

MOBILES

NEWSLETTER N. 4

09/2026

MONITORING AND DETECTION OF BIOTIC AND ABIOTIC POLLUTANTS BY ELECTRONIC, PLANTS AND MICROORGANISMS BASED SENSORS

The MOBILES project is an innovative project funded by the European Union under Horizon Europe Programme. By developing advanced electronic and organism-based biosensors, the project aims to detect and monitor harmful organic chemicals, antimicrobial-resistant bacteria, and pathogens across soil, water, and air. Furthermore, soil metagenomic analysis will be conducted on contaminated areas across Europe, and a metagenomic database will be constructed in order to identify a pool of genes linked to soil specific pollutants.

OUR VISION

MOBILES is dedicated to safeguarding environmental health through real-time, portable diagnostic tools, enabling rapid and precise detection of biotic and abiotic pollutants in soil, water and air.

KEY OBJECTIVES

- **Next-generation electronic biosensors:** Eco-friendly devices to detect organic chemicals, antimicrobial-resistant (AMR) bacteria, and pathogens.
- **Organism-based biosensors:** Usage of genetically engineered plants, bacteria, and marine diatoms to monitor organic and inorganic pollution.
- **Metagenomic analysis:** Comprehensive soil microbiota analysis in polluted areas across Europe to uncover gene clusters and genetic diversity. This helps assess microbial functions and provides genetic markers to quick evaluation of soil and land health.
- **Environmental performance testing:** Validating biosensors using real-world samples from polluted sites.
- **Safety assurance:** Rigorous evaluation of environmental impacts associated with these modified organisms and innovative devices.



WORK PACKAGES PROGRESS

ELECTRONIC BIOSENSORS FOR ENVIRONMENTAL MONITORING (WP1)

A team of researchers, led by INRAE (National Research Institute for Agriculture, Food and Environment, France), is developing advanced electrochemical biosensors to detect pollutants such as pesticides, pathogenic bacteria, antimicrobial resistance genes, and spores in soil, water, and air. These sensors will integrate conductive materials and biological components to ensure accuracy, stability, and sensitivity to various contaminants.

Recent progress in WP1 is captured in two deliverables. *Deliverable D1.2* presents the engineering work behind the new portable readout platform for MOBILES electrochemical biosensors. The team transformed laboratory-level measurement requirements into a compact, protected device integrating a full three-electrode signal chain, USB-powered control, and software-driven acquisition. After validating methods on a benchtop potentiostat, the procedures were transferred to the EmStat Pico platform and enclosed in a custom-designed housing that stabilizes the PCB, connectors and disposable sensors. Functional tests with the 17 β -estradiol aptasensor confirmed reliable CV and SWV responses, demonstrating that the complete reader-to-electrode pathway is operational. The system is now deployed at NTUA, UBE and INRAE to support ongoing biosensor development, with performance results to be reported in Deliverable D1.4.

Deliverable D1.3 outlines the development of the microfluidic network designed to interface with the MOBILES electrochemical biosensors. EDEN Tech, working closely with NTUA, created and tested several microfluidic prototypes tailored to the project's common screen-printed electrodes. Multiple replicas of a fully compliant device were successfully produced and delivered to NTUA, where they are now used for ongoing laboratory and field testing.

Further progress was demonstrated during joint testing with the AquaBioSens project in Southampton. Seawater samples collected in Southampton Bay were used to evaluate the MOBILES 17 β -estradiol biosensor under real environmental conditions. The sensor successfully detected estradiol in the collected samples and, although originally developed and optimised for freshwater applications, also performed well in seawater. These encouraging results provide a basis for further validation of the sensor across different environmental conditions.

In addition, A MOBILES publication previously featured in our newsletter, In Situ Electrochemical Monitoring of *Bacillus cereus* Biofilm Formation, has now been indexed in FAO AGRIS, the global bibliographic database maintained by the Food and Agriculture Organization of the United Nations. The indexing increases the discoverability of the research within the international food and agricultural science community, extending the reach of MOBILES findings on pathogen detection and contamination monitoring.



DETECTION OF POLLUTANTS VIA BIOTIC SENSOR (WP2)

Under the leadership of the University of Rome (UR), scientists are developing advanced biosensors to detect environmental pollutants such as heavy metals (e.g., arsenic), pesticides, antibiotics, and microplastics. These sensors will help monitor soil, water, and air quality using biological components like plants, bacteria, and diatoms (a type of algae).

WP2 has reached an important milestone summarized in the *Deliverable D2.2*: the development and functional validation of a plant-based biosensor that can visibly signal the presence of arsenic. Using the model plant *Arabidopsis thaliana*, researchers engineered a sensing system that responds to arsenic by activating the RUBY reporter, which produces a vivid red pigment. As a result, arsenic exposure can be translated into an easily visible change from green to red, without the need for specialised detection equipment.

The team also worked to improve the plant's response to arsenic and incorporated an important biosafety feature. A heat-activated containment system was developed to induce sterility, helping prevent unwanted propagation of the genetically modified plants. Together, these advances establish a promising basis for a living, visually readable tool for monitoring arsenic contamination and for its further development.

METAGENOMICS DATABASE AND FULLY-SEQUENCED POLLUTED SOIL MICROBIOTA (WP3)

In the MOBILES project, under work package 3 (WP3), researchers are studying bacterial/microbial community in the soil to better understand how pollution affects them and how they can help restore damaged land. By analysing the genetic material of these microbes, researchers aim to identify key biological markers that indicate soil health and can guide soil rehabilitation efforts. These findings will help develop new strategies for managing contaminated environments more effectively.

Recent progress in WP3 is captured in two complementary deliverables. *Deliverable D3.2* establishes the reference protocols and bioinformatic workflows used within MOBILES to analyse soil microbial communities through DNA and RNA sequencing. Three complementary approaches allow researchers to identify which bacteria are present, obtain a more detailed picture of their diversity, and investigate which microbial genes are actively expressed. The protocols cover the process from sequencing preparation through data processing and biological interpretation, providing a common analytical framework for the consortium. These workflows have already been applied to soil samples collected across European sites during the spring 2025 MOBILES sampling campaign (*Fig. 1*) and will help ensure that results remain comparable across locations and sampling periods.

Deliverable D3.3 provides the computational infrastructure needed to put these analytical methods into practice at scale. Metagenomic and metatranscriptomic studies generate large and complex datasets, requiring substantial computing and storage capacity as well as carefully controlled analytical environments. The MOBILES platform combines high-performance computing, multi-tier data storage and automated workflow management to enable reliable and reproducible processing of sequencing data. It supports the analytical pipelines defined in D3.2, including the MeToReS metatranscriptomic workflow developed by WP3 partners, while providing access for researchers with different levels of technical expertise. Together, the analytical workflows and supporting infrastructure establish the framework through which MOBILES sequencing data can be transformed into comparable biological information about polluted soil microbiomes.

Alongside these developments, MOBILES continued its Europe-wide soil sampling campaign in 2026, returning to sites across the six participating countries. The repeated sampling is designed to capture changes in soil microbial communities over time and help researchers distinguish natural variation from microbial patterns associated with different types of pollution. Samples collected during the campaign will feed into the sequencing and analytical workflows established within WP3, expanding the dataset available for identifying potential indicators of soil health.

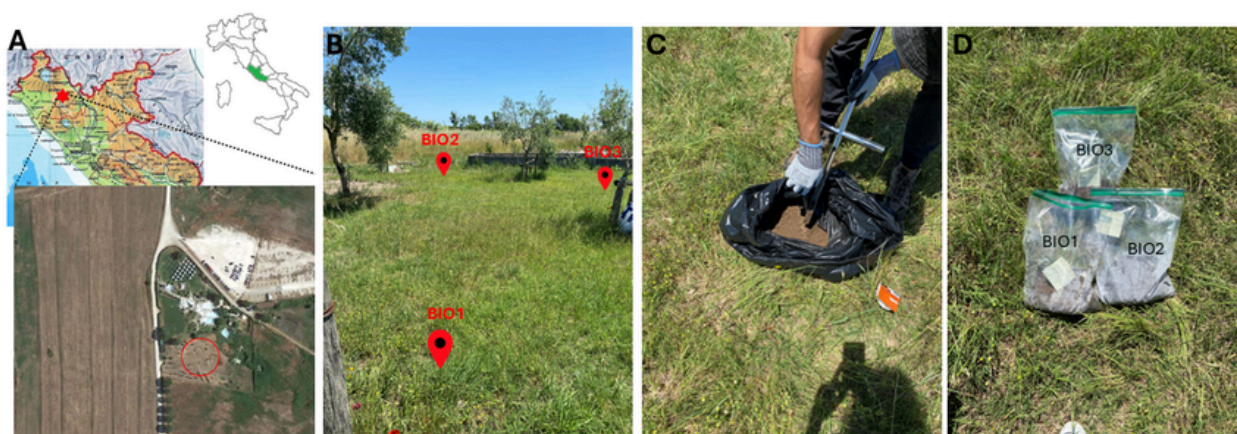


Fig.1 Bagnaccio study site (Viterbo, Central Italy) and soil sampling procedure. (A) Location of the study area. (B) Field sampling plots (red markers). (C) Representative soil core collected for characterization. (D) Soil samples used for physicochemical and biological analyses.

ENVIRONMENTAL PERFORMANCE AND SAFETY OF DEVELOPED ORGANISMS, AND PACKAGING OF SENSOR DEVICES (WP4)

Scientists are working on improving biosensors—specialized devices that detect environmental pollutants. These biosensors use biological components, such as enzymes and microorganisms, to identify harmful substances in soil and water. To ensure their effectiveness in real-world conditions, researchers are also focusing on practical issues such as proper packaging, durability, safety, and performance testing. This activity is supervised by RICPA (Research and Innovation Center Pro-Akademia, Poland).

Work on the environmental safety assessment of the modified organisms developed within MOBILES has now moved further into experimental testing. A panel of six bacterial biosensor strains has undergone phenotypic and molecular characterisation, while long-term monitoring has provided new information on the stability of their antibiotic-resistance characteristics under different growth conditions. Experiments investigating horizontal gene transfer, the potential transfer of genetic material between microorganisms, are also underway. The next steps will examine how long the modified bacteria persist in natural soil and water and whether they affect native microbial communities.

Safety assessment is also progressing for the plant-based biosensors developed in WP2. Technical information on the modified *Arabidopsis thaliana* has been reviewed and used to prepare the hazard assessment required for the subsequent contained-use regulatory procedure. The team has also received the necessary technical data for *Pteris vittata*, which will undergo the same assessment process.

Progress is also being made on the materials supporting the future packaging and protection of MOBILES electrochemical biosensors. Chitosan- and alginate-based materials have been prepared and tested for application on electrode surfaces using different deposition methods. The resulting layers have been characterised, and the established preparation and deposition procedures will next be transferred for testing. This work will support the subsequent optimisation of protective layers, storage conditions and sensor shelf life.

DISSEMINATION, EXPLOITATION AND COMMUNICATION OF PROJECT OUTCOMES (WP5)

The project team is working to ensure that the project is visible and its results will reach policymakers, businesses, researchers, and the general public, helping to improve environmental protection efforts.

Recent progress in WP5 is reflected in [Deliverable D5.3](#), the updated Dissemination, Exploitation & Communication Plan (DECP). The update reviews how MOBILES communicates and disseminates its emerging results and adjusts the strategy to reflect the project's progress as it moves through its second phase, focused on the dissemination of early results. It brings together the project's communication channels, scientific dissemination, collaborative activities and approaches for reaching different stakeholder groups, while setting the direction for activities through the remainder of the project.

Importantly, the update also strengthens the project's focus on exploitation and future uptake of its results. This provides an early basis for following how MOBILES technologies and knowledge can progress towards further research, innovation and potential practical use as the project develops.

PROJECT MANAGEMENT AND COORDINATION (WP6)

As MOBILES continues to generate new research data, the project's Data Management Plan has been updated through [Deliverable D6.3](#). The updated plan provides the framework for managing, storing, sharing and preserving data in line with FAIR principles and Horizon Europe requirements, while addressing the different types of data produced across the project.

SCIENTIFIC PUBLICATIONS



CHEMOSENSORS

**Micro- and Nanoplastic
Water Contamination: Comparative
Review of Classical Analytical
Methods and Advanced Sensors**

MICRO- AND NANOPLASTIC WATER CONTAMINATION: COMPARATIVE REVIEW OF CLASSICAL ANALYTICAL METHODS AND ADVANCED SENSORS

Brankica Kartalovic and Jasmina Vidic

Micro- and nanoplastics are increasingly detected in aquatic environments, yet their reliable monitoring remains challenging, particularly as particle sizes decrease. Established analytical techniques can provide detailed information on plastic particles, but often require specialised equipment and complex sample preparation, creating a need for faster and more accessible detection approaches. A new systematic review by Brankica Kartalović and MOBILES researcher Jasmina Vidic (INRAE) examines 53 studies published between 2021 and mid-2026, comparing conventional analytical methods with emerging sensor technologies for detecting micro- and nanoplastics in water. The review highlights rapid progress in sensor-based detection, but also an important gap between laboratory research and environmental application, since many studies still rely on artificially prepared samples rather than real environmental waters. The authors identify validation in realistic samples, reliable nanoplastic detection and more frequent monitoring among the key challenges for the field.

[Read more](#)



TALANTA OPEN

**17β-Estradiol electrochemical
biosensors: recognition elements,
platforms, and analytical validation**

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ANALYTICAL METHODS

**Natural pigment-based
biosensors for
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ANALYTICAL METHODS

**Isothermal Amplification
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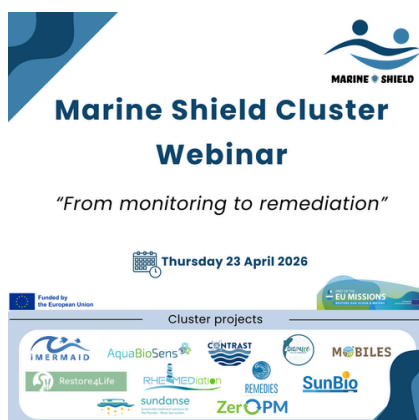
COOPERATION WITH OTHER PROJECTS

AQUABIOSENS ANNUAL MEETING



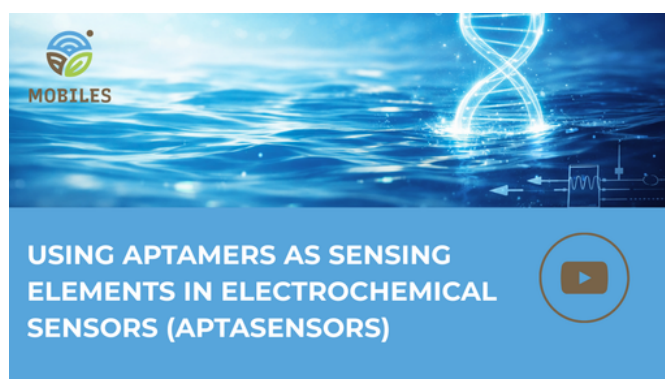
Cooperation with AquaBioSens also continued through its Annual Meeting, held on 6–8 July at the National Oceanography Centre in Southampton. MOBILES researchers presented progress from WP1 and WP3 and joined technology demonstrations and field testing alongside the AquaBioSens team. The meeting provided an opportunity to compare different biosensing approaches, discuss implementation challenges and explore possibilities for further collaboration between the two projects.

MARINE SHIELD CLUSTER WEBINAR



MOBILES continues to strengthen cooperation with other European research initiatives working towards improved environmental monitoring. In April, MOBILES contributed to the Marine Shield Cluster webinar "From Monitoring to Remediation", which brought together EU-funded projects addressing different stages of the marine pollution challenge. Angelo Ferraro (NTUA) presented the MOBILES work on the use of aptamers as recognition elements in electrochemical sensors, providing an opportunity to share the project's progress and exchange knowledge with other members of the cluster.

Want to learn more? A recording of the MOBILES presentation is available.



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News on published papers, experimental work, events where MOBILES partners participate, public deliverables and other public activities are constantly published on such communication channels. Explore a selection of our latest stories below.

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PROJECT

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- Budget: €4.6 million
- DOI: <https://doi.org/10.3030/101135402>

COMMUNICATION

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- Join us on our mission to revolutionize environmental monitoring and create a sustainable future!

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