

BioSpace25 - Biodiversity insight from Space  
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# Prototyping a Policy-Driven EO Service for Monitoring Critical Wetland Habitats in Natura 2000 Sites

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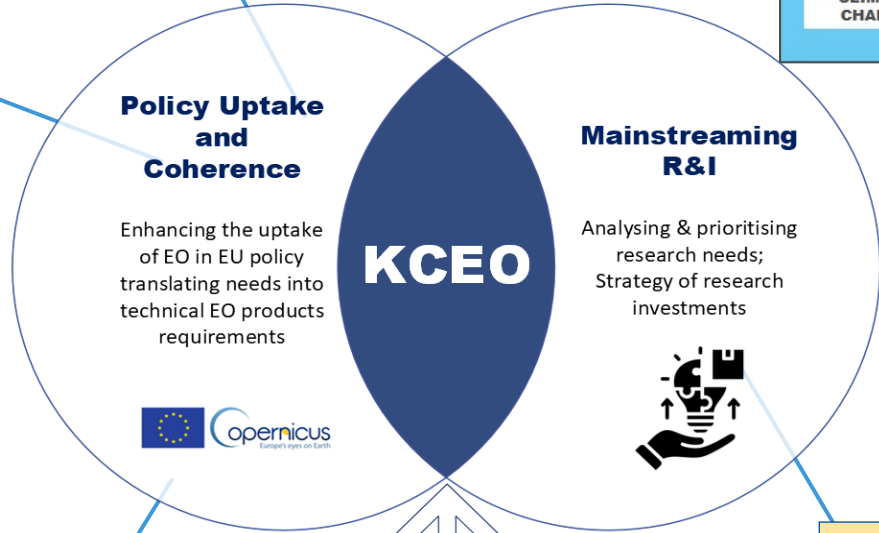
# EC Knowledge Centre on EO

## Copernicus Services

Are you looking for an EO-GLOSSARY?

**Deep Dive Assessments on Specific Policy Areas: Biodiversity, Urban Climate Adaptation & Compliance Assurance with 7 policy DGs**

**Survey across 15 EC DGs (66 units)**



**Shallow Dive assessment on reporting burden**

**Focused entry point**  
Inclusiveness & Transparency  
Dialogue with external partners, international organisation and society

**Strategic Research and Innovation Agenda for EO**



# KCEO Deep Dive assessment on Biodiversity

## MONITORING OF THE EU BIODIVERSITY STRATEGY (BDS) TARGETS

**NEEDS:** High-resolution (HR) and long-term indicators on a yearly basis to effectively monitor progress towards the targets outlined.  
**STATUS:** Two online tools for tracking and reporting the progress of the BDS implementation: [Actions tracker](#) and [Dashboard](#).  
**GAPS:**

- Lack of yearly HR maps to track changes.
- Absence of suitable ground-based biodiversity data for training and validation.

## BIODIVERSITY MONITORING IN KEY AFRICAN LANDSCAPES FOR CONSERVATION AND DEVELOPMENT (KLCDs)

**NEEDS:** Detailed indicators, encompassing performance monitoring and accountability measures to support the conservation of ecosystems and the expansion of the protected areas network, while fostering livelihoods and human development.  
**STATUS:** EO products integrated in the [AKP](#) provide a baseline for monitoring across the selected KLCDs. A user-friendly tool will be developed in the context of [NaturAfrica](#) and the Regional Centres of Excellence Programme.  
**GAPS:** Insufficiency in integrating ancillary data, including socio-economic information derived from UNESCO and EU Delegations.

## BIODIVERSITY MONITORING IN AGRICULTURE LANDSCAPE

**NEEDS:** Indicators for biodiversity monitoring and evaluation to meet the 10% target for High Diversity Landscape Features.  
**STATUS:** [SWF](#) and [LUCAS](#) Landscape Features module partially address the needs.  
**GAPS:**

- Lack of integration between SWF and LUCAS module.
- Absence of independent and traceable quality assessment of SWF with respect to policy requirements.
- Inadequate frequency and latency of available products.

## MONITORING SHIFTS IN GEOGRAPHIC RANGES, DISTRIBUTION AND CONDITIONS OF SPECIES POPULATION AS A FUNCTION OF CHANGING CLIMATE

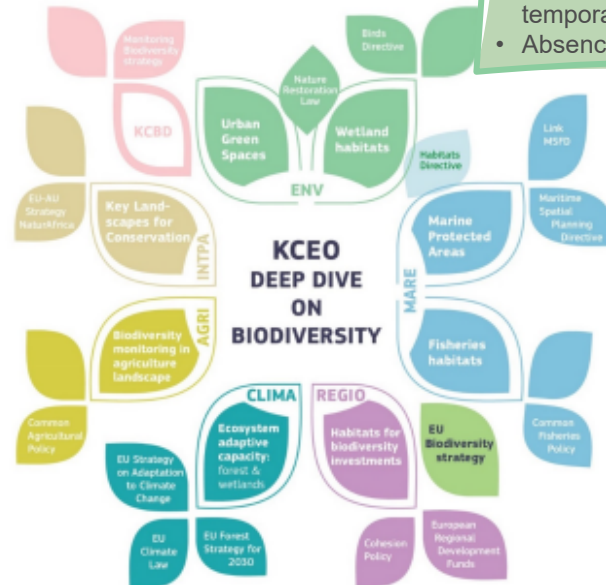
**NEEDS:** Assessment of the impacts of Climate Change on ecosystems' functions and structures, on species abundance and distribution.  
**STATUS:** Climatic data products are suitable for bioclimatic models.  
**GAPS:**

- Low spatial resolution of EO products.
- Lack of operationality in combining bioclimatic modelling technologies with bioclimatic products (under development by C3S).
- Insufficiency in parametrising biological processes to be included in models.
- Inaccuracy and lack of performance assessment of bioclimatic models.

## MONITORING OF URBAN GREEN SPACES

**NEEDS:** Multitemporal HR maps covering various types of urban green infrastructures.  
**STATUS:** [Urban Atlas](#) and [Small Woody Features](#), among others, partially fulfill the need.  
**GAPS:**

- Inadequate temporal frequency, thematic granularity, and spatial coverage.
- Geometric inaccuracy.



## ASSESSMENT AND MONITORING OF EU FOREST HEALTH

**NEEDS:** A forest monitoring system to alert about disturbances, assess the impact of climate change on biodiversity, and predict disturbance risks.  
**STATUS:** Copernicus [CLC+ Backbone](#) and [High Resolution Layer Forest](#), among others, partially address the needs.  
**GAPS:**

- Lack of HR yearly maps on forest status and changes.
- Insufficient delineation of forest types.
- Insufficient integration of ground and satellite data.
- Limited access to and use of training and reference data for accuracy assessment of Copernicus products.

## MONITORING WETLAND HABITATS

**NEEDS:** HR maps of delineating wetland habitats and long-term indicators for assessing overall conditions and changes.  
**STATUS:** [Land cover map on riparian zones](#), a dataset on [long-term dynamics of surface water](#), and [in-situ soil moisture observations](#).  
**GAPS:**

- Lack of common definition for wetlands, based on generalized, objective, and measurable criteria.
- Insufficiency in geographic coverage, thematic granularity, spatial and temporal consistency, and lack of a long-term record.
- Absence of a user-friendly platform to facilitate products accessibility.

## MONITORING ESSENTIAL FISH HABITATS AND VULNERABLE MARINE ECOSYSTEMS, & MARINE BIODIVERSITY

**NEEDS:** HR maps for assessing marine protected areas (MPAs), characterising fisheries resources and identifying vulnerable ecosystems.  
**STATUS:** [EMODnet](#) and the [Copernicus Marine Service](#) partially address the needs.  
**GAPS:**

- Lack of centralised and easy access to satellite and in-situ national data.
- Absence of informative indicators on species richness and abundance hotspots, overlaps between hotspots and MPAs, and areas impacted.
- Insufficient spatial and temporal resolutions.

## MONITORING ECOSYSTEMS HEALTH TO SUPPORT BIODIVERSITY INVESTMENTS

**NEEDS:** Monitoring system to guide and assess EU investments in biodiversity and ecosystems.  
**STATUS:** Available EO products partially address the needs.  
**GAPS:**

- Insufficient generation of targeted indicators, such as phenology or productivity indices.
- Lack of operationality.
- Inconsistencies and gaps in the time series.
- Coarse thematic granularity of land cover maps, limiting a comprehensive understanding of ecosystems.

Prototyping a Policy-Driven EO Service for wetlands Monitoring

The collage includes:

- A satellite in orbit over Earth.
- A map showing Earth Observation data for Urban Climate.
- The cover of the report 'Earth Observation for Biodiversity'.
- A document titled 'SCIENCE FOR POLICY BRIEF'.
- A document titled 'Earth Observation for Biodiversity' with a 'HIGHLIGHTS' section.
- An 'INTRODUCTION' section from the report.

**HIGHLIGHTS:**

- Examining biodiversity-related concerns through the lens of Earth observation (EO) has revealed significant synergies across different policy areas, e.g. in the assessment of wetlands. The identification of common needs and solutions can lead to increased efficiency gains and improved coherence in EU policymaking through consistent data and information.
- This study underlines technical gaps in EO biodiversity data, including issues related to accessibility, geographic coverage, temporal inconsistency, and thematic considerations. The analysis of the technical requirements for such specific use cases could lay recommendations and actions for future improvements in the use of EO data in biodiversity policies.

**INTRODUCTION:**

One of the most important global challenges we are currently facing is the loss of biodiversity, which has profound environmental, social, and economic implications. The EU Biodiversity Strategy (BDS) for 2030 includes comprehensive plans to safeguard and restore Earth's biodiversity, in full alignment with the Sustainable Development Goals (SDGs).

Earth observation (EO) has a crucial role in supporting biodiversity-related policies. Copernicus Services are increasingly important in offering products and tools to monitor changes in ecosystems and biodiversity, thereby supporting the EU BDS, the Convention on Biological Diversity and reporting actions of the Sustainable Development Goals (SDGs).

The European Commission's Knowledge Centre on Earth Observation (KCEO) provides a qualification mechanism inside the European Commission (EC) to maximise the quality of the Copernicus programme for EU actions. Focusing on the translation of policy needs into concrete requirements for EO products and services.

The Deep Dive assessment launched by the KCEO analyses a defined policy area to earth to how and to what extent existing EO products and services meet policy needs, to identify gaps, and to provide recommendations on the future evolution of Copernicus products and services to address these needs.

This brief summarises the findings of the Deep Dive assessment on Biodiversity, coordinated by the co-chairs of the KCEO – the Directorate General for Defence Industry and Space (DGDIR) and the Joint Research Centre, in collaboration with the EC Directorate-General for Environment (DG ENV), Regional and Urban Policy (DG REGIO), Climate Action (DG CLIMA), International Partnerships (DG IPA), Maritime Affairs and Fisheries (DG MARE), Agriculture and Rural Development (DG AGRI), Research and Innovation (DG RTD) and the Statistical Office of the European Union (DG STAT).

A case-by-case assessment – The Deep Dive assessment addressed one use case. Illustrated in the schematic on the cover with the main outcomes of these assessments.

# Habitat protection - Policy Context

**Habitat Directive:** Protects 232 Habitat types (Annex I) and thousands of non-bird species (Annex II – fauna and flora)

**Humid habitats:** a list of 10 major groups has been defined based on NRL annexes

Three key provisions requiring geospatial monitoring:

- Article 4.4: MS must identify Habitats to protect, and protect a sufficient proportion in [Natura 2000 sites](#) (Site designation)
- Article 6.2: MS must prevent degradation within Natura sites (Compliance)
- Article 17: MS must report every 6 years on conservation status across their entire territory (Monitoring)

EO is needed to automatise the monitoring and reporting



Habitat Group	Number of Types
Coastal and salt habitats	11
Rivers and lakes	20
Temperate heaths	2
Peat grassland	1
Alluvial meadows	4
Sphagnum acid bogs	6
Calcareous fens	4
Boreal mires	2
Bog woodland	2
Alluvial/riparian forests	8

**Overall conservation status**

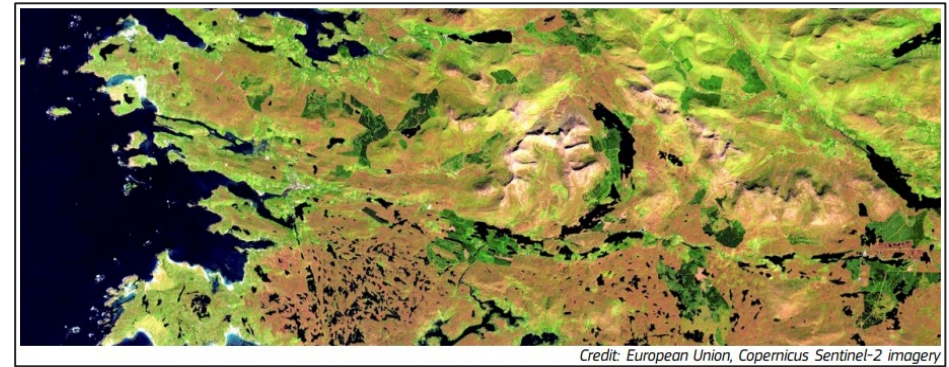
FV	Favourable ('green')
U1	Unfavourable – Inadequate ('amber')
U2	Unfavourable - Bad ('red')
XX	Unknown (insufficient information to make an assessment)

**Synergies with other Legislations:** The Birds Directive, The Nature Restoration Law, The Forest Monitoring Law, The CRCF, The WFD and the MSFD, the CAP, LULUCF

# Requirements for EO-derived outputs and analysis

- **Coverage & Resolution:** Full territorial monitoring with focus on Natura sites to detect local changes (HR), along with regional analysis of environmental conditions and climate impacts (MR).
- **Temporal aspects:** Trend analysis from historical baseline (1992/2000) with annual monitoring to track early signs of degradation, Anomaly detection of environmental conditions.
- **Key Elements to Monitor:** Protected site boundaries, habitat extent and conditions, signs of degradation (human vs climate impacts), accounting for natural wetland variability.
- **Data Integration:** Integrate EO data with field measurements, local expertise, and modeling.
- **Access Platform:** Develop user-friendly web application for local experts to extract policy-relevant information.

# From assessment to prototyping



**Design an operational geospatial information system to monitor critical wetlands, detect degradation, and assess conservation status within Natura 2000 sites, through the following steps:**

- **Ecological Characterisation:** Analyse European wetland habitats (part of Annex1) to understand their ecological functioning and identify key pressures and threats leading to degradation.
- **EO-based indicators:** Identify relevant EO-based products for selected habitats using reference sites. Prioritize wetland types based on degradation levels (per Article 17 of the Habitats Directive), relevance beyond the Directive, and biodiversity value.
- **Analytical tools:** Design dedicated spatial and temporal analytical tools for policymakers and conservation managers, integrating EO technologies, ground-truth data and modelling.

# From Ecological function to observable indicators

## Ecological Status Assessment: Characterizing various European wetland habitats (part of Annex1), their ecological functioning, and main pressures and threats leading to degradation

**Good functioning:** Ability of the ecosystem to maintain its natural processes and provide essential services that support biodiversity, water quality, and overall environmental health.

**Pressure and Threats leading to degradation:** Distinction between different levels of deterioration including direct human activities and broader environmental changes affecting the structure, function, and resilience of ecosystems, i.e. *agriculture intensification, urban development & habitat fragmentation, water management practices, invasive species, water pollution, climate change impacts.*

- Support of expert's network through [Science Service for Biodiversity](#) & Workshop organisation (End 2025)
- Based on reported pressures and threats (Art17)
- DG ENV study on monitoring and assessing the condition of various habitat types (ongoing)



# Key EO proxy parameters

- **Selection of relevant indicators** that can be observed through EO and modeling
  - To be refined with ecological knowledge of specific pressures and threats
- **Fitness for purpose** (for each indicator needed):
  - Define the minimum & optimum technical requirements based on application needs
  - List the available products based on various criteria (spatial and temporal resolution, thematic content, geographic and temporal coverage, spatio-temporal consistency)

*Based on SEPLA project analysis (Milenov et al. 2023) & DD assessment on Biodiversity & Compliance Assurance*

- **Next: Prototyping** on selected reference sites

## Soil

- Soil moisture
- Ground movement monitoring

## Hydrology

- Surface water presence & seasonality
- Hydrological modelling

## LC/Vegetation Characteristics

- Land cover/use & changes
- Vegetation indices and phenology
- Vegetation structure

## Environmental and climate impacts

- Water quality
- Fire occurrence and risk
- Meteorological and climate variables



# Challenges and recommendations

- EO Products for monitoring:
  - Lack of HR products and consistent annually updated long-term records for trend analysis
  - Need for developing wetland-specific change analysis methods
- Lack of detailed outline of habitats (needed for pixel aggregation in monitoring analysis)
- Need for addressing data accuracy and uncertainty issues due to insufficient in-situ reference data (CalVal)
- Establishing clear connections between habitat characteristics to EO signals is challenging due to significant variability across the EU's diverse landscapes
- Need to integrate multiple data sources: EO (from various sensors), ecological expertise, in-situ measurements and modeling techniques
- Need for a user-friendly platform to improve products accessibility and enable analysis at local and regional scales

# Thank you



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