

# From space to species

Our planet relies on the preservation of biodiversity for a number of life-defining characteristics, the team at **BIO\_SOS** discuss their plans to conduct a deeper understanding, assessment and prediction of the impacts that human induced pressures may have on biodiversity conservation



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## Could you outline the overarching goals of the BIO\_SOS project?

Our main objective is to develop a preoperational ecological modelling system suitable for effective and timely multi-annual monitoring of NATURA 2000 sites and their surrounding areas, particularly those exposed to different and combined types of pressure. Its input data sources are satellite-based measurements and on-site in situ data. The system is based on expert knowledge rule-based techniques for both land cover (LC) and habitat mapping, including biodiversity indicator extraction.

## Three of your study areas are situated in Mediterranean countries. Why has knowledge on biodiversity in the Mediterranean not been more strongly developed to date?

Status, trend and disturbance monitoring using cost-effective tools is important throughout Europe, but more so in Mediterranean areas, which typically lack long-term baseline data for assessing changes and evaluating biodiversity

indicator trends. Moreover, some threatened vegetation types of ecological importance do not correspond to any habitat type in relation to the EC's council directive on conservation of natural habitats and wild flora and fauna. We also take into consideration that the efficient assessment of biodiversity requires a variety of biological, ecological and cultural information. Even in countries like the US and the UK, where this information is readily available, it is generally not acquired as part of a coordinated environmental management system. The biodiversity information in the Mediterranean Basin still has many gaps and is scattered among different organisations in incompatible formats, leaving its location and integration problematic.

## Why has a case study been set up in Brazil? How will information from this study be integrated within the project?

A case study in Brazil and India are contributions to Group on Earth Observations and Biodiversity Observation Network (GEO BON). It is important to know if approaches developed in and for Europe can be applied

elsewhere. If it is possible to develop a Global Monitoring for Environment and Security (GMES) product that will not only be used in NATURA 2000 sites, but can also be applied in other biomes, then it is Europe's global responsibility to share its approach and make harmonisation possible. The Convention on Biological Diversity (CBD) and the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) have commissioned GEO BON to develop a global biodiversity observation system. This case study is small, but its contribution is essential. It allows us to judge the use of in situ and remote sensing tools in combination.

## Could you outline the range of specialist skills represented by consortium members?

The BIO\_SOS consortium consists of 16 partners with different backgrounds and specialist skills, ranging from Earth Observation data analysis based on pattern recognition and artificial intelligence techniques, to ecological modelling and high botanic expertise. In addition to 12 high-level research institutes, four SMEs



# Safeguarding biodiversity in Europe

Understanding the **BIO\_SOS** pilot project, which was established to develop consistent, multi-annual monitoring tools and devices to assess biodiversity conservation status in Natura 2000 protected areas and their surroundings exposed to a combination of human induced pressures

contribute to the adaptation of solutions to end-user requirements for a possible commercialisation of the output and ensure the full compatibility with the Infrastructure for Spatial Information in the European Community (INSPIRE) initiative as well as the adaptation and localisation of the project results to the stakeholders involved in Biodiversity monitoring and management.

**What long-term impact do you expect the project to have? Will research results be disseminated widely at the project's conclusion?**

The project aims to contribute to GMES and, most importantly, we want to deliver preoperational elements of an Earth Observation System for Habitat Data Monitoring, which can be used at regional and local scale. It will include an observation system, software and manuals. We want to make GMES work for biodiversity observation and present this work to European communities that require tools for both biodiversity monitoring and following up the impact of existing and new policies.

We want to link LC classification in the FAO-LCCS system and habitats through the habitat classification system that have been developed in a predecessor project EBONE. This could potentially lead to a globally harmonised system for habitat classification.

We will also make recommendations on purposes for hyperspectral and LiDAR data in the field of habitat monitoring, and defining differences between habitat types and regions as we test in various Natura 2000 sites.

**BIODIVERSITY REFERS TO** the broadest range of flora and fauna on our planet and how we measure the health of the ecosystems. Each species plays an important role in ecosystem productivity and preserving this diversity in our environment is crucial to sustaining life. Our survival and progression as a species is dependent on a variety of life on Earth, which contribute to ecological services such as food security, raw materials, water and energy. There are issues with the weakening of biodiversity, which have become more apparent as estimated species loss rises throughout the world. Biodiversity loss could increase our risk of encountering a number of dilemmas, including:

- Costs due to expenditure on ecosystem services, eg. pollution, land irrigation and investment in soil reclamation
- Effects on human health and prevalent risk of contracting diseases
- More extreme, unpredictable weather
- Lack of employment

The extinction of other species has become more prominent as human growth and activity continue to dominate and exploit habitats across the globe. Human induced pressures impact heavily on biodiversity and their effects are worrying; the results of which include over-harvesting (which causes land degradation), pollution and waste, habitat fragmentation and environmental destruction. Achieving a clearer, deeper understanding of how to monitor and assess humans in relation to these rapidly growing challenges, is paramount to the sustainability of our environment.

## NATURA 2000

The European Union have built up a network of naturally protected areas as part of their commitment to biodiversity security in Europe. Under the legal basis of Natura 2000 – an area of great importance within the EU's nature and biodiversity policy – the network aims to manage the future preservation of the most threatened species and environments in Europe. Natura 2000 conservation areas consist of bird, marine and habitat sites where a diverse range of species thrive under their protection.

These sites account for 20 per cent of European territory, which highlights the magnitude of the networks, and the importance of the project. Citizens of the EU are never far away from one of these sites which again emphasises the attachment we have to these protected areas. Although an important network in the EU, Natura 2000 needs support from other policies to truly grow and develop: "If we want to conserve Europe's natural capital, then agriculture, energy and transport policies must be sustainable too," suggests Dr Palma Blonda, the Project Coordinator for Biodiversity Multi-SOource Monitoring System: From Space to Species (BIO\_SOS).

## ANTHROPOGENIC AFFECTATIONS

There are a number of human activities that affect biodiversity, not only in Natura 2000 sites, but around the world. High-input farming methods are often responsible for land degradation as well as damage to agriculture and semi-natural habitats. Intensive farming, which requires pesticide and chemical fertiliser use, have played a role in the death of important



## BIO\_SOS

### BIODIVERSITY MULTI-SOURCE MONITORING SYSTEM: FROM SPACE TO SPECIES

#### OBJECTIVES

To develop tools for consistent monitoring of NATURA 2000 sites and their surroundings. The emphasis of the project is on NATURA 2000 sites in the Mediterranean part of Europe, but also sites in the Netherlands, Wales, India and the tropical rainforest of Brazil.

#### PARTNERS

CNR, Italy • University of Ioannina, Greece • Centre For Research And Technology, Greece • Alterra, Wageningen UR, The Netherlands • Ashoka Trust for Research in Ecology and the Environment, India • PLANETEK, Italy • ALTAMIRA, Spain • University of Bari, Italy • Universidade Do Porto, CIBIO, Portugal • Università Di Milano-Bicocca, Italy • University of Aberystwyth, UK • Maison de la Teledetection, IRD, France • PLANETEK HELLAS, Greece • Italian Space Agency, Italy (ASI) • Université Paul Sabatier, Toulouse III, France

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**DR PALMA BLONDA** has been a researcher at CNR since 1984 and is a specialist in digital image processing.

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**JENS STUTTE** has lengthy industry experience as a Software Architect. He is Technical Manager at Planetek Italia and coordinates among others the implementation of the European INSPIRE Geportal.

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insects, pollution to areas of land and water, and health problems.

The construction of new buildings and infrastructures often facilitates the occurrence of potentially hazardous activities, some of which include poaching, illegal hunting, logging and fires in areas that have not been properly managed and planned. "Conversion to agriculture or infrastructure for tourism brings about habitat loss and fragmentation, as well as intrinsic quality decreases," adds Blonda.

#### ADDRESSING THE CHALLENGES

BIO\_SOS is an EU-funded project tasked with addressing, monitoring and detecting the impact of human induced pressures on naturally protected areas within the Natura 2000 networking programme. Started in December 2011, the project aims to make big strides in combating the challenges that biodiversity faces as a result of human activity: "Areas bordering protected NATURA 2000 sites, which are set to become such sites, are particularly prone to illegal environmental abuse, including higher than average rates of forest fires, logging, mining, poaching and spillage of waste," Blonda explains.

One of the main goals of the BIO\_SOS project is to develop an innovative monitoring method in support to management authorities responsible for ensuring that the Natura 2000 sites are protected from irresponsible human use. The aim of the work is to respond to this challenge by providing 'change maps' through an operational system based on high definition satellite technology combined with in situ data. These road maps will enable local authorities to take appropriate action against environmental offenders. A major goal is to identify impacts in a timely and effective way, in order to then minimise negative impacts.

Study areas are currently located in three Mediterranean countries and two areas of Western Europe, as well as further tropical areas in Brazil and India, where BIO\_SOS suggests that advance monitoring of biodiversity is important due to its scarcity. The Mediterranean, for example, was chosen as a study area due to its lack of previous biodiversity research and data collection and its inaccessibility in certain areas. BIO\_SOS use a single methodology that combines two observational tools including remote sensing and ground-based analysis, which is fundamental to the development of a complete observation system regarding biodiversity and Natura 2000 sites. Remote sensing (eg. satellite and aerial sensors)

observations can cover large areas and can be done remotely and repetitively with ease. In situ observations are needed to both follow specific changes (eg. animal population or habitat changes) in ecosystems, which cannot be carried out successfully remotely and validate the maps produced from space. A harmonisation of the two methods then, seems to be an effective way of approaching a compatible classification system based on life forms.

#### FUTURE PLANS

The nature of the project is twofold: "On the one hand, we are doing high-quality research on habitat categories definition and their relationships based on expert knowledge and Earth Observation (EO) data; on the other hand, we have the goal to transform this domain knowledge into concrete software and workflow definitions," Blonda elucidates. The BIO\_SOS team hope that they can demonstrate both of these tasks effectively in the future months and the project hopes to have a positive impact on biodiversity monitoring within the EU and beyond: "The project's main outcome is a flexible service chain with ready-to go processors, that can be easily adopted through parametrisation and ancillary data choice on different sites," highlights Blonda.

**Achieving a clearer, deeper understanding of how to monitor and assess humans in relation to these rapidly growing challenges is paramount to the sustainability of the environment**

The development of their modelling system should allow for the harmonisation of remote sensing data and in situ data for effective monitoring of sites where biodiversity is under threat from numerous pressures. With support from 16 partners, each partner offers a unique range of skills for achieving the overarching research objectives. BIO\_SOS is well-placed to successfully demonstrate high-level research useful for biodiversity conservation and Natura 2000 site management in the near future, and their work will be much anticipated by those with an interest in biodiversity protection in Europe and beyond.

