedition

At the core of BIOcean5D are over 70 000 samples gathered by the TREC/Tara Europa expedition. Involving 21 coastal countries and 35 marine labs, the expedition ranged from the Arctic seas to the Mediterranean, contributing the largest data collection on marine biodiversity ever gathered.

The expedition collected information on a wide range of species and their habitats. The sampling strategy was designed to encompass various habitats, ranging from areas impacted by human activity to pristine environments. The diverse marine environments sampled stretch from the brackish waters in the Baltic Sea to the warm, hypersaline waters in the Mediterranean.

The TREC/Tara Europa expedition was not the only data collection effort. Sixty sediment cores were taken from 12 sites along the European coastline, providing insight into environmental histories reaching back over 100 years. The team also compared data gathered over recent decades, such as plankton time series collected at marine stations in France and Italy. Outside of Europe, the project focused on tropical coral holobionts in French Polynesia and deep-sea organisms in the Mid-Atlantic Ridge.

Building a data hub to guide marine governance

BIOcean5D gathered a vast amount of data using multiple methods, including sediment samples, time series, acoustic sensing and eDNA. The project integrated all the data gathered plus existing marine biodiversity information into one open-access data hub.

This hub brings together expertise in microbiology, macroecology and taxonomy to harmonise multi-method data streams that range from molecular omics to imaging and acoustics on a common metadata framework. This single, interoperable knowledge base enables partners to fill knowledge gaps through comparison across different technologies.

The harmonised BIOcean5D data hub has enabled models and frameworks of marine life that will guide governance actions to protect marine habitats. A notable contribution is the JEDI metabarcoding marker, a simple and effective assessment tool for monitoring biodiversity. The project also recommends reimagining the way marine protected areas (MPAs) are designated. By using the wealth of data increasingly available, a move away from static to dynamic boundaries is appropriate for MPAs.

The project is dedicated to sharing results with diverse audiences. Articles, workshops and volunteer participation brought the scientific community, policymakers and citizen scientists together. By sharing low-cost, open-source tools with marine scientists and institutions that work with people who make a living from the sea, BIOcean5D has laid the foundation for a long-term European coastline monitoring network.

PROJECT

BIOcean5D – MARINE BIODIVERSITY ASSESSMENT AND PREDICTION ACROSS SPATIAL, TEMPORAL AND HUMAN SCALES

COORDINATED BY

European Molecular Biology Laboratory in Germany

FUNDED UNDER

Horizon Europe – Food, Bioeconomy, Natural Resources, Agriculture and Environment

CORDIS FACTSHEET

cordis.europa.eu/project/id/101059915

PROJECT WEBSITE

biocean5d.org/

Living sensors meet robotics for aquatic biodiversity monitoring

Using biohybrid robots, an EU-funded project offers a new way to track aquatic biodiversity and detect ecosystem responses to climate change.

Imagine robots that use living organisms as sensors, continuously monitoring the health of lakes and oceans. The EU-funded BioDiMoBot project is working towards this vision through the development of biohybrid robots that combine biology, engineering and artificial intelligence to monitor biodiversity and water quality in a novel way.

Traditional monitoring of aquatic biodiversity relies largely on technical sensors and laboratory-based chemical analyses that are expensive, labour-intensive and typically carried out at isolated time points. While these methods provide precise measurements of individual parameters, they often miss the biological responses that reflect how ecosystems function.

“BioDiMoBot was designed to address these limitations by developing biohybrid monitoring systems that use living organisms as sensing elements, thereby complementing existing technologies with biologically integrated, cost-effective and scalable monitoring solutions,” says project co-coordinator and biologist Wiktoria Teresa Rajewicz.

Living sensors in action

BioDiMoBot’s system combines advanced sensors with optic and sensing technologies in novel ways. Living aquatic organisms are embedded as biohybrid sensors.

“Biohybrid sensors combine the sensitivity of living organisms with the robustness of electronic systems,” explains Rajewicz. “Coupled with optical and electronic readout units, they allow us to automatically record their behavioural and physiological responses to multiple environmental stressors and transmit them in real time as digital data.”

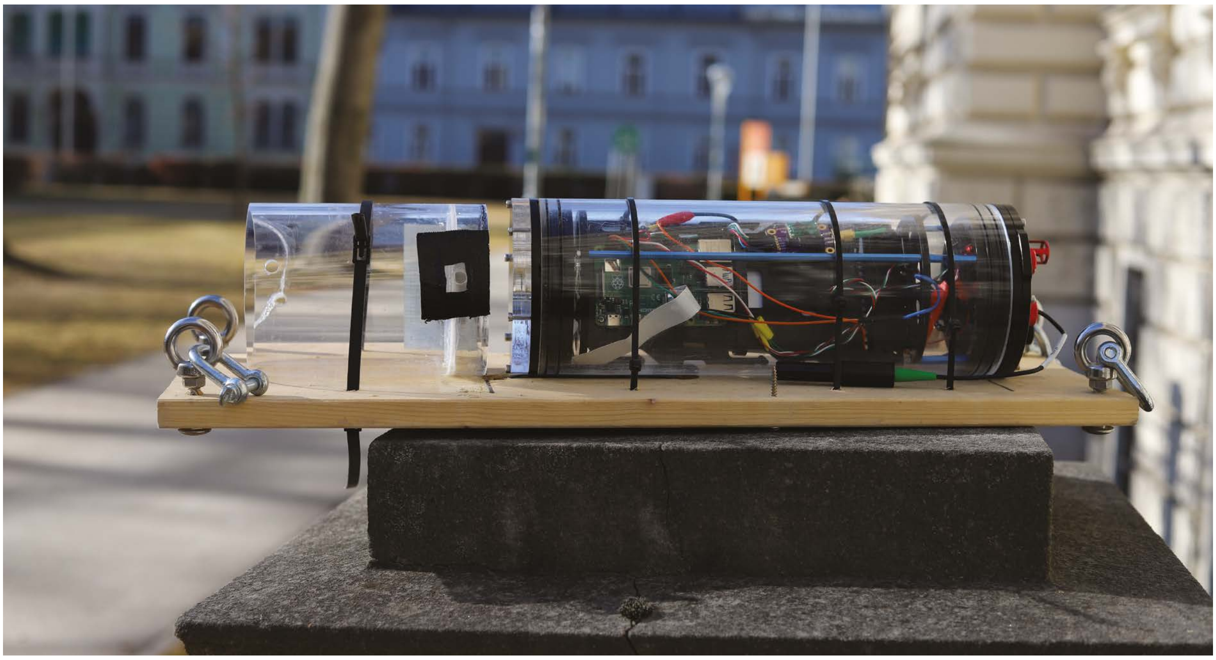
One example is a Daphnia module, which combines a small cage hosting Daphnia – commonly known as water fleas – with an electronic core containing a camera and a single-board computer. As water flows through the cage, the system records the animals’ swimming behaviour and analyses it automatically. Changes in their movement patterns provide information on the combined effects and bioavailability of substances in the environment, offering direct insight into water quality.

The system’s data streams can reveal early warning signals of ecosystem stress and long-term ecological trends. “This kind of data supports climate change impact assessment, informs adaptive management strategies and helps guide mitigation and conservation actions,” adds Rajewicz.

Tracking environmental change over time

Understanding aquatic ecosystems requires observation over long periods, as environmental pressures linked to climate change can emerge slowly, appear only during extreme events or result from several stressors occurring simultaneously. Monitoring based on short-term or occasional sampling poses a risk of overlooking trends, thresholds or early warning signals of ecosystem degradation.

Instead of measuring isolated parameters, the project’s approach, which relies on living organisms, reflects how environmental conditions are experienced by aquatic life as a whole. These organisms capture the effects of physical, chemical and biological factors over time. As Rajewicz says, “By enabling continuous, real-time observation without the need for



By enabling continuous, real-time observation without the need for frequent human intervention, BioDiMoBot's autonomous biohybrid systems provide a more holistic and temporally resolved understanding of ecosystem health and aquatic biodiversity.

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BioDiMoBot builds on earlier work from the Robocoenosis project, shifting the focus to broader biodiversity and water quality monitoring. While the full prototype is currently under development, key system components have already been partially validated.

The project's biohybrid systems were tested both in controlled laboratory conditions and in real freshwater environments, including Lake Millstatt, Lake Neusiedl and local ponds in Austria, as well as bays in Greenland. Field trials evaluated system stability, data quality and organism responses under natural environmental variability.

Preliminary results have been encouraging, showing that biohybrid monitoring systems can operate reliably over extended periods while capturing biologically meaningful responses to environmental change. These findings demonstrate how biohybrid robots could complement existing monitoring approaches, supporting more informed biodiversity assessment and climate change research.

PROJECT
BioDiMoBot – Autonomous Longtime Aquatic Biodiversity and Ecology Monitoring Robot

COORDINATED BY
University of Graz in Austria

FUNDED UNDER
Horizon Europe – Food, Bioeconomy, Natural Resources, Agriculture and Environment

CORDIS FACTSHEET
cordis.europa.eu/project/id/101181363

PROJECT WEBSITE
biodimobot.eu/

How countries align biodiversity monitoring across Europe

A European partnership is turning fragmented national monitoring into shared protocols, repeatable pilots and guidance across invasive alien species, pollinators and DNA-based plant tracking.

Biodiversity policy often depends on data collected differently across countries. Species lists, survey effort and reporting cycles vary, making it hard to compare trends, spot emerging risks or coordinate action across borders.

Building a shared backbone for observation across countries

The European Biodiversity Partnership, Biodiversa-plus, brings together research funders and environmental authorities to improve the monitoring of biodiversity and ecosystem services across Europe. The partnership focuses on coordination and harmonisation: agreeing on what needs to be measured, testing approaches in practice and helping countries adopt methods that fit real budgets and responsibilities.

Biodiversa-plus has brought data producers, data users and EU bodies together for the first time.

For monitoring, the first step is to get the right people in the same room, agree on shared obligations and define clear use cases. Petteri Vihervaara, who leads the monitoring workstream of the EU-funded Biodiversa-plus project, explains that "Biodiversa-plus has brought data producers, data users and EU bodies together for the first time." That shift matters because it moves monitoring away from after-the-fact comparisons of national datasets and towards co-designed frameworks in which partners can agree on requirements, variables and minimum common denominators.

In practice, this work is being trialled through thematic monitoring pilots built on standardised protocols. All partners follow the same methodology, launched simultaneously and supported by central coordination, with only minimal adaptation to local conditions. This goes beyond harmonising pre-existing approaches: it generates directly comparable data from the outset, while still ensuring outputs meet policy and reporting needs.

A monitoring pilot for invasive alien species

One pilot focuses on invasive alien species (IAS), where speed and consistency are essential. It was designed to test repeatable, scalable approaches that work within existing reporting cycles, while acknowledging uneven national capacities, data gaps and costs. The aim is to translate pilot outputs into routine national monitoring by providing protocol templates, workflows with cost estimates, and practical guidance.

Automation is a key part of that plan. Toke Thomas Høye, who coordinates Biodiversa-plus's invasive alien species monitoring pilot, notes: "Using automated image recognition in an operational context will speed up and standardise the timely mass-monitoring of specific invasive alien species by delivering high-quality monitoring data." The same processes can also be adapted for other data modalities (e.g. sound) and other taxa, helping countries expand monitoring coverage without relying only on labour-intensive fieldwork.

Linking funded projects to a more usable evidence base

Biodiversa-plus also supports funded projects that tackle monitoring gaps and make outputs more comparable. ANTENNA, a Biodiversa-plus-funded project on pollinator monitoring, is developing transnational data pipelines to turn observations into curated datasets and policy-relevant indicators. This connects to priorities such as insects, habitats, common species and protected areas, while involving scientists, NGOs, citizen scientists and policymakers so that tools can be implemented outside research settings.

For DNA-based monitoring, MetaPlantCode, a Biodiversa-plus-funded project focused on harmonising plant metabarcoding pipelines, is working on 'good enough', fit-for-purpose alignment. Project coordinator Birgit Gemeinholzer frames what adoption requires: "'Good enough' harmonisation for plant metabarcoding would mean that, rather than enforcing identical methods, best practice recommendations (lab methods, reference databases, bioinformatic pipelines) have to be agreed upon that are both scientifically robust and usable by diverse users, from research labs to monitoring agencies and other practitioners."

The goal is to agree on data and metadata standards so results can be shared through GBIF, the Global Biodiversity Information Facility, and interpreted consistently for practical use. Beyond monitoring methods, the partnership also aims to make biodiversity information easier to find and link to decision-making needs, including in areas such as finance and sustainability reporting.

PROJECT
Biodiversa-plus – The European Biodiversity Partnership

COORDINATED BY
La Fondation pour la recherche sur la biodiversité in France

FUNDED UNDER
Horizon Europe – Food, Bioeconomy, Natural Resources, Agriculture and Environment

CORDIS FACTSHEET
cordis.europa.eu/project/id/101052342

PROJECT WEBSITE
biodiversa.eu/

Building better biodiversity monitoring systems for farmers

Traditional biodiversity indicator systems combined with new monitoring technologies shed light on how agricultural practices in a range of habitats affect species diversity.

Through pollination and pest control, many species have a positive impact on farming. But unsustainable agricultural practices are responsible for reduced biodiversity on cultivated land, undercutting the valuable contributions of insects and other organisms to food production.

The EU-funded BioMonitor4CAP project has introduced several new technologies, many of them nearly autonomous, to create a strong database of biodiversity observations. The project aims to improve biodiversity monitoring systems and empower evidence-based decision-making by policy makers and farmers.

A range of agro-ecosystems

With a consortium of 23 partners from 10 countries, BioMonitor4CAP sought to test instruments in a variety of landscapes. The project is focused on improving observations in four key areas: land cover, soils, insects and birds. Test sites are located in nine European countries and Peru, a country with very high biodiversity.

Field sites include vineyards, grassland, coastal heathland, agro-forestry and field crops. The variety of landscapes provides a broad view of biodiversity in agricultural contexts but also helps researchers identify which methods perform best under different conditions.

New tools in biodiversity monitoring

Existing monitoring systems indicate that agriculture practices can have a negative impact on biodiversity. For example, the farmland bird index shows a 42 % decline in farmland bird populations over the past three decades. But to better understand – and mitigate – the interplay between biodiversity and agriculture, more advanced monitoring systems are needed.

BioMonitor4CAP has gathered information using a variety of optical and acoustic sensors, drones and passive collections traps. "We have used hundreds of small, light-weight time-lapse cameras to photograph insects visiting plants and deployed hundreds of acoustic sensors to record bird songs. These devices are easy to install and compatible with agricultural operations," explains project coordinator Christoph Scherber.

AI-powered identification and molecular characterisation of soil samples also improve monitoring systems. "We have used a new molecular biodiversity technique called environmental DNA (eDNA) to develop soil biodiversity indicators, including metrics for species richness and community composition," Scherber shares. "Samples can be taken by anyone, preserved in a special buffer solution, and can be transported across Europe without requiring a cold chain for transportation."

We urgently need affordable monitoring technologies for farmland. The project has allowed us to test hundreds of devices and exciting new technologies across Europe, paving the way towards results-based agri-environment strategies in the future.

The project's website hosts an agrodiversity database where users can explore biodiversity observations and indicators. Through conferences, workshops and scientific publications, BioMonitor4CAP seeks to disseminate the project's work and encourage its replication.

Leveraging eDNA and other new technologies, BioMonitor4CAP points the way to improved agricultural practices. Solutions include reduced chemical output, high nature value farming, crop diversification and integrating trees into pastures and fields.

As Scherber says: "We urgently need affordable monitoring technologies for farmland. The project has allowed us to test hundreds of devices and exciting new technologies across Europe, paving the way towards results-based agri-environment strategies in the future."

Stakeholder engagement to improve agricultural practices

Farmers care about the land and want to know more about biodiversity and how to move away from unsustainable practices. However, farming is labour-intensive and stakeholders need tools that will not add to their workload. Many of the devices introduced by BioMonitor4CAP do not require human interaction once installed. Cameras and microphones provide information for AI-based identification, and drones, which can carry these sensors to remote locations, extend monitoring systems to hard-to-reach locations.

PROJECT
BioMonitor4CAP - Advanced biodiversity monitoring for results-based and effective agricultural policy and transformation

COORDINATED BY
Leibniz Institute for the Analysis of Biodiversity Change in Germany

FUNDED UNDER
Horizon Europe - Food, Bioeconomy, Natural Resources, Agriculture and Environment

CORDIS FACTSHEET
cordis.europa.eu/project/id/101081964

PROJECT WEBSITE
biomonitor4cap.eu/en/

New AI maps help protect biodiversity across sectors

Satellite and citizen data feed scalable biodiversity indicators, helping planners, consultants and managers compare risks, target surveys and act sooner.

Biodiversity decisions often depend on incomplete data. A site might have a few surveys conducted in different years by different teams using different methods. This makes it difficult to compare locations, spot trends early and explain trade-offs when new infrastructure, land use or conservation measures are being considered.

The EU-funded GUARDEN project set out to improve the situation with a practical monitoring toolbox. By combining satellite-based indicators, AI modelling, citizen-science platforms, acoustic sensors and augmented reality tools, it aims to enable more frequent updates to biodiversity and ecosystem services information and to support the application of that information in real-world planning.

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In real-world conditions, the combination of Earth observation data with AI-based ecological modelling proved to be one of the most robust and scalable monitoring approaches within GUARDEN.

Satellite and AI indicators that scale across landscapes

GUARDEN's most consistent results came from combining Earth observation with AI-based ecological modelling. As project coordinator Pierre Bonnet explains, "In real-world conditions, the combination of Earth observation data with AI-based ecological modelling proved to be one of the most robust and scalable monitoring approaches within GUARDEN." Those satellite-derived habitat indicators were designed to be repeatable across different landscapes and governance contexts, supporting comparisons between areas and scenarios.

To make the outputs easier to use, GUARDEN made its map set accessible through the GeoPl@ntNet web mapping tool. The approach works best for landscape-scale patterns and trend tracking, while fine-scale local features and rare species can still be hard to capture without targeted fieldwork.

Blending methods to reduce blind spots

GUARDEN treated monitoring as a combination problem, because each method breaks in a different way. Citizen science observations via specific platforms, namely MINKA and Pl@ntNet, can provide valuable field records; however, they are sensitive to uneven sampling effort and observer bias. Acoustic sensors can be highly repeatable, but performance drops when recordings are masked by wind, rain and machinery or when target species are rare.

The project's takeaway is blunt: "One key lesson was that no single monitoring method is sufficient on its own. The most reliable results emerged when tools were explicitly combined, with each one compensating for the blind spots of the others," says Bonnet. Before data entered models, GUARDEN added quality-control layers including duplicate and anomaly checks, confidence scoring for identifications, uncertainty thresholds, and cross-validation using reference datasets and expert-reviewed samples.

Ground validation, benchmarking and what changed on the ground

Validation was iterative, mixing targeted field surveys, existing monitoring programmes, expert assessments and citizen observations. A notable technical step was benchmarking GUARDEN's deep learning framework through the GeoLifeCLEF and PlantCLEF international challenges, providing external performance benchmarks and helping calibrate models.

When the maps and field observations diverged, the response was to diagnose and adjust rather than discard. Bonnet notes, "When discrepancies emerged between field observations and model outputs, they were treated as signals for improvement rather than failures." Causes included training data gaps, scale effects and local management factors, with local refinements made where needed, including for legal expectations.

In practice, GUARDEN outputs informed route option reviews for transport infrastructure, helped concentrate field surveys on model-flagged hotspots, supported management prioritisation in peri-urban habitats and enabled quicker flagging of potentially invasive species using citizen data.

PROJECT
GUARDEN – safeGUARDing biodivErsity aNd critical ecosystem services across sectors and scales

COORDINATED BY
Centre de coopération internationale en recherche agronomique pour le développement in France

FUNDED UNDER
Horizon Europe - Food, Bioeconomy, Natural Resources, Agriculture and Environment

CORDIS FACTSHEET
cordis.europa.eu/project/id/101060693

PROJECT WEBSITE
guarden.org/

New AI tools for monitoring Europe's protected nature

AI tools turn camera images and sound recordings into usable biodiversity data, helping nature managers track species and habitat health across Europe.

Biodiversity monitoring often falls short because nature is vast, field capacity is limited and many species are present only at certain times or under specific conditions. The EU-funded MAMBO project is developing tools that use cameras, sound recorders and remote sensing to help agencies and site managers track species and assess habitat conditions more frequently, across larger areas and with less manual work.

AI that recognises species from photos and sound

MAMBO has contributed to better performance in widely used identification and mapping services, including Pl@ntNet,

Observation.org and GeoPl@ntNet. In real-world terms, automated detection in images can work well, but reliable identification depends on the species group and the available training data. Project coordinator Toke Thomas Høye explains: "For animals, the detection level is generally satisfactory, but for identification, recognition works best for birds and moths, while recognition of, for example, some bat species from ultrasound and many other insect groups from images remains challenging."

The project also developed tools that can analyse a whole vegetation plot from a single image, helping standardise plant surveys and reducing the burden on expert botanists.

Habitat condition maps from LiDAR, drones and satellites

Species data is only half the picture. Protected areas also need habitat condition metrics that are comparable across sites and countries. MAMBO developed a pipeline to extract vertical woody structure metrics from airborne LiDAR and scaled it up using national LiDAR surveys. It also explored drone workflows, for example, estimating shrub cover and biomass in rewilding sites, mapping dead wood in woodlands and detecting large mammal tracks in reedbeds.

The scalable technology developed for species and habitat mapping has allowed access to consistent predictions covering Europe at an unprecedentedly high spatial resolution of 50 m, which cannot be achieved by traditional in situ biodiversity monitoring.

A major gain is consistent coverage at fine detail. As the team notes, "By capitalising on existing satellite imagery and biodiversity data, the scalable technology developed for species and habitat mapping has allowed access to consistent predictions covering Europe at an unprecedentedly high spatial resolution of 50 m, which cannot be achieved by traditional in situ biodiversity monitoring." Keeping maps current still requires updated satellite inputs and continued ground observations for training and evaluation.

From research pipelines to usable tools, and what comes next

Many AI workflows work well on a laptop but struggle in real operations, where teams need simple interfaces, clear outputs and support. MAMBO flagged that gap early: "A key challenge has been to combine the latest AI developments and functionality with user-friendly tools for accessing the results in formats relevant to stakeholders," project participant Niels Raes underlined.

Several outputs are already usable. The project provides a tutorial and a public web app for image-based plant-quadrat surveys, and GeoPl@ntNet lets users visualise and summarise habitat and plant species predictions at different spatial scales. MAMBO's LiDAR workflow has been applied across multiple European demonstration sites and produces harmonised metrics describing vegetation height, cover and structural complexity.

MAMBO's tools will also feed into the Biodiversity Meets Data (BMD) project, which will create a centralised digital platform – the Single Access Point – for high-throughput monitoring by Natura 2000 managers and policymakers. This project is coordinated by Niels Raes. In that set-up, MAMBO's image and sound algorithms support (semi)automated identification from camera-trap images and recordings, while BMD focuses on packaging tools, data and analyses into an access point that supports reporting under the EU Nature Directives.

PROJECT
MAMBO - Modern Approaches to the Monitoring of BiOdiversity

COORDINATED BY
Aarhus University in Denmark

FUNDED UNDER
Horizon Europe - Food, Bioeconomy, Natural Resources, Agriculture and Environment

CORDIS FACTSHEET
cordis.europa.eu/project/id/101060639

PROJECT WEBSITE
mambo-project.eu/

Bringing marine biodiversity into focus with new technologies

Europe's seas are under growing pressure from anthropogenic activity. New genomic and sensor technologies are transforming how we monitor marine biodiversity.

Currently, only 2 % of EU seas are covered by marine protected areas, whereas since 1970 there has been a decline of more than 70 % in the average size of wildlife populations. Despite these dismal statistics and need for conservation, marine biodiversity data remain fragmented, unevenly accessible and difficult to integrate across borders. As a result, there is an imminent need for monitoring fisheries, protecting endangered species and restoring habitats.

Connecting fragmented observation systems

The EU-funded MARCO-BOLO project set out to change this by connecting existing observation capacity, improving technologies and aligning biodiversity monitoring with European and global standards. The project focused on improving access to biodiversity data, developing new monitoring technology and generating predictive models. "Our goal was to strengthen Europe's base for marine biological observation," outlines project coordinator Nicolas Pade.

Although Europe has extensive monitoring programmes, lack of coordination across national and regional schemes limits their collective impact. The project's findings indicate that stronger cross-border coordination could substantially improve biodiversity assessments, particularly in freshwater and coastal systems. To improve data access and reuse, the consortium utilised various platforms (EMODnet, OBIS and GBIF).

Technological innovations

On the technological front, MARCO-BOLO has tested and integrated a range of advanced tools for biodiversity mapping and monitoring. Environmental DNA has been extensively evaluated, demonstrating reliability comparable to traditional sampling methods and, in some cases, superior performance for detecting rare, cryptic or microscopic species.

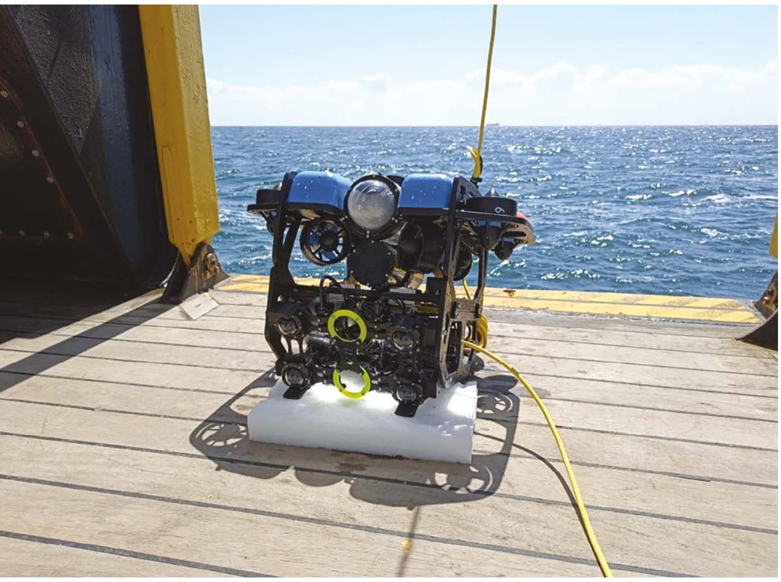
A unique development in MARCO-BOLO is the design of software that allows many sensors deployed at the same time to communicate and ensure the accurate geolocation of all samples.

The project has also integrated satellite remote sensing with genomic observations to improve predictions of plankton bloom composition.

"A unique development in MARCO-BOLO is the design of software that allows many sensors deployed at the same time to communicate and ensure the accurate geolocation of all samples," highlights Pade. Large-scale field deployments in the North Sea, involving research vessels, moored instruments and autonomous vehicles, demonstrated the feasibility of integrated, cost-effective monitoring systems.

Engaging stakeholders and shaping governance

Recognising that data only matter if they are used, MARCO-BOLO established a community of practice to connect data generators with policymakers, environmental agencies and other end users.



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"The aim was to engage with different marine stakeholders to understand their needs and bottlenecks in getting information and data products to the right people and in the right formats," explains Pade.

Collaboration with initiatives such as Biodiversa-plus, OBAMA-NEXT and BioEcoOcean has strengthened links to European and global observation frameworks, including GOOS and GEO BON. These interactions revealed a significant knowledge gap in marine biodiversity within parts of the policy community, underlining the importance of capacity building and clear communication.

A foundation for future monitoring

Beyond specific technologies, MARCO-BOLO's broader success lies in demonstrating that coordinated European action can enhance marine biodiversity observation. By improving data accessibility and advancing multi-sensor integration, the project has raised the standard for biological monitoring across coastal and oceanic waters.

According to Pade: "The real achievement of MARCO-BOLO is not just collecting more data but integrating biological monitoring into Europe's observation systems in a coherent and standardised way." The project now calls on national programmes and EU institutions to build on its recommendations, ensuring that Europe implements marine biodiversity monitoring considering the accelerating environmental change.

PROJECT
MARCO-BOLO - MARine COastal BiOdiversity Long-term Observations

COORDINATED BY
European Marine Biological Resource Centre, European Research Infrastructure Consortium in France

FUNDED UNDER
Horizon Europe - Food, Bioeconomy, Natural Resources, Agriculture and Environment

CORDIS FACTSHEET
cordis.europa.eu/project/id/101082021

PROJECT WEBSITE
marcobolo-project.eu/

Digital intelligence and forensics prevent biodiversity loss

A new predictive platform helps conservationists anticipate poaching, habitat loss and wildlife conflicts across Europe using digital twins, AI and near real-time biodiversity monitoring.

What if biodiversity loss could be detected before it becomes visible on the ground? Conservationists are confronted with fragmented data, delayed responses and growing pressures on ecosystems – challenges that demand preventing damage instead of reacting to it.

The platform has enabled nature conservation practitioners to centralise and align data in one system, integrate information from multiple sources and conduct more effective analyses and risk assessments, ultimately supporting better-informed and more timely management decisions.

The EU-funded NATURE-FIRST project set out to make biodiversity monitoring near real-time, detect changes at an early stage and translate predictions into timely, actionable interventions. The project combines remote sensing technologies with environmental forensics; a discipline focused on analysing evidence to prevent wildlife and environmental crime.

These methods are brought together through a conservation technology platform supporting data collection, monitoring, insights, analysis and reporting. "The platform has enabled nature conservation practitioners to centralise and align data in one system, integrate information from multiple sources and conduct more effective analyses and risk assessments, ultimately supporting better-informed and more timely management decisions," says project coordinator Jan-Kees Schakel.

NATURE-FIRST delivered results across four nature reserves in four countries: Stara Planina Mountain in Bulgaria, Ancares-Courel in Spain, the Danube Delta in Romania and the Maramures Transboundary Area in Romania and Ukraine.

Turning biodiversity data into predictive intelligence

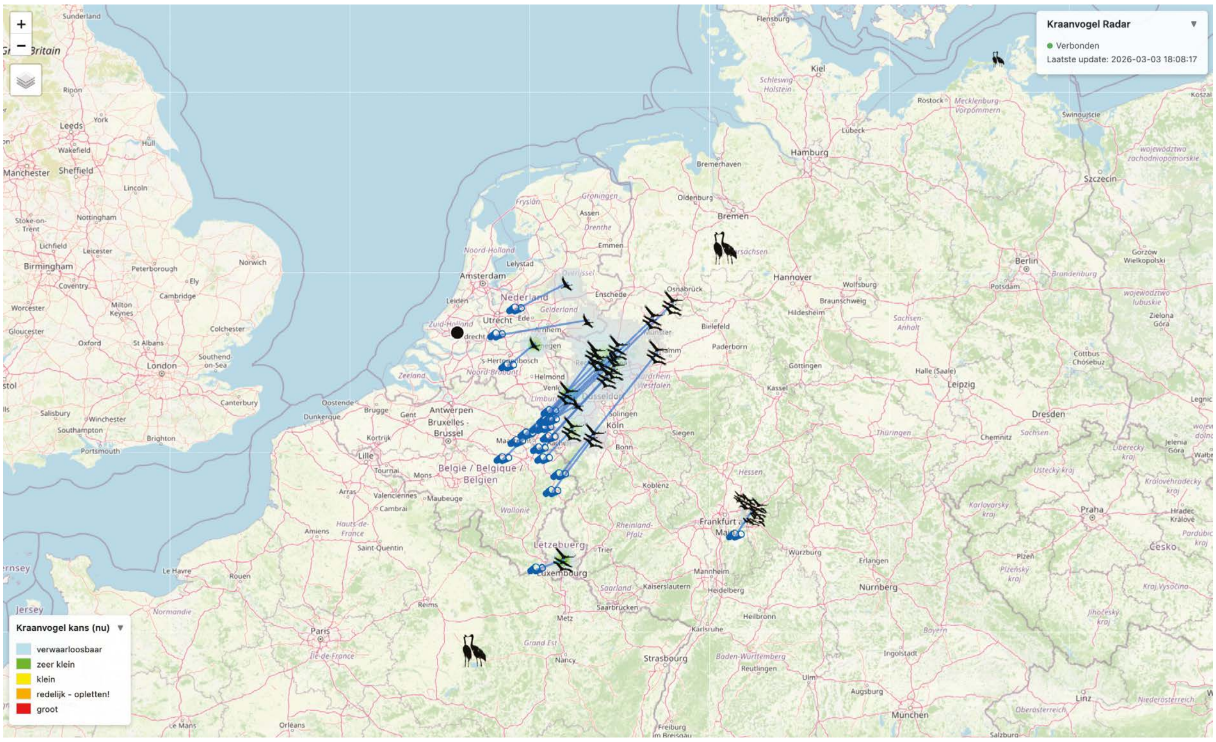
The platform integrates field data from multiple sources, including data collection apps, animal trackers, camera traps and open-source datasets. Using AI, it provides real-time monitoring, advanced analysis and reporting.

One of the project's most significant innovations is the use of digital twins: data-driven virtual representations of species or ecosystems that are continuously updated as new information becomes available. In the Danube Delta, a digital twin developed for sturgeons improves predictions of spawning periods, allowing stakeholders to anticipate poaching risks or habitat disturbances and strengthen protection measures when and where they are most needed.

In Bulgaria, a digital twin was explored to forecast potential human-bear conflicts. While not fully implemented in Stara Planina, the basic models were adapted to other field sites, supporting preventive action for decision-makers managing human-wildlife issues.

Insights from European reserves

Across the project's demonstration areas, the platform generated new insights into ecosystem change. In Ukraine, it improved understanding of large carnivore movements and behaviour, identifying drivers of human-wildlife conflicts, particularly involving farmers and beekeepers.



In Romania, it clarified the dynamics and seasonality of bear movements, improving patrolling efforts in sensitive areas. In Bulgaria, ecological and anthropogenic data enabled early detection of vegetation trends and disturbances.

In Spain, continuous automated habitat mapping highlighted the impact of rural depopulation, abandonment of agrarian activities, changes in forestry practices and forest fires, while also revealing the recovery of brown bear breeding in the region.

From evidence to action

Environmental forensics was another pillar of NATURE-FIRST. By combining ecological data with forensic methods, the project helps transform field observations into legally valid evidence. Targeted training programmes equipped rangers and conservation staff with criminal investigation skills, strengthening deterrence, reducing enforcement costs and supporting compliance with EU environmental regulations.

The project also showed that digital tools succeed when grounded in local knowledge and supported by training, trust and clear benefits for stakeholders. As Schakel notes, the platform is “highly flexible, adaptable and works with any ecosystem, in any region within and beyond Europe, with any species.”

Partners are now working to integrate these predictive tools into conservation management across Europe, expanding them to new regions, ecosystems and organisations.

PROJECT

NATURE-FIRST – Forensic Intelligence and Remote Sensing Technologies for nature conservation

COORDINATED BY

Stichting Sensing Clues in the Netherlands

FUNDED UNDER

Horizon Europe – Food, Bioeconomy, Natural Resources, Agriculture and Environment

CORDIS FACTSHEET

cordis.europa.eu/project/id/101060954

PROJECT WEBSITE

naturefirst.info/

Making sense of ocean observations

A toolbox that integrates new technologies with existing marine observation techniques to deliver maps, models and indicators helps safeguard marine environments.

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In the fight against climate change, managing marine resources and biodiversity is essential. But for an environment to be well-protected, it must first be understood. To this end, the EU-funded OBAMA-NEXT project has developed information products readily accessible to stakeholders involved in protecting marine habitats.

New tools for describing marine ecosystems

Improving the quality and quantity of ocean observations is a long-standing goal, both in Europe and around the world. Since 1991 the Global Ocean Observing System (GOOS) has been gathering data to inform stakeholders about ocean health, empower weather monitoring and provide predictive assessments related to climate change.

The most important contribution from OBAMA-NEXT is the development of standardised algorithms for translating 'raw data' into information.

OBAMA-NEXT brings next-generation tools to this endeavour. Satellites, drones and in situ data collection provide important information, as do eDNA and applications of algorithm-driven machine learning and statistical modelling. As project coordinator Jacob Carstensen shares: "The most important contribution from OBAMA-NEXT is the development of standardised algorithms for translating 'raw data' into information."

A focus on information products

Technical advances have enabled data collection, but raw data need processing to be useful for policymakers and most other stakeholders involved in the stewardship of marine environments. "The success of OBAMA-NEXT is through turning observations into information," Carstensen explains. "Most new technologies provide massive amounts of data, but these data need to be translated into meaningful information for decision makers. We have demonstrated this through the information product (IP) approach."

The project's IPs were co-designed with policymakers, conservation managers and other practitioners across Europe. This collaborative and iterative process ensures that the IPs address the needs of stakeholders and align with EU policy frameworks such as the Marine Strategy Framework Directive and other EU-funded projects such as Marine Protected Areas Europe.

Among the IPs developed are high resolution spatial models of habitat and species distributions and habitat suitability modelling for various organisms. Several mapping IPs were developed as well, including maps of coastal vegetation using remote sensing and predictive maps related to fish reproduction. Monitoring efforts using drones and AI applications to quantify the amount of macroplastic on beaches will help evaluate the efficacy of beach-cleaning efforts.

A range of learning sites

To demonstrate the efficacy of the project's approach, OBAMA-NEXT focused on 12 learning sites that represent the diversity of European marine environments. The learning sites include all four of Europe's major marine environments: the Atlantic Ocean as well as the Baltic, Black and Mediterranean Seas.

The wide diversity of the learning sites was not the only criterion for their selection. The project's goal – to produce high-resolution IPs – requires more data than could be collected within the scope of the project. "Since the project could not accommodate large-scale sampling efforts, we looked into where data had already been collected with new technology, and based on those investigations we decided upon the 12 learning sites," Carstensen explains.

Stakeholders have positive feedback regarding IPs, suggesting ways they might guide biodiversity monitoring and management of marine areas. Already these tools have been adopted by other research projects. OBAMA-NEXT solutions are adding to the pool of precise and relevant information on ocean observation.

PROJECT
OBAMA-NEXT - OBSERVING AND MAPPING MARINE ECOSYSTEMS – NEXT GENERATION TOOLS

COORDINATED BY
Aarhus University in Denmark

FUNDED UNDER
Horizon Europe - Food, Bioeconomy, Natural Resources, Agriculture and Environment

CORDIS FACTSHEET
cordis.europa.eu/project/id/101081642

PROJECT WEBSITE
obama-next.eu/project/

How science is helping reverse the decline of wild pollinators

Why are wild pollinators disappearing in Europe? New research reveals key trends and shows ways to protect bees, hoverflies and butterflies.

The gentle buzz of bees and the flutter of butterfly wings: these are the sounds and sights of ecosystems at work. Yet across Europe, wild pollinators are declining. The stakes are high, as more than 75 % of global food crops depend, at least in part, on pollinators, according to a global study.

To help reverse wild pollinator losses, the EU-funded Safeguard project brings together 22 partners from 14 European countries and three universities in China. Combining environmental, economic and societal perspectives, the project aims to understand the drivers of pollinator declines and identify which actions are most effective to protect them.

"The key innovation lies in linking high-quality biodiversity data with large-scale environmental data across Europe," explains project coordinator Ingolf Steffan-Dewenter. "This allows consistent analyses of how major environmental pressures and drivers shape pollinator communities and plant-pollinator interactions at scales relevant for both policy and management."

Mapping pollinator decline

One of the project's main achievements is the development of publicly accessible databases on pollinator distributions, traits and interactions. These include the European Plant-Pollinator Networks database (EuPPollNet), the largest compilation of pollination interaction studies at European level to date. It gathers data on 2 223 pollinator species and 1 411 plant species, covering around one third of Europe's main pollinator groups such as bees, hoverflies and butterflies.

Pollinators are affected by combinations of pressures, and the direction and strength of these effects depend on environmental context.

Using these and other datasets, based on more than 13 million individual observations, Safeguard applied robust models to assess population trends, extinction risks and future environmental impacts. A major outcome is an updated European red list of bees, showing that 10 % of wild bees in the region are now at risk of extinction. The list is crucial to informing conservation priorities and EU policies, including the Nature Restoration Regulation.

The project showed that pollinator declines are rarely driven by a single pressure. "Pollinators are affected by combinations of pressures, and the direction and strength of these effects depend on environmental context," says Steffan-Dewenter.

For example, warmer temperatures led to regional community homogenisation and reinforced wild bee decline in agricultural landscapes, particularly in drier climates. Landscapes with more semi-natural habitats mitigated the effects of extreme weather on cold-adapted species.

What works to protect pollinators

Safeguard also collected empirical data on bee, butterfly and hoverfly diversity in more than 300 high-value protected areas. These field studies demonstrated the importance of local habitat quality, floral diversity and nesting sites to pollinator diversity. At a larger scale, organic farming, connected habitats and small crop fields with high edge density in agricultural surroundings proved to benefit pollinator communities in protected areas.

The project also tested pollinator-promoting interventions, identifying effective measures such as reduced mowing frequency, mosaic mowing systems and flower sowing with native perennial species. To support decision-making, Safeguard developed an integrated assessment framework based on the driver-pressure-state-impact-response model, adaptable from local to European scales.

Alongside this, the Safeguard knowledge exchange hub provides access to data, tools and insights for researchers, practitioners, citizens and policymakers. As Steffan-Dewenter mentions, there is a need for "multiple and integrated actions to halt pollinator and wider biodiversity decline." Safeguard has built the scientific foundation to guide those actions, providing evidence to understand pollinator patterns and anticipate future challenges across Europe.

PROJECT
Safeguard - Safeguarding European wild pollinators

COORDINATED BY
Julius Maximilian University of Würzburg in Germany

FUNDED UNDER
Horizon 2020 – ENVIRONMENT

CORDIS FACTSHEET
cordis.europa.eu/project/id/101003476

PROJECT WEBSITE
safeguard.biozentrum.uni-wuerzburg.de/

Strengthening Europe's taxonomic capacity

Biodiversity protection starts with knowing what species exist. Europe's taxonomic capacity is advanced via training, tools and a unified resources' marketplace.

Biodiversity loss is accelerating worldwide, yet efforts to protect ecosystems often stumble over a basic obstacle: insufficient taxonomic knowledge. Knowing which species exist, where they occur and how they change is fundamental for conservation, regulation and sustainable use. However, taxonomy as a discipline has been steadily losing capacity, with fewer trained experts, fragmented resources and limited visibility in policy and education.

Advancing taxonomy capacity

The EU-funded TETTRIs project aims to reverse this decline by strengthening taxonomy as an instrumental science for biodiversity conservation. Its ambition was to fill knowledge gaps and build lasting systems that support taxonomic research, training and career pathways.

With TETTRIs, we wanted to transform how taxonomy is practiced, supported and valued by investing in people, tools and systems.

The project brought together 17 partners, including leading taxonomic institutions unified under the Consortium of European Taxonomic Facilities (CETAF), the European Citizen Science Association (ECSA), linked research infrastructures, the Catalogue of Life (CoL) and the Distributed System of Scientific Collections (DiSSCo), as well as practitioners close to biodiversity hotspots.

"With TETTRIs, we wanted to transform how taxonomy is practised, supported and valued by investing in people, tools and systems," explains Ana Casino, executive director of CETAF and TETTRIs technical coordinator.

A marketplace for taxonomic resources

A central innovation of TETTRIs is the taxonomic e-services and expertise marketplace, a web-based platform that provides a structured entry point to taxonomic capacity across Europe. Rather than hosting raw data, it connects users to experts and services, making expertise visible, searchable and traceable.

Researchers, practitioners and policymakers can search expert profiles and taxonomic services using harmonised metadata, matching needs such as species identification, access to collections or applied biodiversity assessments. On the supply side, taxonomists and institutions register their expertise following standardised workflows, improving consistency and interoperability.

"The marketplace aims to improve the visibility, accessibility and traceability of taxonomic capacity, supporting more efficient connections between research, policy and applied biodiversity needs," highlights Casino.

Training the next generation of taxonomists

Capacity building formed the second pillar of TETTRIs. Training activities responded to real-world needs, combining academic rigour with field-based practice and public participation in science. Programmes ranged from e-learning resources and mentoring to laboratory and field training, targeting students, early-career researchers, professionals and volunteers.

A key achievement was the development of 'train the trainers' courses on soil and freshwater fauna and pollinators. These courses combined online learning with hands-on training in biodiversity hotspots. Additional workshops and summer schools introduced participants to innovative tools such as molecular methods, AI-based imaging and sound recognition. "Our goal was sustainable knowledge transfer," emphasises Casino.

From awareness to policy impact

Beyond research and training, TETTRIs invested heavily in awareness-raising and policy engagement. The annual Taxonomy Recognition Day grew into a global communication campaign under the banner #NameItToSaveIt, increasing visibility for taxonomy among citizens, industry and decision-makers.

A set of 10 policy briefs and a comprehensive blueprint translating lessons learned into practical recommendations for supporting and advancing taxonomic capacity, together with the successful funding of satellite projects, demonstrate how targeted investment can generate tangible impact.

As TETTRIs concludes, its results will be carried forward providing a roadmap for embedding taxonomy more firmly into research, governance and education.

PROJECT
TETTRIs – Transforming European Taxonomy through Training, Research, and Innovations

COORDINATED BY
Royal Belgian Institute of Natural Sciences (RBINS) in Belgium

FUNDED UNDER
Horizon Europe – Food, Bioeconomy, Natural Resources, Agriculture and Environment

CORDIS FACTSHEET
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RESULTS PACK ON NATURE-BASED SOLUTIONS IN AGRICULTURE

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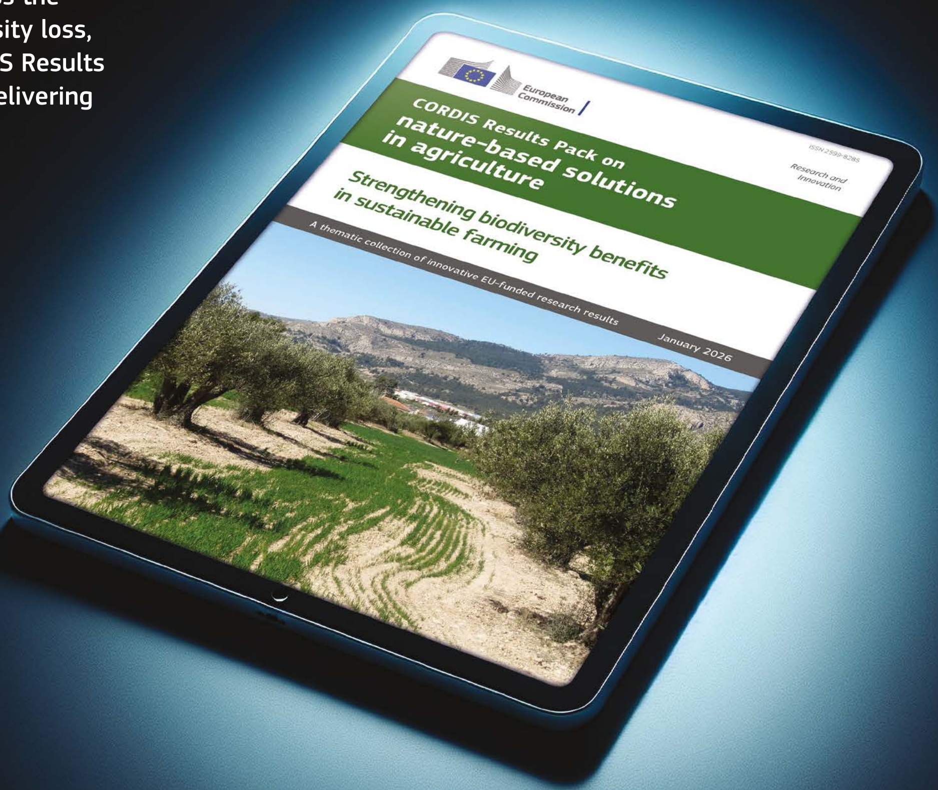

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