

# Biodiversity and ecosystem e-science: the LifeWatch infrastructure

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LifeWatch-ERIC

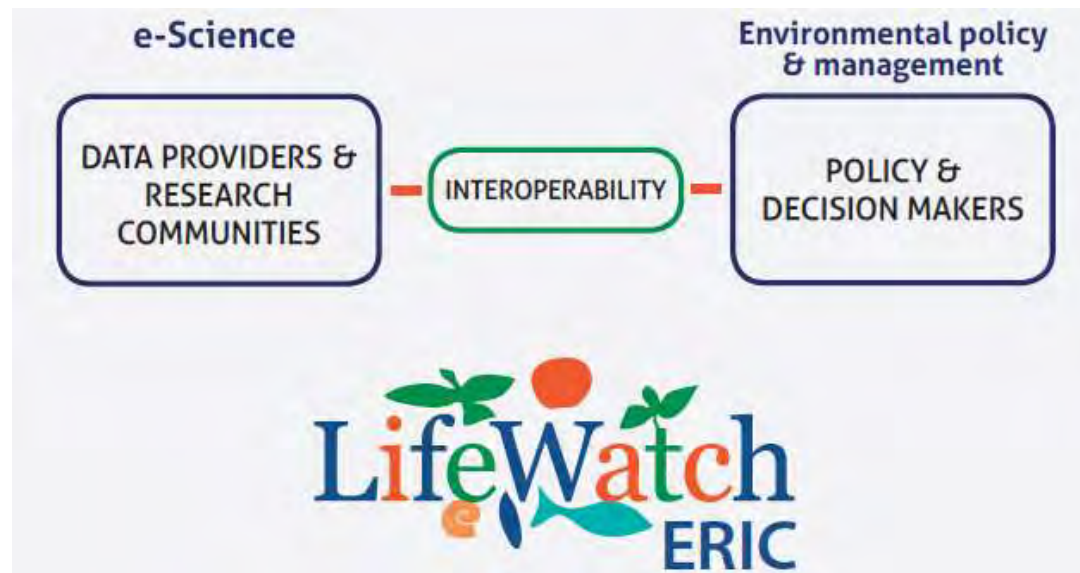


“SPACED: Using Earth Observations to Protect Natural Landscapes”  
Brussels January 10<sup>th</sup>, 2018



This project is funded by  
the European Union

LifeWatch is the **European Infrastructure** supplying **e-Science** research facilities for scientists seeking to increase our knowledge and deepen our understanding of **Biodiversity** organisation and **Ecosystem** functions and services, with the goal of supporting **civil society** in addressing the key planetary challenges.



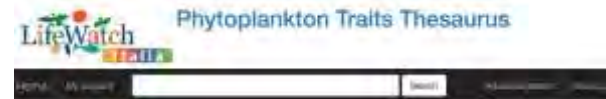
DATA RESOURCES



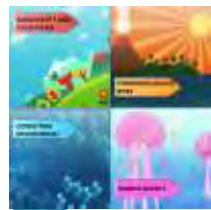
Catalogue of Life



DATA SERVICES



Tools, Services &  
Virtual Research Environments



ETRAINING SERVICES



COMPUTATIONAL POWER &  
REMOTE SENSING

**BiMaS**  
Biodiversity Monitoring and Assessment

**Q-LAB**  
LifeWatch Virtual Research Environment

**IGI-LIFEWATCH / INDIGO-WP2 Case Study**

**Monitoring & Modelling ALGAE BLOOM in a Water Reservoir**

LIFE+ Project used by a SME, collecting monitoring data, environmental status, water quality and sediment profiles, and modeling hydro-thermo-dynamics.

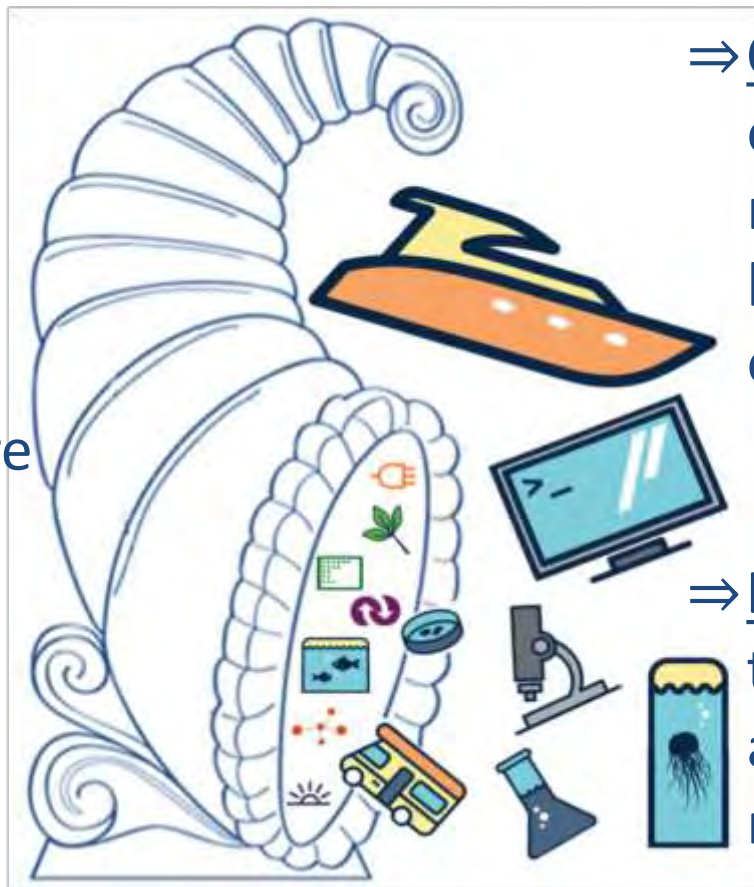
- USE WETTED TORSION BAROMETRIC LAKE USE
- HYDROLOGICAL INPUT
- ESTIMATION OF CHLOROPHYLL A

**PRESERVE NEW OPEN RESEARCH DATA & ANALYSIS**

World already existing in Portugal  
Algarve Water Management, 2000  
Phosphorus, Nitrogen, heavy metals, etc. by

DATA SERVICES

LifeWatch-ERIC is:  
⇒ **Data driven:** the data available are the real infrastructure;



⇒ **Community driven:** orienting construction to run frontier research on biodiversity and ecosystems;

⇒ **ICT driven:** innovation & technology for big data aggregation, analysis & modelling.



## LIFEWATCH-ERIC MAIN SCIENTIFIC DIRECTIONS

### Computer Science

Core Technologies & Computation



Semantics



Tools & Orchestrator



Apps



### Data



### Biological Science



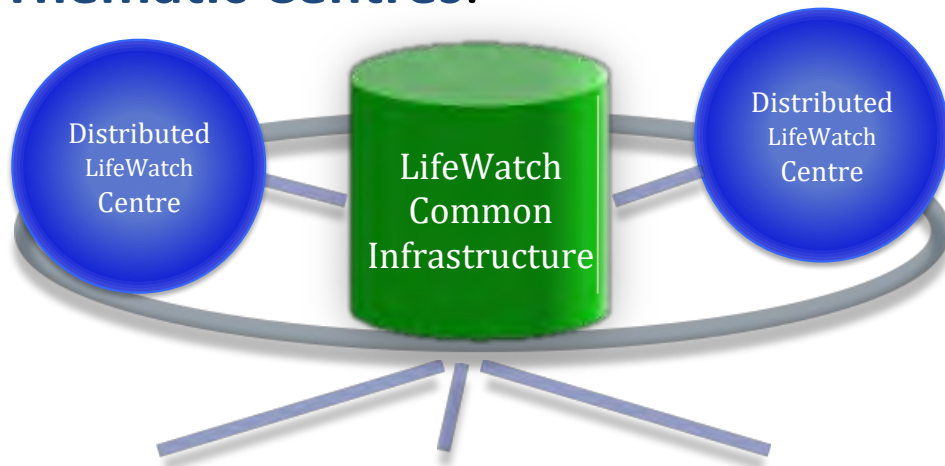
Priorities  
Questions?  
Requirements?

- ← Providing data
- ← Validating facilities
- ← Running experiments
- ← Building new knowledge
- ← Deepen understanding
- ← Supporting policy

LifeWatch Community

LifeWatch e-infrastructure

LifeWatch-ERIC is a distributed infra-structure, operating through **Common 'central' Facilities** and **Thematic Centres**.



**Thematic Centres** are in member countries (and REGIONS) and develop components of the **e-Science facilities**

*Virtual Labs and Innovations Centre*  
(Amsterdam, The Netherlands)



*Service Centre*  
(Lecce-Regione Puglia, Italy)



*Headquarters-Statutory Seat & ICT e-Infra Office*  
(Andalusia, Spain)



TYPE: distributed  
 COORDINATING COUNTRY: ES  
 MEMBER COUNTRIES: BE, EL, ES, IT, NL, PT, RO  
 March 7<sup>th</sup>, 2016 update  
 PARTICIPATING COUNTRIES: FI, FR, HU, NO, SE, SI, SK

#### TIMELINE

- ESFRI Roadmap entry: 2006
- Preparation phase: 2008-2011
- Construction phase: 2011-2016
- Operation start: 2016

#### ESTIMATED COSTS

- Capital value: 66 ME
- Operation: 10 ME/year

#### HEADQUARTERS

Statutory Seat: Seville (ES)  
 Common facilities: ES-IT-NL

#### WEBSITE

<http://www.lifewatch.eu>

**Distributed LifeWatch-ERIC Centres** are new infrastructures or upgrades of existing facilities, managed by **national networks**.

## LifeWatchGreece Research (e-)Infrastructure

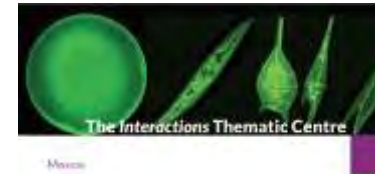


They provide access to:

- ⇒ Distributed observatories/sensor networks;
- ⇒ Interoperable databases or data-networks;
- ⇒ High Performance Computing (HPC), Grid, Cloud and Big Data technologies;
- ⇒ Apps for data visualization, analysis and modeling

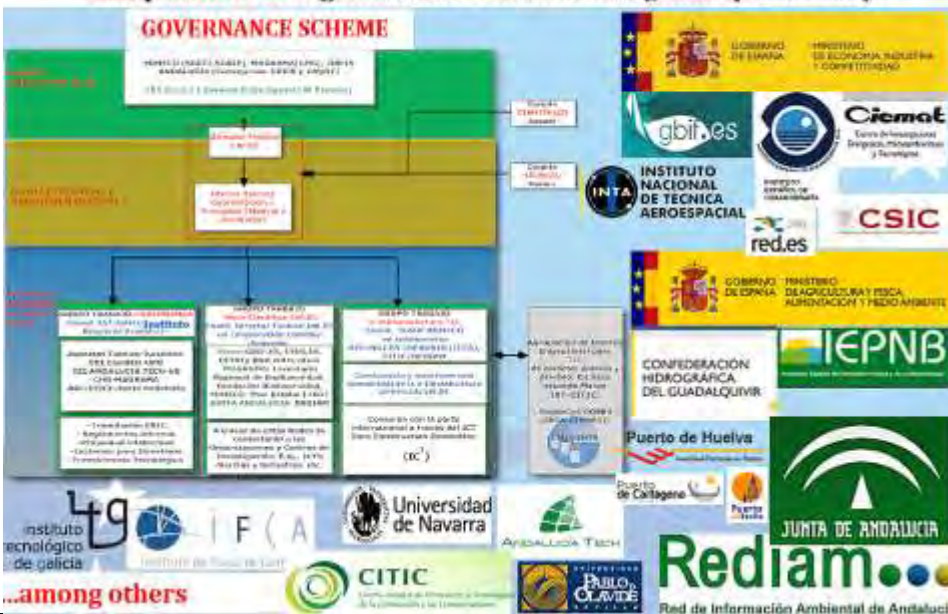


LifeWatch-ERIC national networks (BE, EL, ES, IT, NL, PT, RO, SI) include a large and representative component of academic and research institutions and national authorities.



**LIFEWATCH SPAIN Community** is structured by its Joint Research Unit (acronym **JRU LW.ES**)

Composed of **30 Organizations & Institutions** (January 8<sup>th</sup>, 2018)



**LifeWatch.BE**



**Flanders**  
VLIZ RESEARCH INSTITUTE NATURE AND FOREST

- Taxonomic backbone
- Observatory
- Data bases and systems
- Data services
- Data archeology



**OBSERVE**

Observatories



**Wallonia - Brussels**  
FEDERATION WALLONIE-BRUXELLES

- Habitat characterization by remote sensing
- Ecotopes database



**ACCESS**

Data Services



**Federal**  
AntaBIF Antarctic observations  
BopCo  
LifeWatch Scientific Node



**ANALYZE**

Virtual Labs

“SPACED: Using Earth Observations .....”



⇒ **LW-ERIC** construction starting date is March 22<sup>nd</sup>, 2017; so, the research infrastructure is currently ‘under construction’.

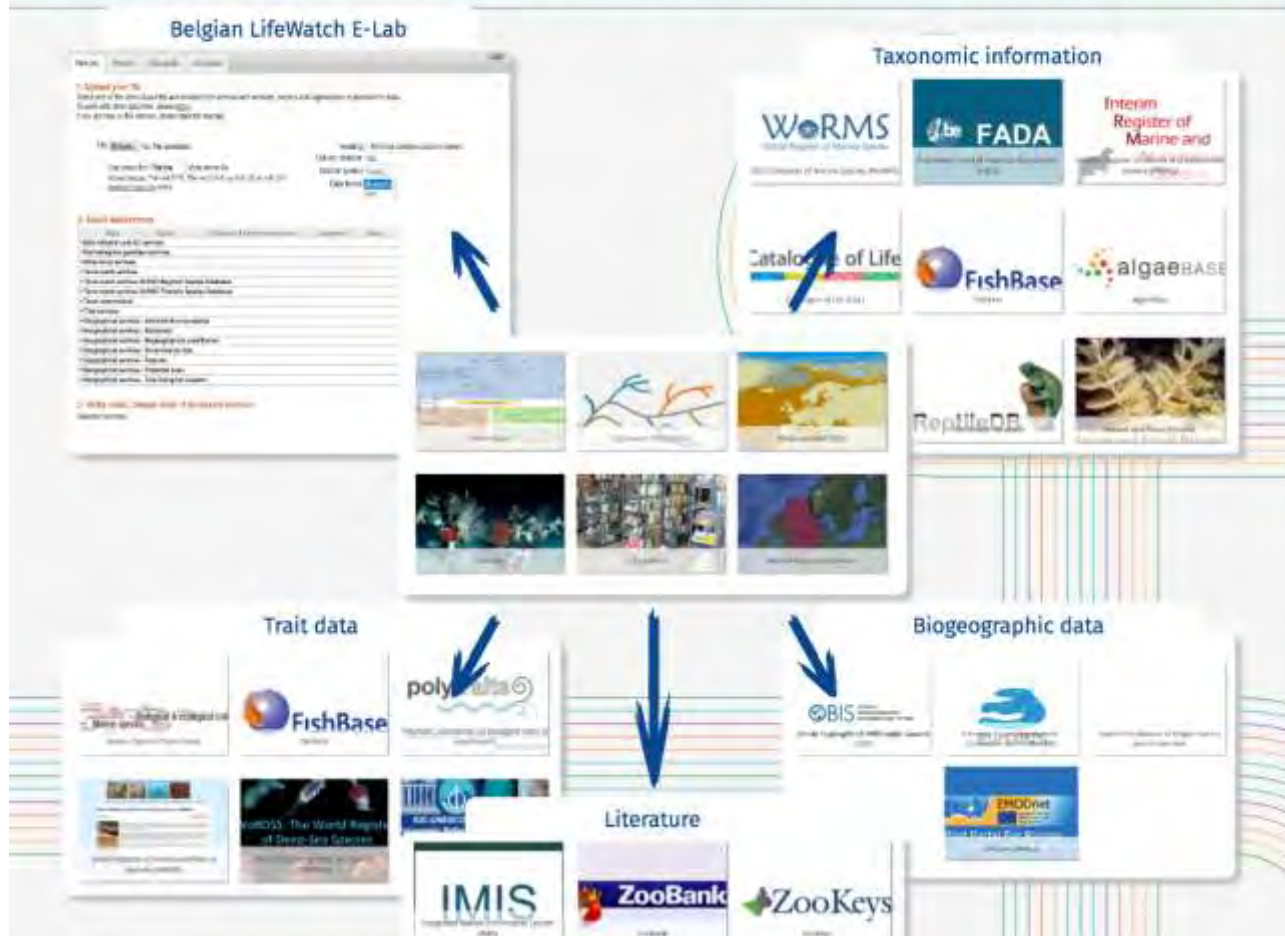
However:

⇒ **LW national nodes** started their construction during the LW transition phase; so

⇒ **LW-ERIC** is integrating what already built by the national nodes or anyway available from other sources, being already **operational while under construction**

# Taxonomic Backbone

Open Data services providing species information and data in support of biodiversity research



## BIOMAS Bioinformatic analysis of Metagenomic Amplicons

A bioinformatic pipeline designed to support biomolecular researchers involved in taxonomic studies of environmental microbial communities.

Fosco G, Santamaría M, Mazzano M, Alonso-Alemán O, Valero G, Dorado G, Menico A, Natarangelo P, Peñal G.  
BIOMAS: a modular pipeline for bioinformatic analysis of Metagenomic Amplicons. BMC Bioinformatics 2019 PMID: 31031112



## Micro-CT vLab

Data creation, processing and publication within Micro-CT vLab



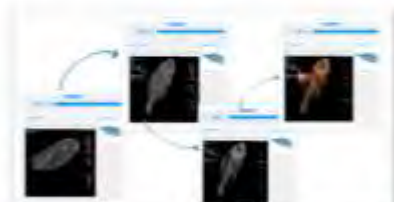
Micro-CT vLab web interface



Micro-CT mobile app



The SliceDrop software functioning



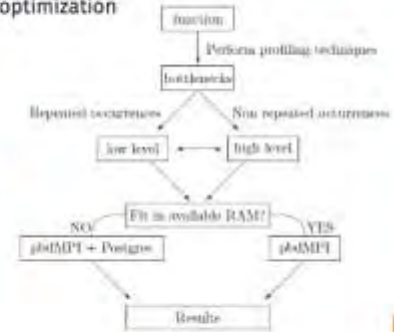


# RvLab

## General architecture design



## Overall pipeline for the optimization



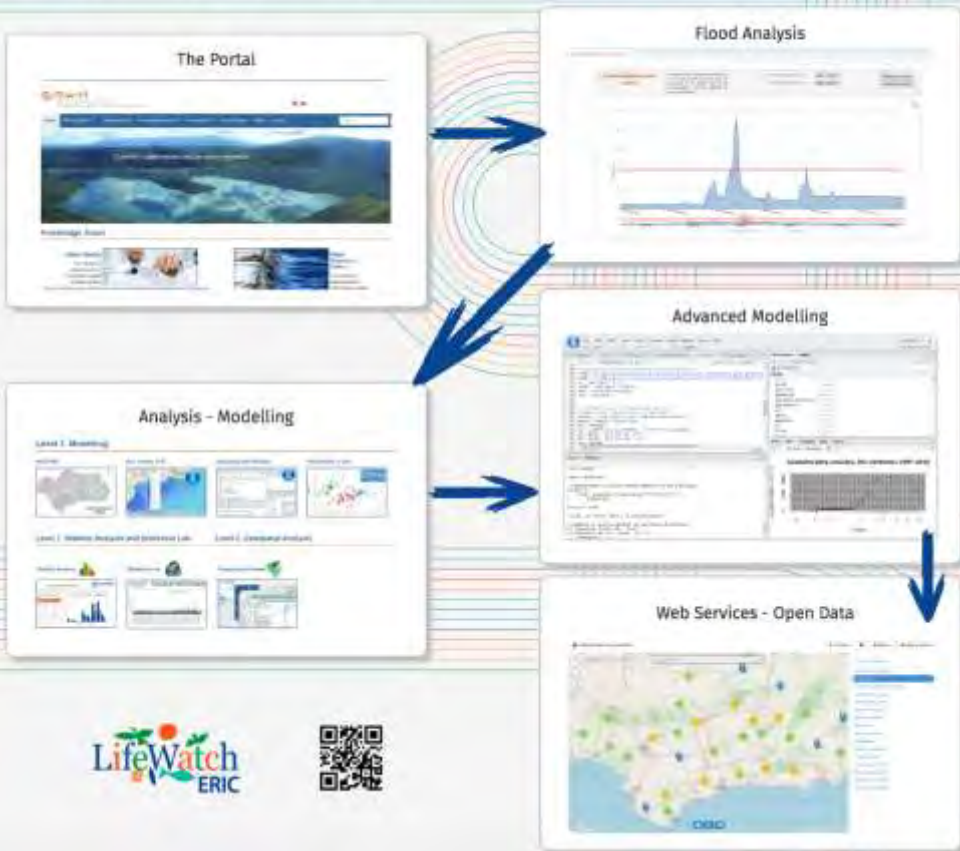
## Results page of RvLab



## RvLab main interface



## SWIRL Scenario-based Water Innovation and Research Laboratory



## Building a Virtual Research Environment for Bird behaviour analyses

The migratory behaviour of birds is one of the most fascinating study areas for biologists and laymen alike. Tracking individual bird movement at multiple scales in space and time is no easy task, but technological advances now provide unprecedented opportunities to study individual birds in great detail. A team at the University of Amsterdam has worked together with support from LifeWatch to develop a flexible, state of the art, Bird Tracking System (JvA-BiTS). Researchers from many organizations are working with this system to study migration, navigation, foraging strategies on land and at sea.



Core information comes from solar powered, light weight GPS trackers with rechargeable batteries, a tri-axial accelerometer, and two-way data-communication to a ground station network. The data is processed automatically and can be visualization in a Virtual Lab environment with (Google Maps) geo-spatial information. But for this type of research it is also essential that data of individual behavior is combined with other sources of data, for instance the weather during migration, and information on land use and habitat availability. These data are also made available in the Virtual Lab.

Current collaborative projects include work in many countries (including Spain, Italy, Belgium, Netherlands, Sweden, Norway, Finland, Germany, Denmark, France, UK, Chile, Australia, USA, South Africa and Oman). The system is available for collaborative research and will continue to develop fostering research needs of a diverse community.



LifeWatch aims to further advance the virtual research environment to study (bird) migration, by supporting the technological developments of the tracking system, providing ICT core support to allow upscaling of the capabilities to analyze and interpret the data, and provide user support for researchers and stakeholders throughout the world that want to use the system for their collaborative research.





## Marine Virtual Research Environment Alien Species Virtual Research Environment

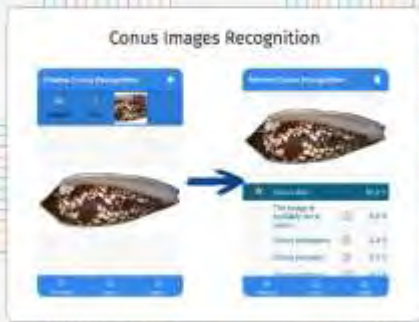
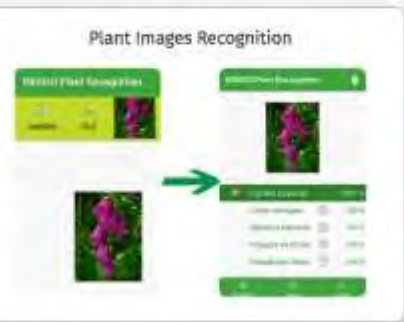
A marine virtual research environment providing open data services in support of marine biodiversity and ecosystem research

A macroecological approach to biological invasion





## Citizen Science Initiatives



## LIFE+RESPIRA

Reduction of exposure of cyclists to urban pollutants | Reference: LIFE13 ENV/ES/000417



## LW-ERIC CONSTRUCTION PRIORITIES INCLUDE:

- ⇒ To establish and operate the infrastructure and information system necessary to mobilise and integrate data and algorithms for biodiversity and ecosystem research, including....societal challenges such as **climate change adaptation and mitigation**....;
- ⇒ Support to and cooperation with national and international facilities and initiatives.....with respect to data mobilisation and data sharing, computational capacity .....
- ⇒ To **foster the exploitation of data and products from Copernicus**, ..... Environmental information is of crucial importance to understanding how our planet and its ecosystems are changing

## TO FOSTER THE EXPLOITATION OF DATA AND PRODUCTS FROM **COPERNICUS**

- ⇒ Building services for data aggregation (Copernicus earth observation) and interoperability with other external sources of abiotic and biotic data and for modelling;
- ⇒ Boosting the development of innovative technologies for enlarging the categories of information on biodiversity, trait diversity and inter-individual interaction detectable through remote sensing;
- ⇒ Establishing/strengthening collaborations with research initiatives and facilities focused on environmental information and monitoring through earth observation & remote sensing.



## TO FOSTER THE EXPLOITATION OF DATA AND PRODUCTS FROM COPERNICUS

- ⇒ Services for Copernicus Earth observation data aggregation and interoperability with other sources of abiotic and biotic data;
  - ⇒ *Ground truth* calibration of remote sensing data;
  - ⇒ Aggregation of *big data*;
  - ⇒ Data interoperability.
- ⇒ Technologies for biodiversity, trait diversity and inter-individual interaction data collection by remote sensing:
  - ⇒ Enlarging categories of biodiversity and trait diversity data *detectable from remote*;
  - ⇒ Boosting the development of *ground truth* proxies of bio-ecological data, as environmental metagenomics is, but detectable by remote sensing;

Monitoring:  
'keystone' species  
Ecosystem status  
Status change  
Ecosystem services

- ⇒ Species risk of extinction
- ⇒ Ecosystem risk of collapse

# TO FOSTER THE EXPLOITATION OF DATA AND PRODUCTS FROM COPERNICUS

⇒ Establishing/strengthening collaborations with research initiatives and facilities focused on environmental information and monitoring through earth observation & remote sensing;



Biodiversity is life  
Biodiversity is  
our life

