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European Biodiversity Partnership

Towards a roadmap for implementation of novel biodiversity monitoring methods

Biodiversa+ expert workshop

REC

The recording of the plenary sessions of this workshop are recorded and will be shared on the Biodiversa+ website and Youtube channel

2nd of February – 9am to 12.30pm CET

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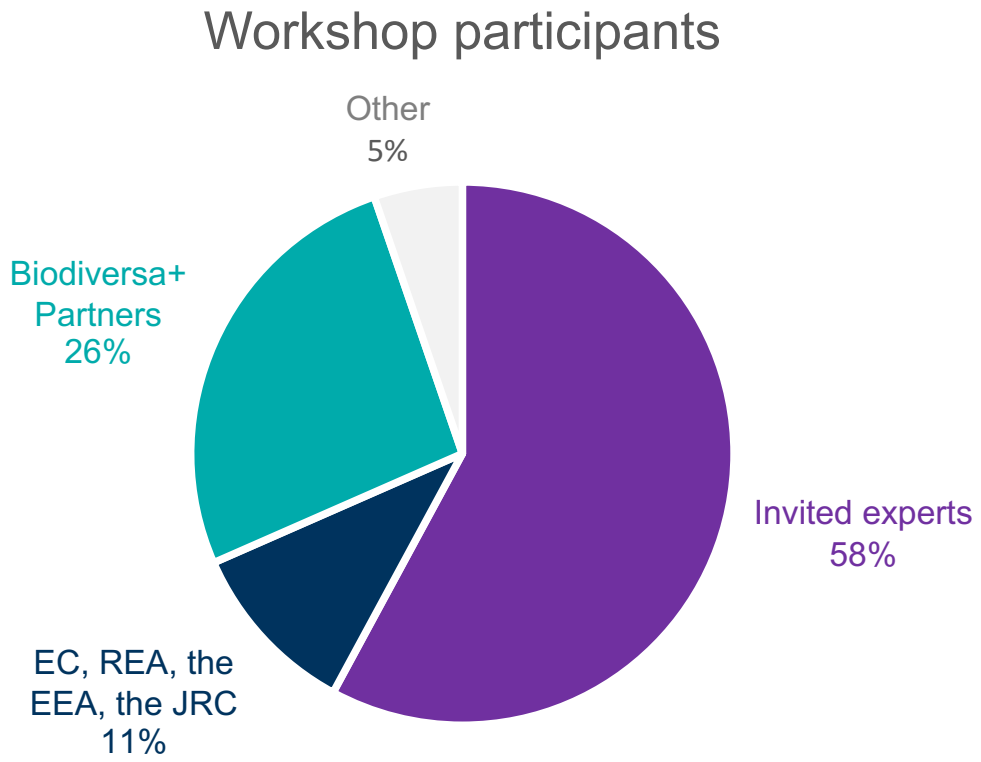
Welcome words

By Lars Dinesen, IFD

Registered participants

60
Registered participants



Agenda of the workshop

9.00 – 9.15: Welcome words and aims of the workshop, Lars Dinesen & Hilde Eggermont

9.15 – 10.30: Key presentations of 10 minutes each followed by 5 minutes of Q&A

Break

10.45 – 12.10: Breakout in four thematic groups

Back to plenary

12.10 – 12.20: Plenary and wrap-up

12.20 - 12.30: Next steps and conclusion of the workshop

Aims of the workshop

- Provide input to a roadmap for *implementation* of novel biodiversity monitoring methods
- This roadmap will guide future Biodiversa+ work
- It will promote operationalisation novel monitoring and identify research gaps
- Will build on work undertaken by EuropaBON
- Look into the need and opportunities for standardization
- The work will feed into future activities in the partnership

Follow-up of the workshop

- Development of a roadmap guiding the Biodiversa+ activities (by Biodiversa+)

- The experts attending the workshop will have an opportunity to provide feedback

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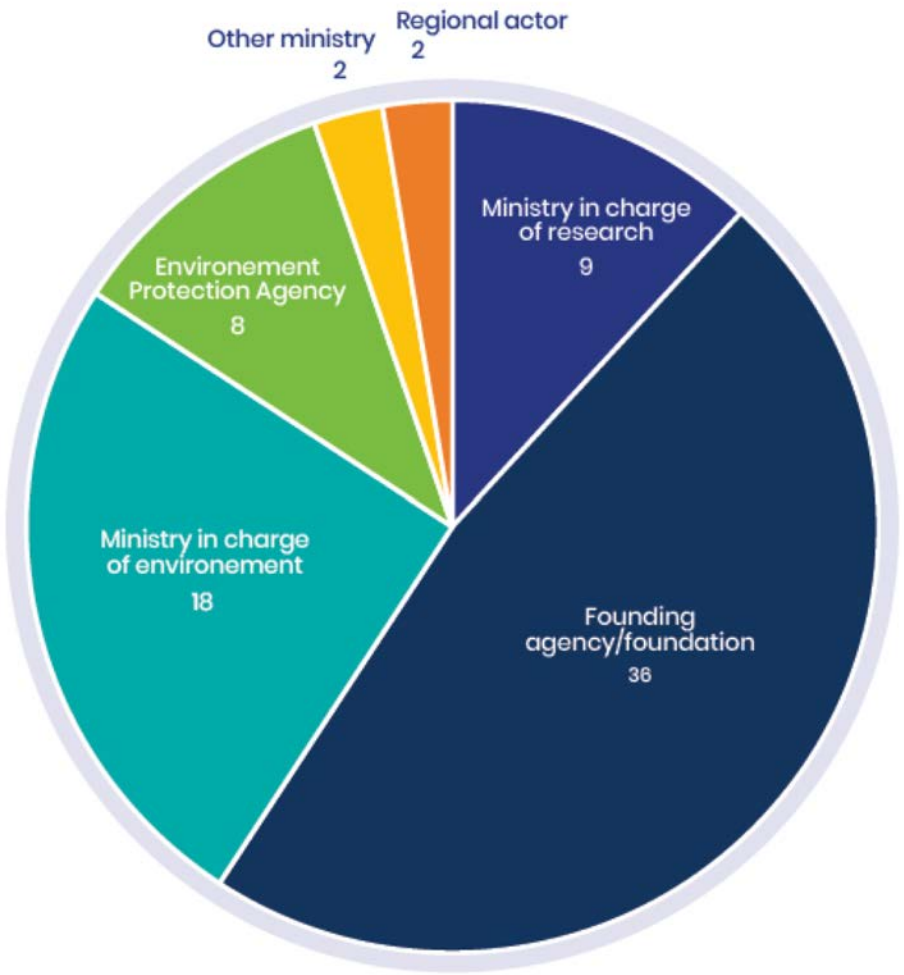
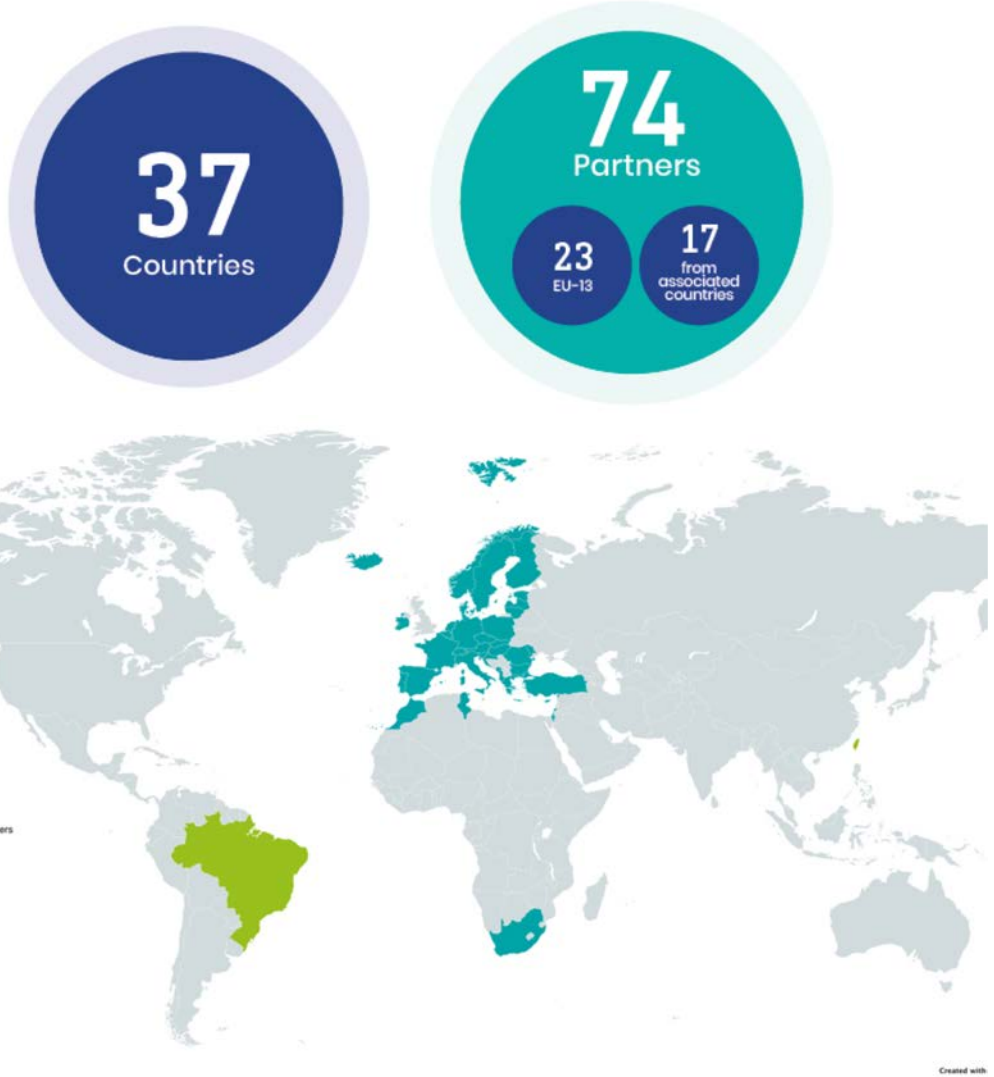
Biodiversa+ introduction

By Hilde Eggermont, BelSPO, Biodiversa+ Chair & Coordinator

Biodiversa+ membership





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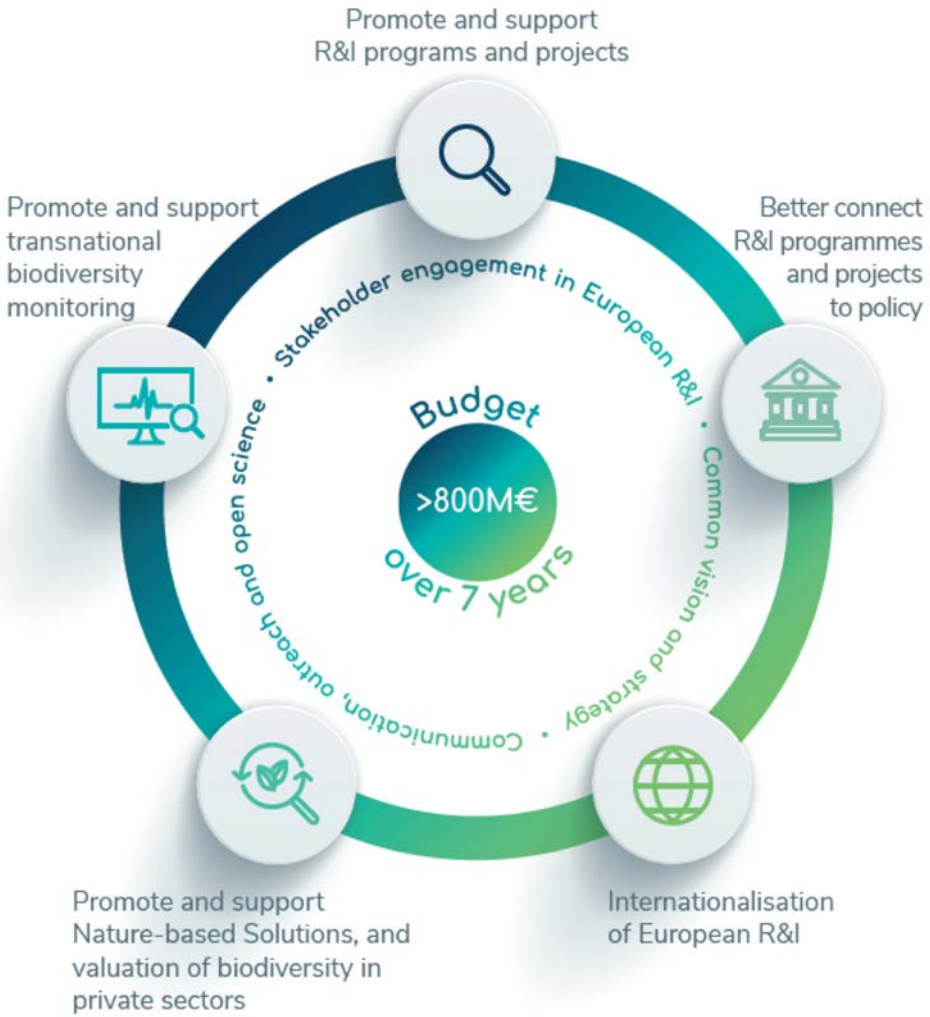
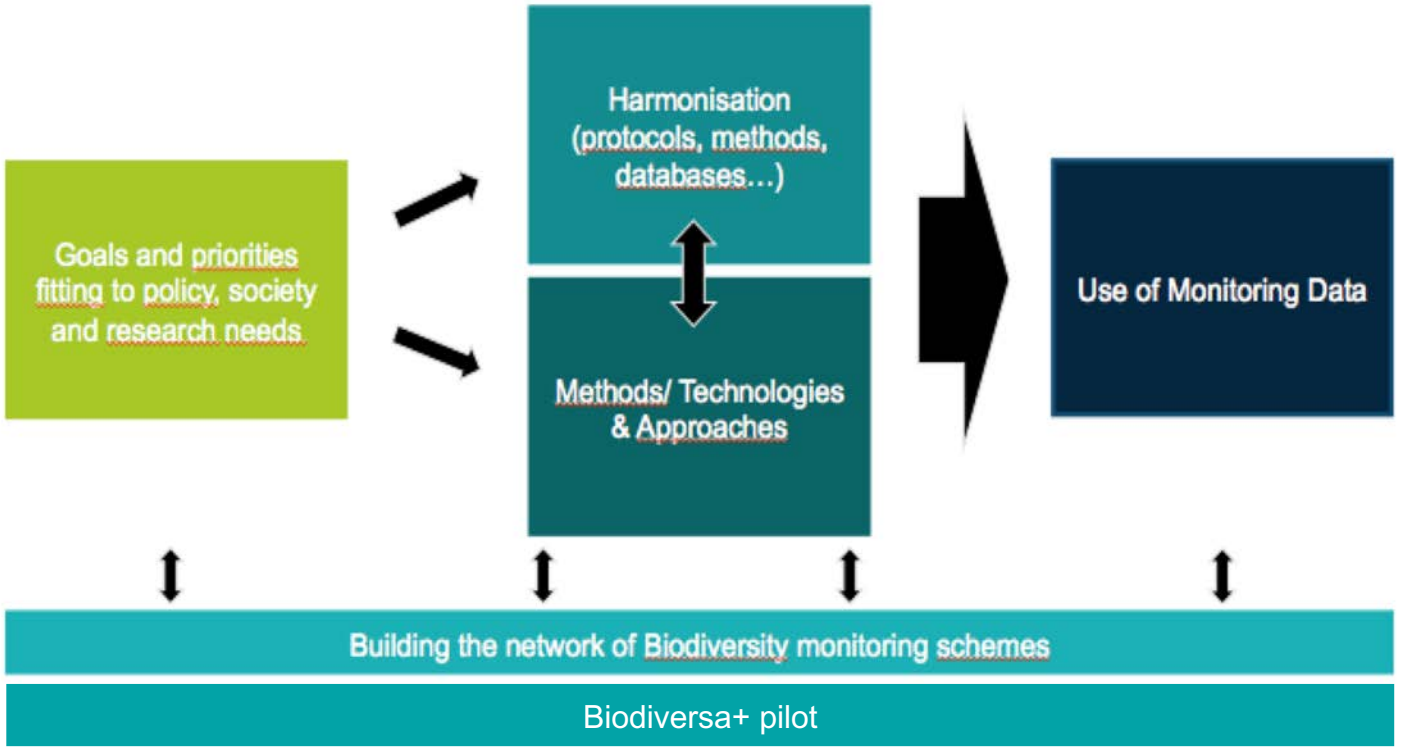
Aligned with the policy context

EU Biodiversity Strategy 2030:

"… making the bridge between science, policy & practice..."

Biodiversity monitoring activities





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EEA

Knowledge Centre for Biodiversity

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www.biodiversa.eu

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Setting the scene

Facilitation by Lars Dinesen and Toke Thomas Høye, IFD

Upcoming key presentations

9.15 - 9.30 Cher Chow, EuropaBON – lead author of report on novel technology for biodiversity monitoring

9.30 - 9.45 Elaine van Ommen Kloeke – showcasing ARISE as a large national biodiversity technology infrastructure

9.45 – 10.00 Florian Leese, University of Duisburg-Essen and coordinator of DNAquaNET - developing standards for molecular biodiversity assessments in freshwater ecosystems

10.00 - 10.15 Adrià López-Baucells and Charlotte Roemer - Acoustic monitoring of bats – a showcase of implementation

10.15 - 10.30 Markus Erhard - European Environmental Agency – How to ensure FAIR data in the implementation of novel technologies and data streams for biodiversity monitoring?

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Main outcomes of the EuropaBON report on novel technology for biodiversity monitoring

By Cher Chow, EuropaBON – lead author

WP 4.2

Novel biodiversity monitoring technologies and methods

Cher Chow, Rob Patchett & Maria Dornelas

CENTRE FOR BIOLOGICAL DIVERSITY, UNIVERSITY OF ST ANDREWS

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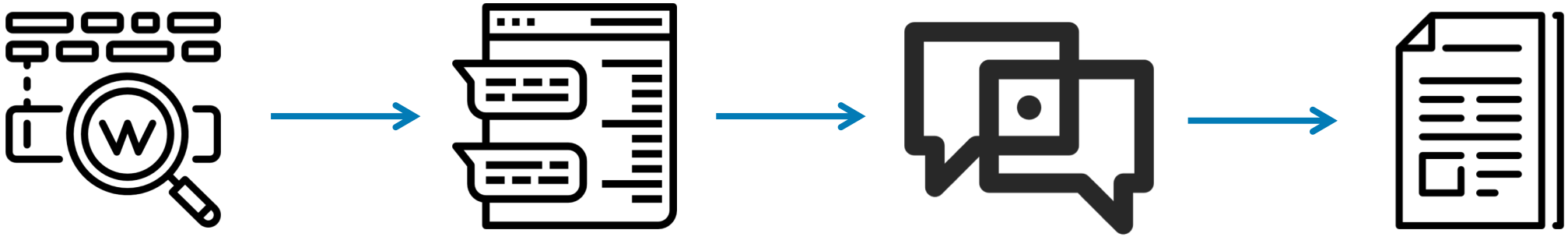
Task aims

1. Identify and systematically characterise emergent/novel methodologies, method components, and/or technologies for monitoring biodiversity according to criteria including but not limited to method readiness/maturity, methodology type, taxonomic applicability, addressed Essential Biodiversity Variables (EBVs), and spatiotemporal coverage

2. Assess whether identified novel methods are suitable and ready to implement in EuropaBON's biodiversity monitoring workflow co-design

3. Identify areas in biodiversity monitoring that are not appropriate for novel methods

Task workflow



Initial search + compilation (categorization, spreadsheet)

External expertise input via survey

Workshop discussion to assess methods thematic sessions by taxa and method classes

Review on findings + assessment

Novel methods meta-database

- Bottleneck solved
- Method Category
- DevStage
- Est Cost
- EBV classes
- Input data type
- Output data type
- Target habitat
- Target taxa
- Pitfalls
- Main advantages
- Validation
- Temporal resolution
- Temporal extent
- Spatial resolution
- Spatial extent

Metadatabase sheet

Preliminary view from literature

285 methods

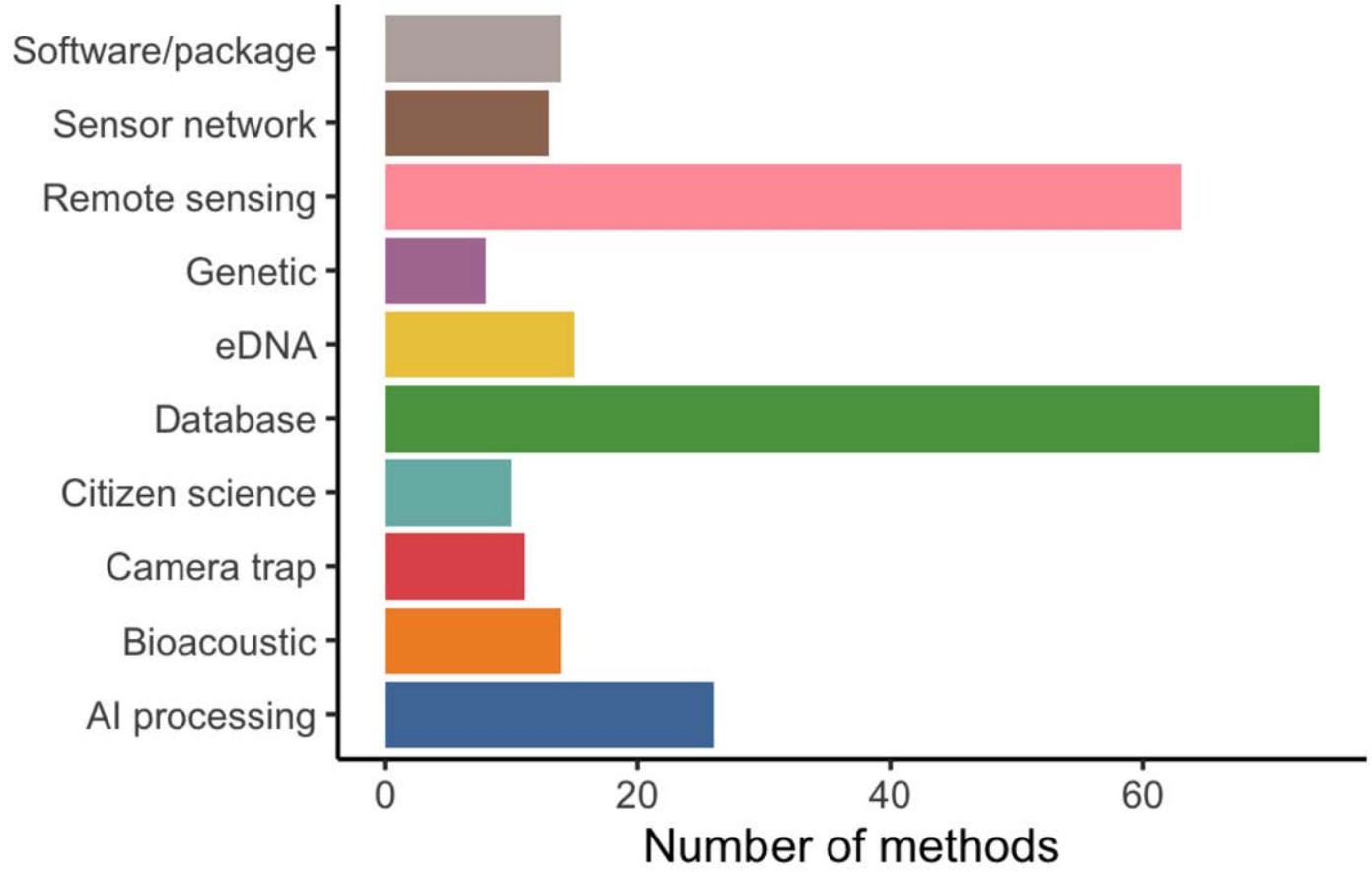
BOTTLENECKS

162 data collection methods

56 analysis methods

60 data integration methods

54 whole pipeline methods



Workshop (May 11-13, 2022)

Discussion focus on critical assessment of implementation

- **Day 1 and 2**: Breakout sessions grouped by taxa expertise and EBV
- **Day 3**: Overarching ideas across all taxa, methodology types, EBVs

Targeted invites to researchers, industry professionals, NGO coordinators, government agencies

207 registrants

111 participants

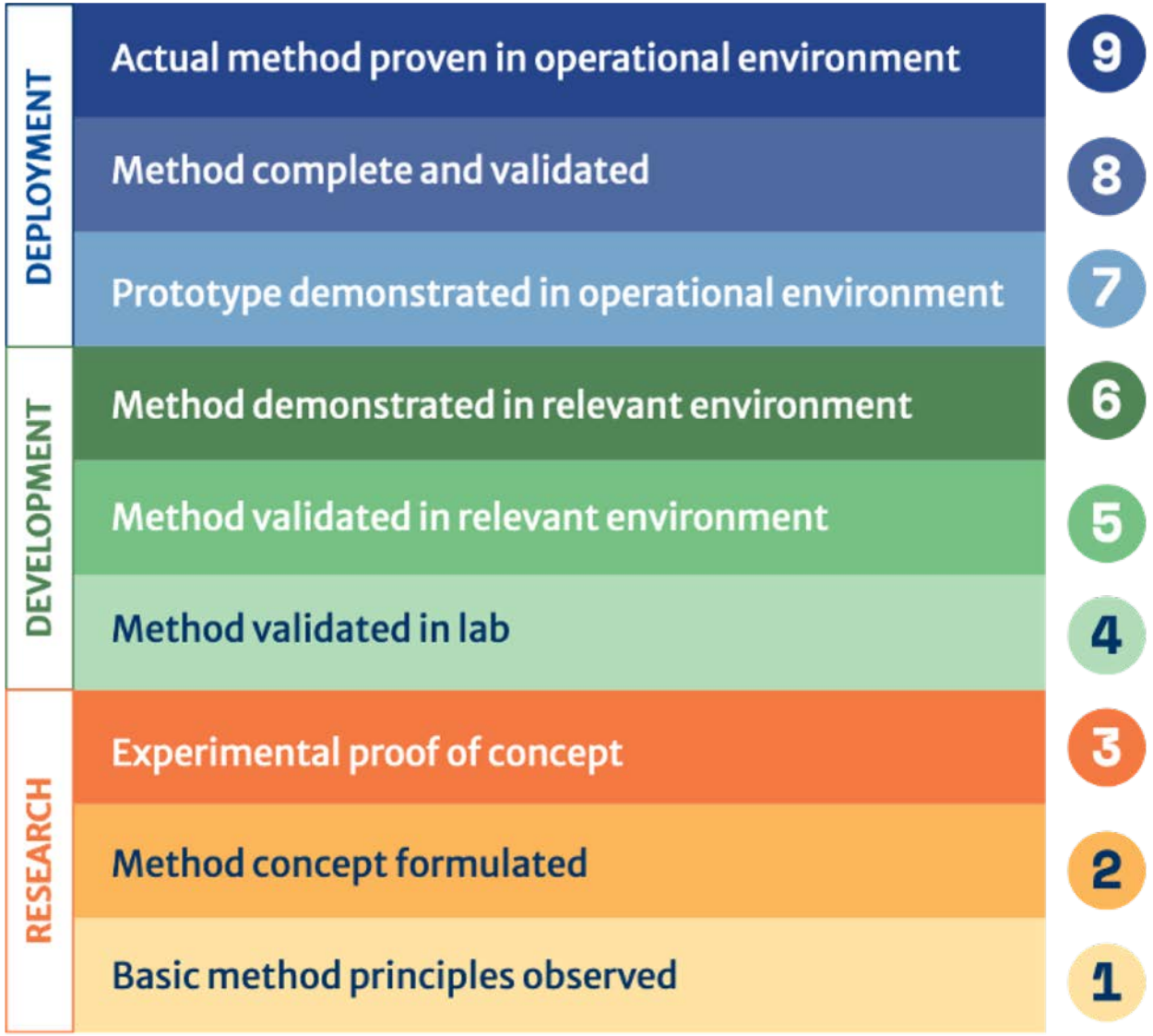
157 potential co-authors

36 countries

Discussion objectives

- Identify novel methods and technologies (not widely used in monitoring)
- Classify methods by technology readiness (NASA scale)
- Assess main strengths and opportunities in practical implementation
- Understand implementation needs and gaps we cannot yet address
- Scientific and sociological reasons to not change methods

Technology Readiness Scale



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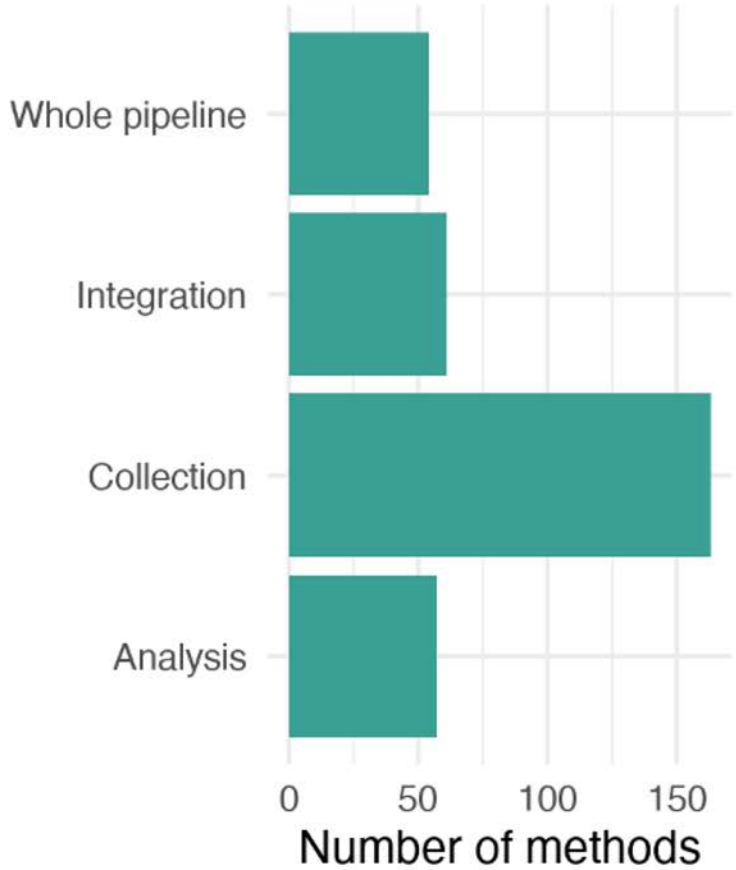
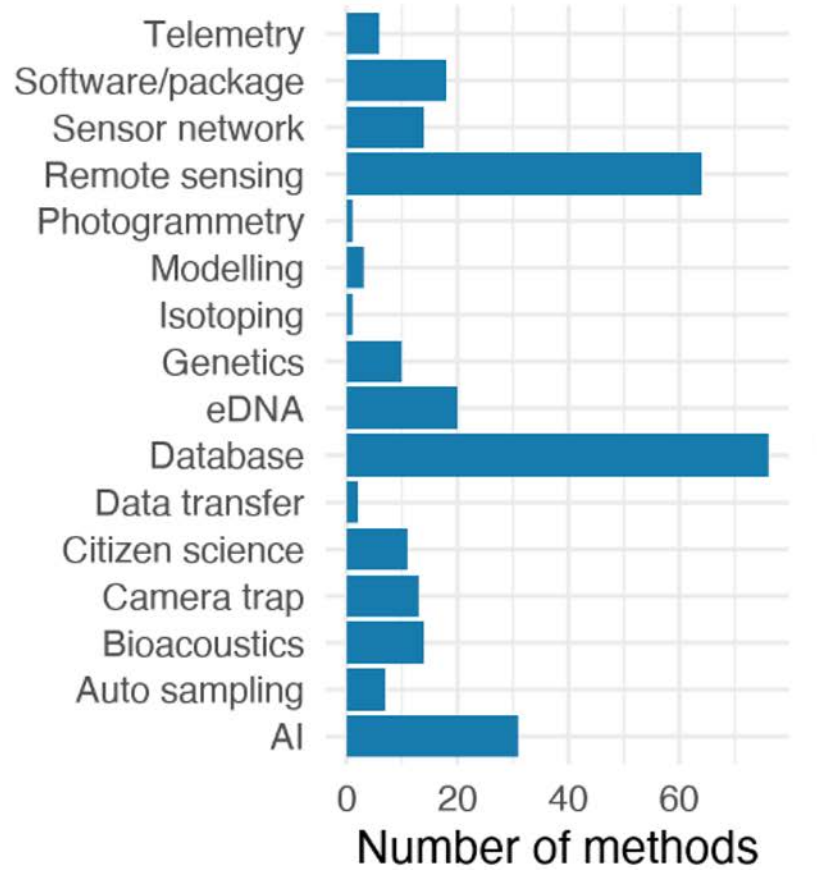
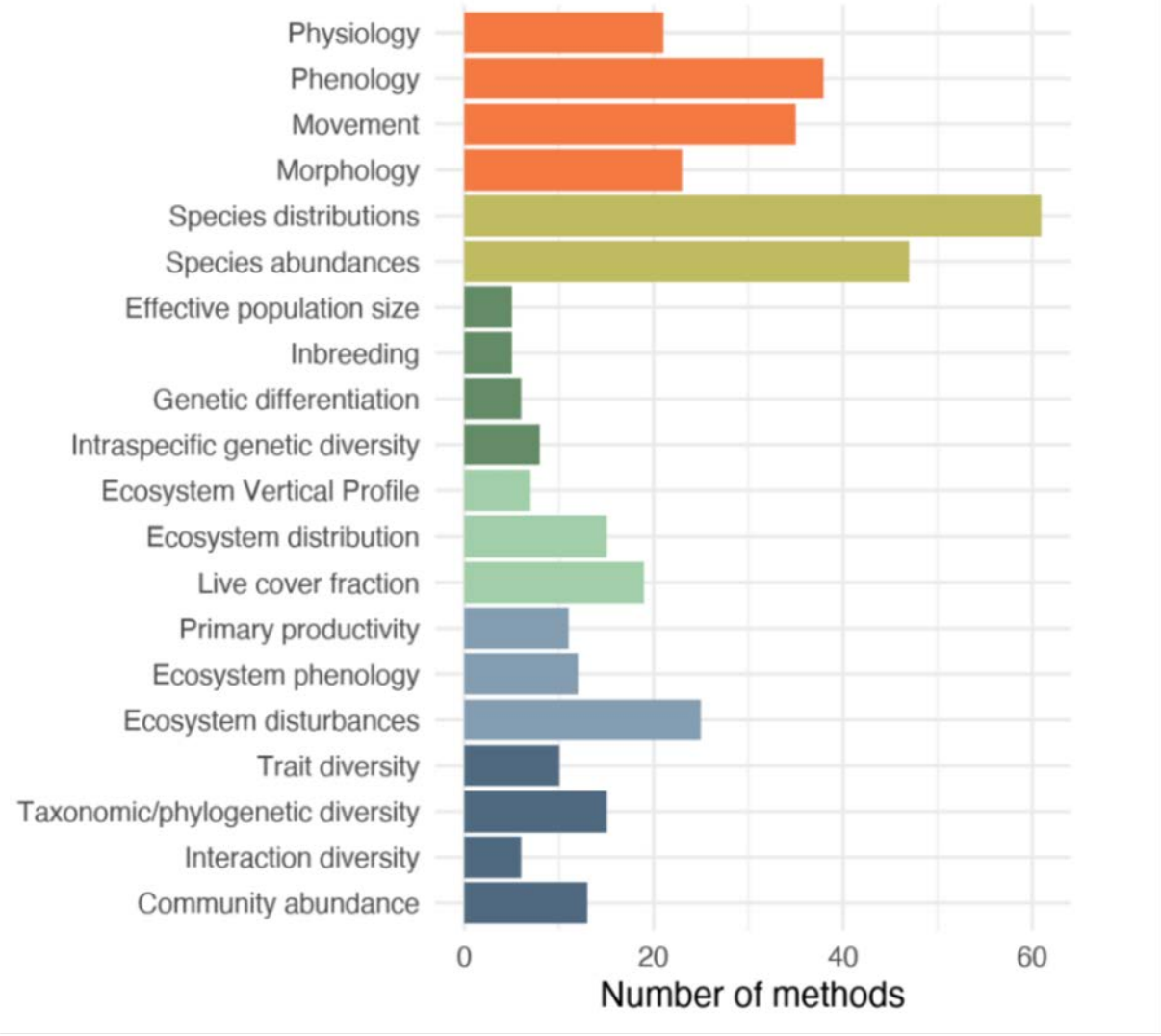

Whole pipeline
Integration
Collection
Analysis
0
50
100
150
Number of methods


Telemetry
Software/package
Sensor network
Remote sensing
Photogrammetry
Modelling
Isotoping
Genetics
eDNA
Database
Data transfer
Citizen science
Camera trap
Bioacoustics
Auto sampling
AI
0
20
40
60
Number of methods



Almost all target monitoring metrics have some novel methods developed

Saturated, well-studied field

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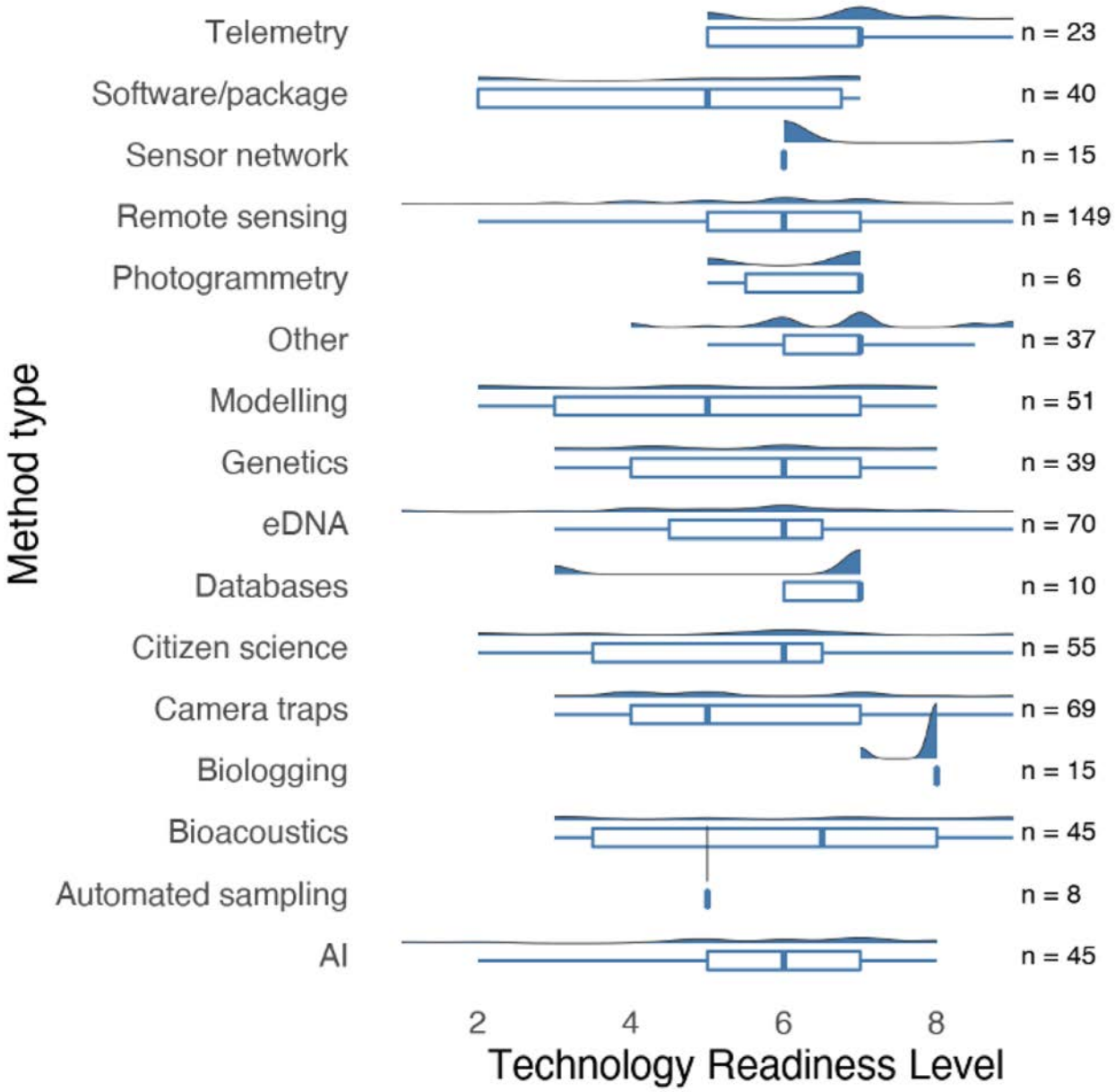
Most method classes had some implementations that were definitely ready for more widespread deployments.

Distribution ranges show that readiness is spread widely for most categories with at least 10 methods



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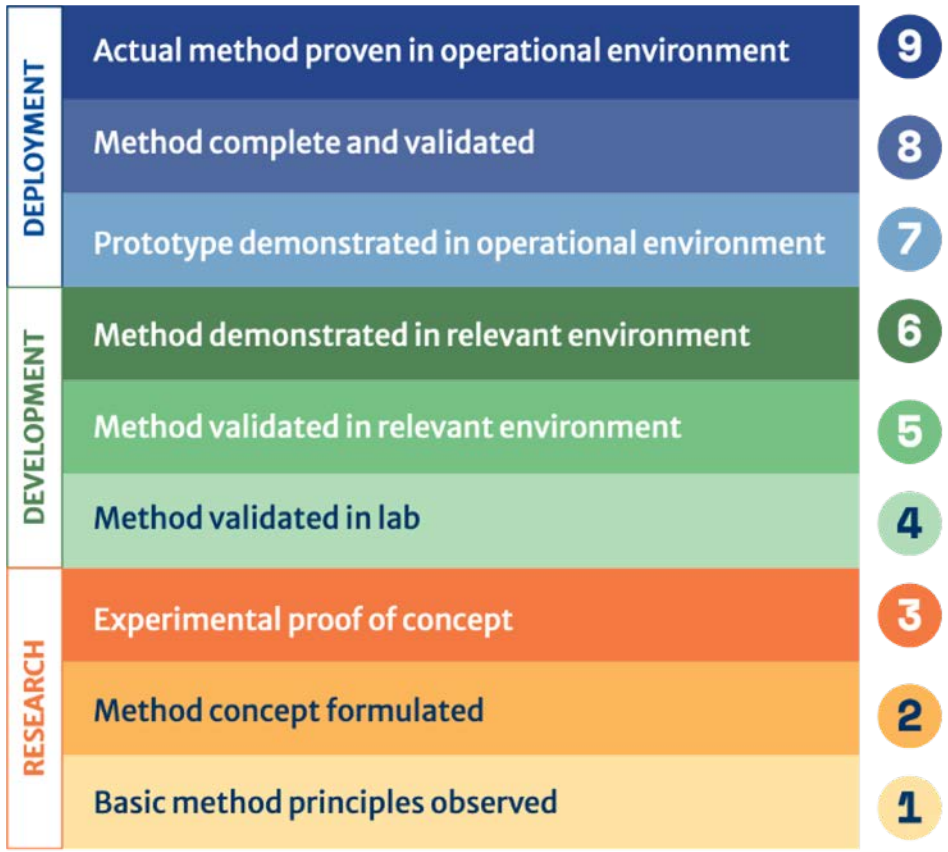
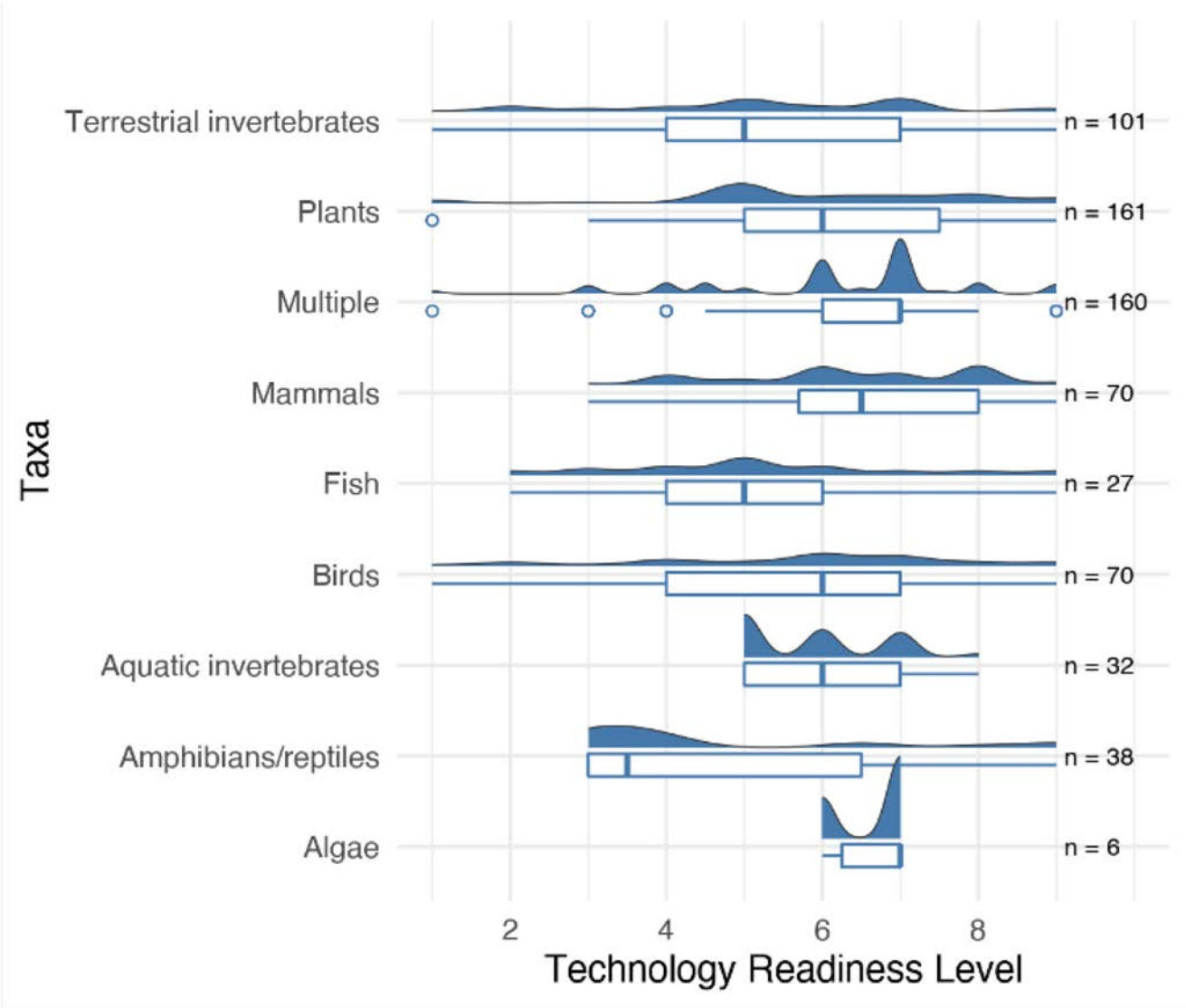

DEPLOYMENT
DEVELOPMENT
RESEARCH
Actual method proven in operational environment
9
Method complete and validated
8
Prototype demonstrated in operational environment
7
Method demonstrated in relevant environment
6
Method validated in relevant environment
5
Method validated in lab
4
Experimental proof of concept
3
Method concept formulated
2
Basic method principles observed
1


Taxa
Terrestrial invertebrates
n = 101
Plants
n = 161
Multiple
n = 160
Mammals
n = 70
Fish
n = 27
Birds
n = 70
Aquatic invertebrates
n = 32
Amphibians/reptiles
n = 38
Algae
n = 6
2
4
6
8
Technology Readiness Level

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Overarching themes

- Need for proper standardisation
  - Interoperable
  - prevents misuse
- Data storage and infrastructure
- Gaps in reference knowledge and databases

Key takeaways

- Validation and testing efforts are largely restricted to a few taxa groups and habitats. Widespread validation is still needed to implement into a Europe-wide workflow
    - Novel tech likely most fit for purpose for specific taxa/EBVs
- The standardisation hurdle: methodology/SOPs, data management and sharing. Common gap
- Longevity as a reason not to change, also initial investments

Next steps

- Synthesising workshop inputs
  - short group session with WP4 members
- Report writing: end of July
- Review manuscript with participants

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Showcasing ARISE as a large national biodiversity technology infrastructure

By Elaine van Ommen Kloeke

ARISE

Authoritative and Rapid Identification System for Essential biodiversity information

Dr. Elaine van Ommen Kloeke
Dr. Chantal Huijbers

arise-biodiversity.nl

UNIVERSITEIT TWENTE.

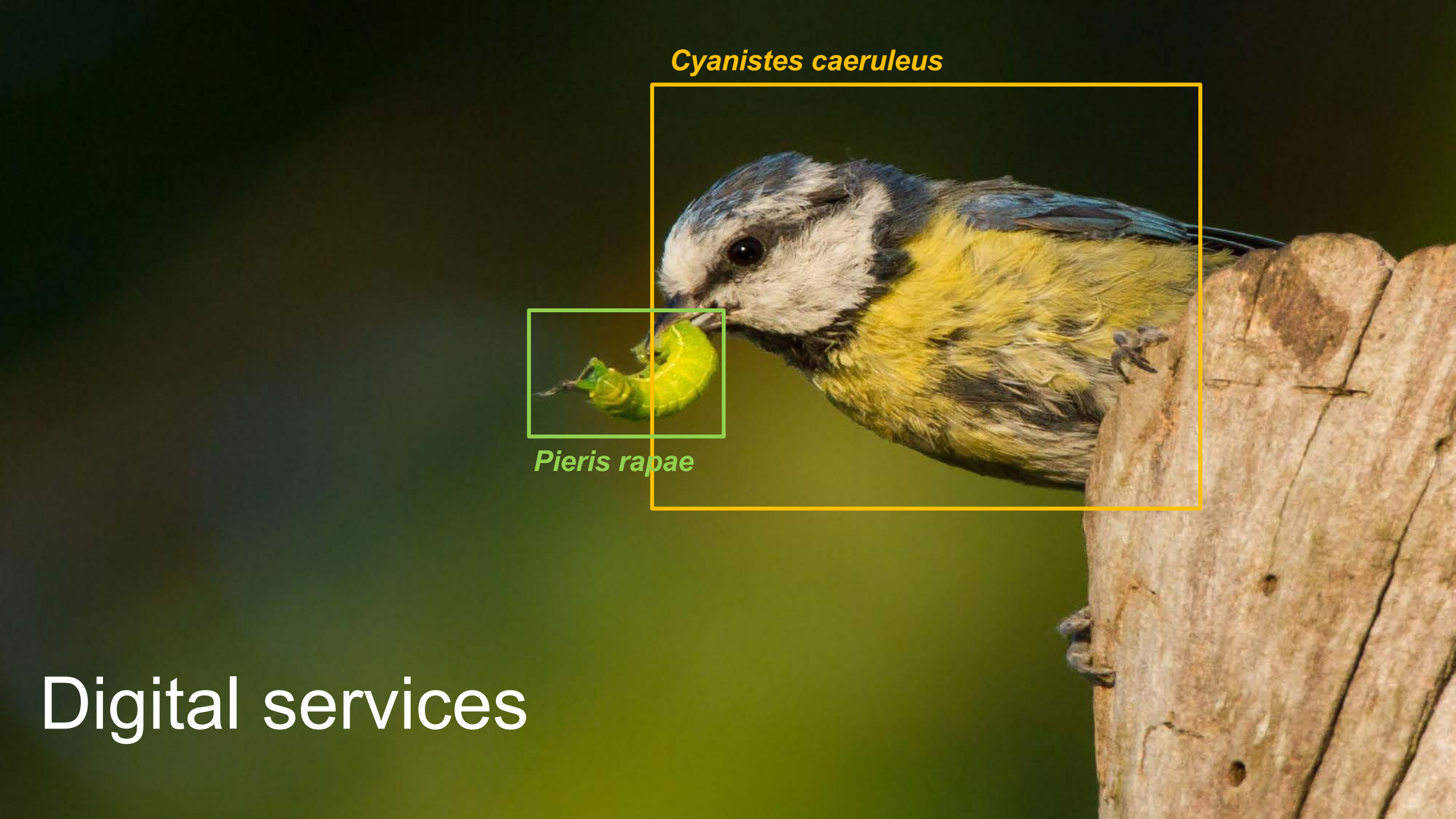
Naturalis Biodiversity Center

WESTERDIJK FUNGALBIO DIVERSITY INSTITUTE

UNIVERSITEIT VAN AMSTERDAM

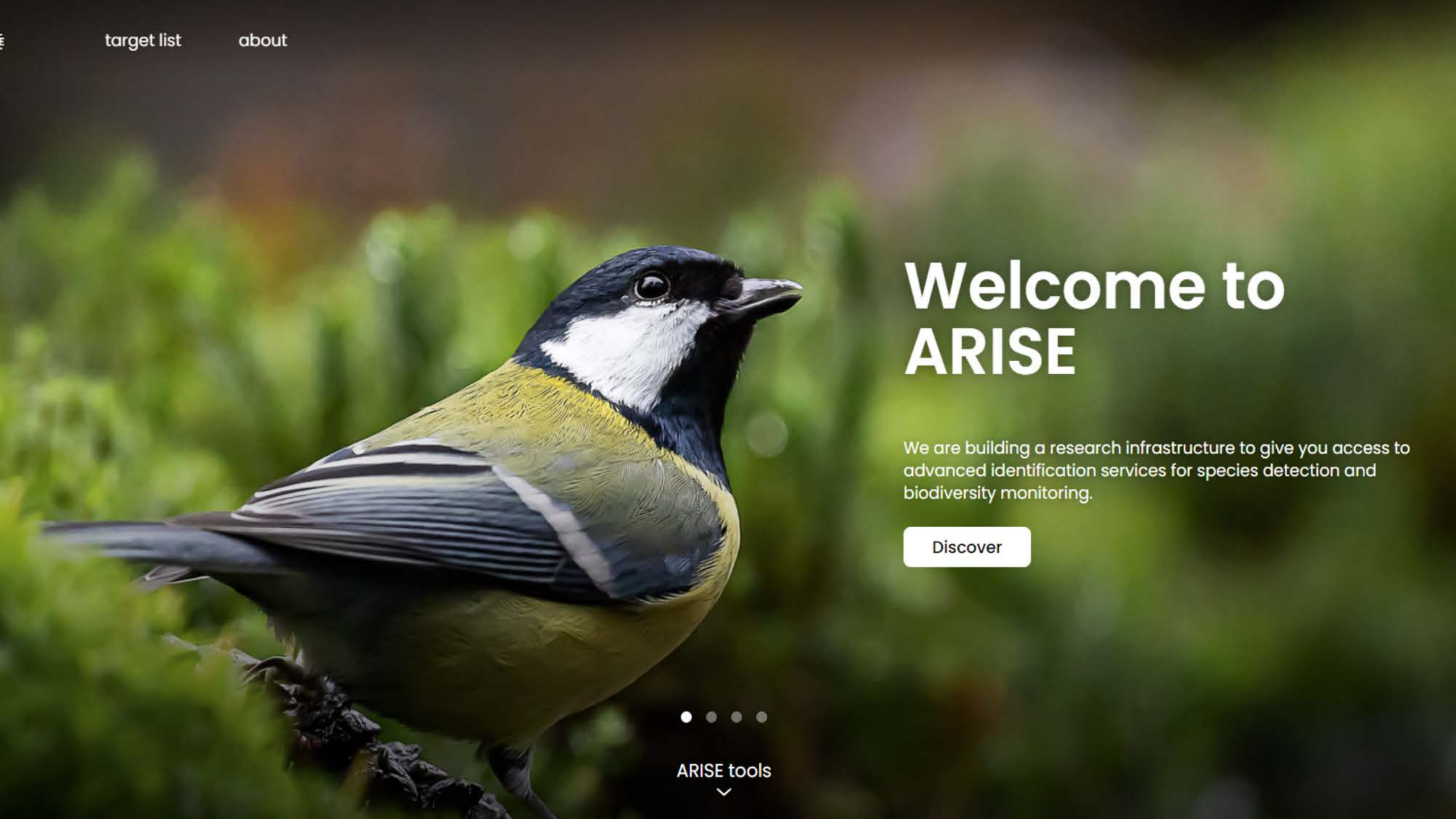

Recognize all species on any location
with new technology
National Research Infrastructure
€18 M
NWO

Innovate



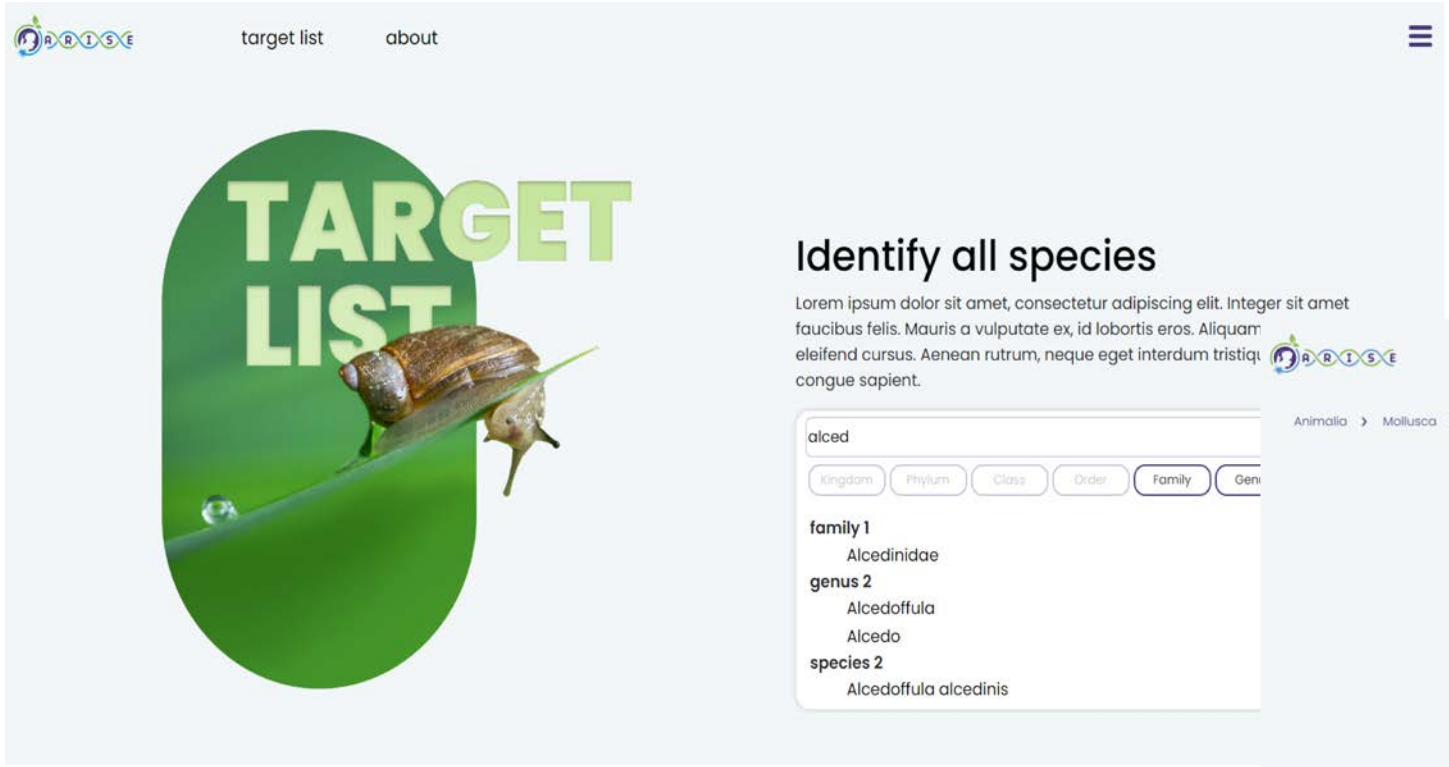
Digital services

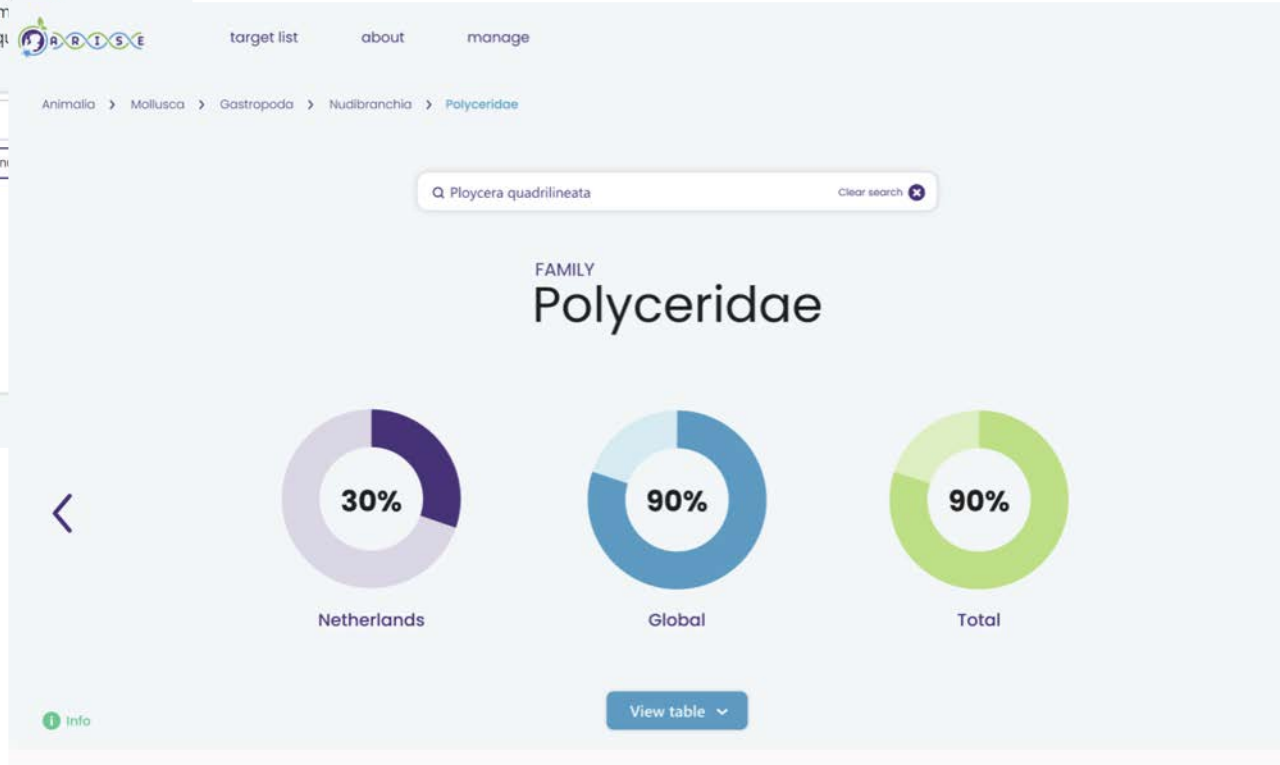

Connected


target list
about
Welcome to ARISE
We are building a research infrastructure to give you access to advanced identification services for species detection and biodiversity monitoring.
Discover
ARISE tools

Demo Target list

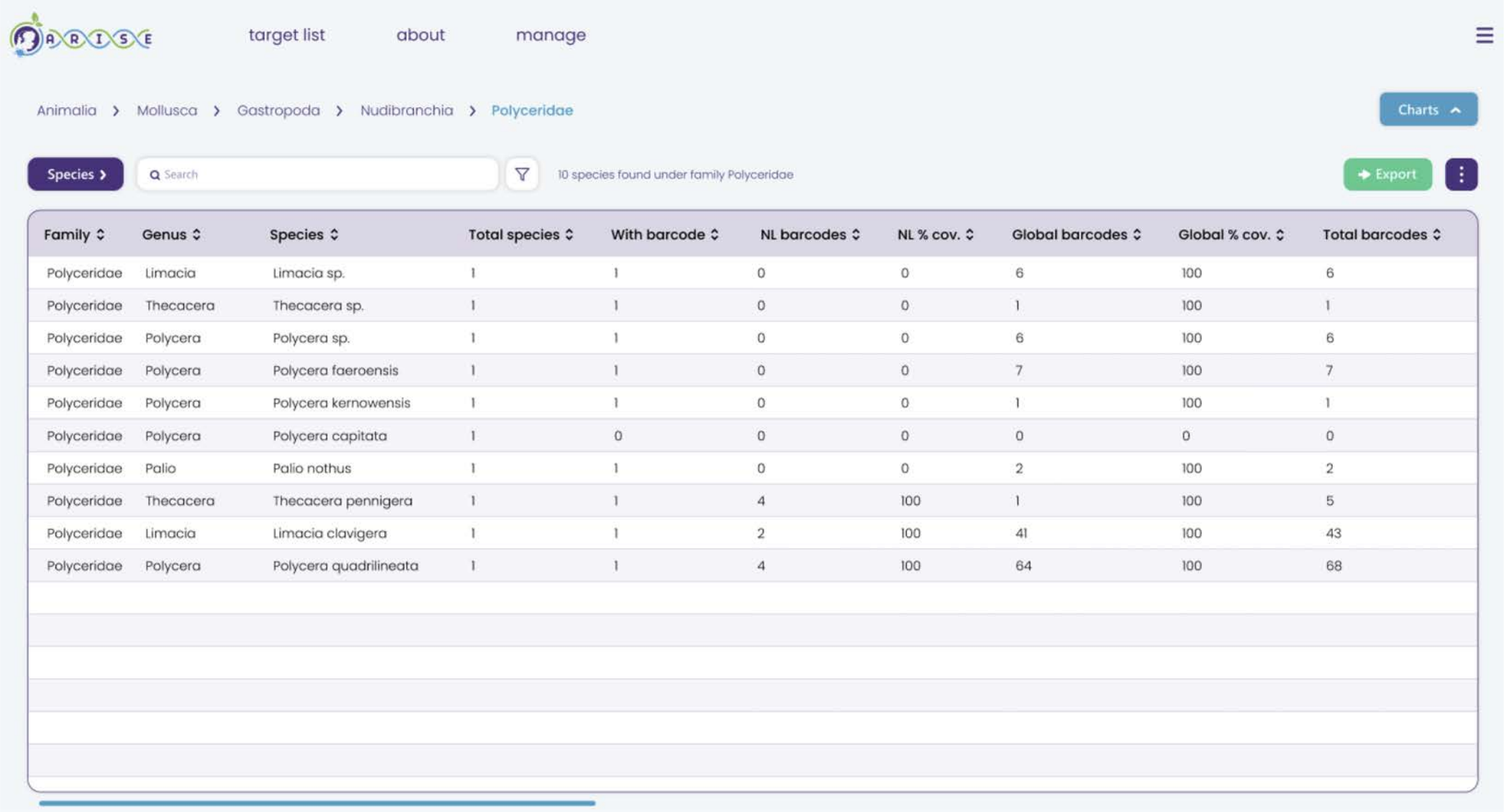
[Targetlist]





Demo Target list

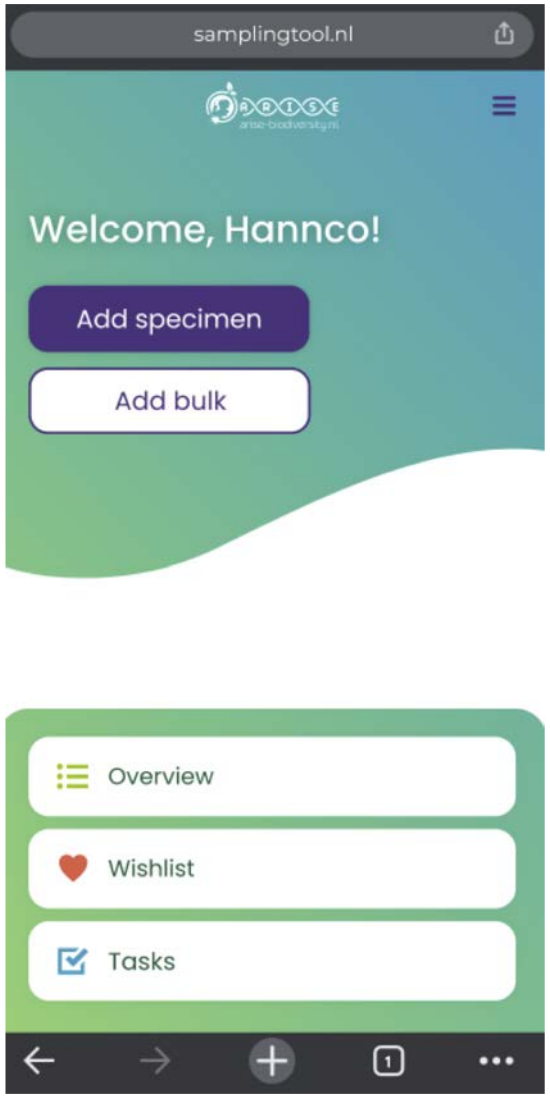
Targetlist

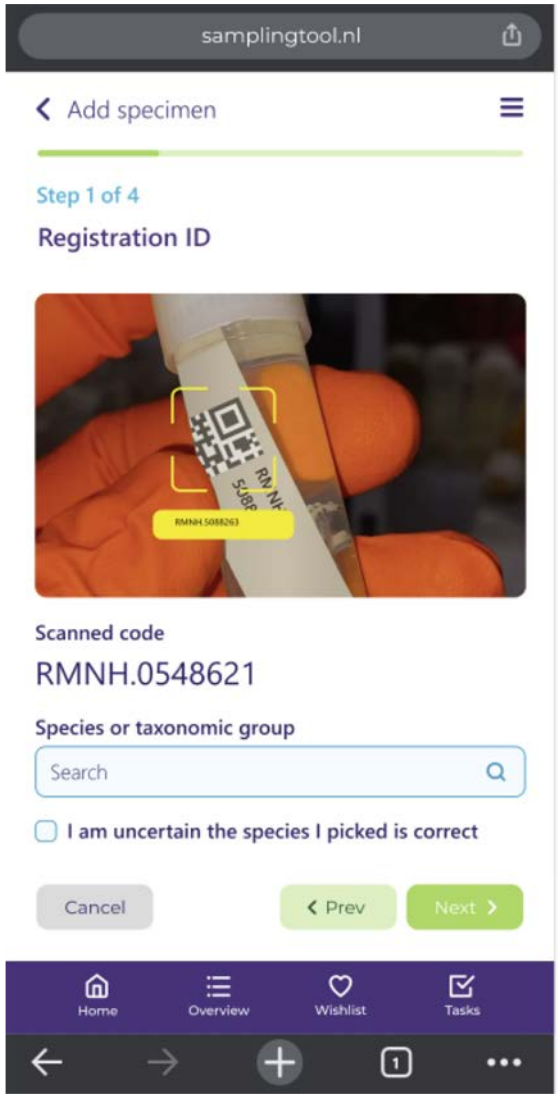


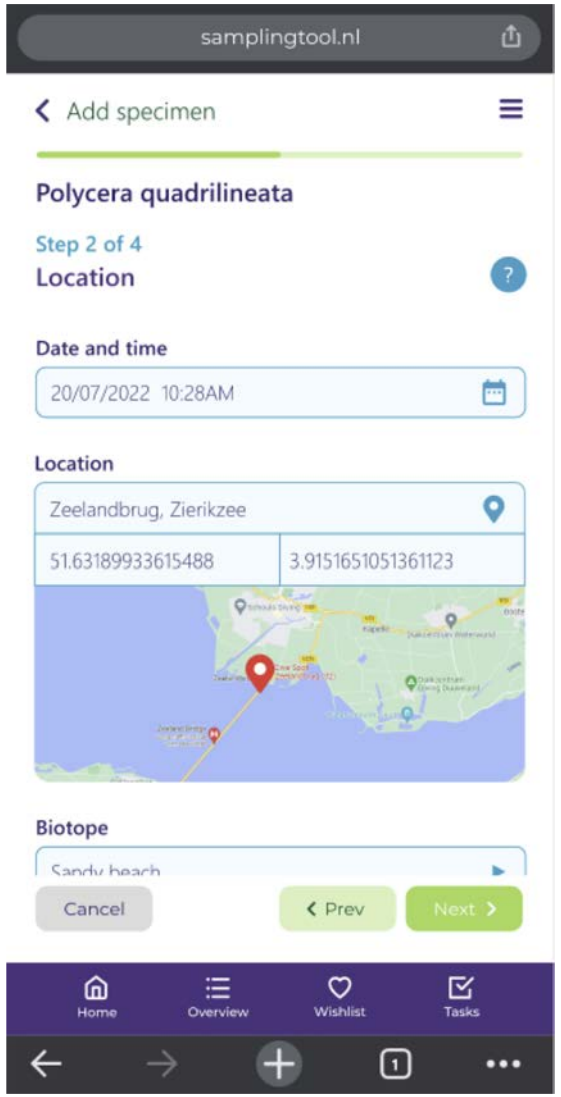
Family	Genus	Species	Total species	With barcode	NL barcodes	NL % cov.	Global barcodes	Global % cov.	Total barcodes
Polyceridae	Limacia	Limacia sp.	1	1	0	0	6	100	6
Polyceridae	Thecacera	Thecacera sp.	1	1	0	0	1	100	1
Polyceridae	Polycera	Polycera sp.	1	1	0	0	6	100	6
Polyceridae	Polycera	Polycera faeroensis	1	1	0	0	7	100	7
Polyceridae	Polycera	Polycera kernowensis	1	1	0	0	1	100	1
Polyceridae	Polycera	Polycera capitata	1	0	0	0	0	0	0
Polyceridae	Palio	Palio nothus	1	1	0	0	2	100	2
Polyceridae	Thecacera	Thecacera pennigera	1	1	4	100	1	100	5
Polyceridae	Limacia	Limacia clavigera	1	1	2	100	41	100	43
Polyceridae	Polycera	Polycera quadrilineata	1	1	4	100	64	100	68

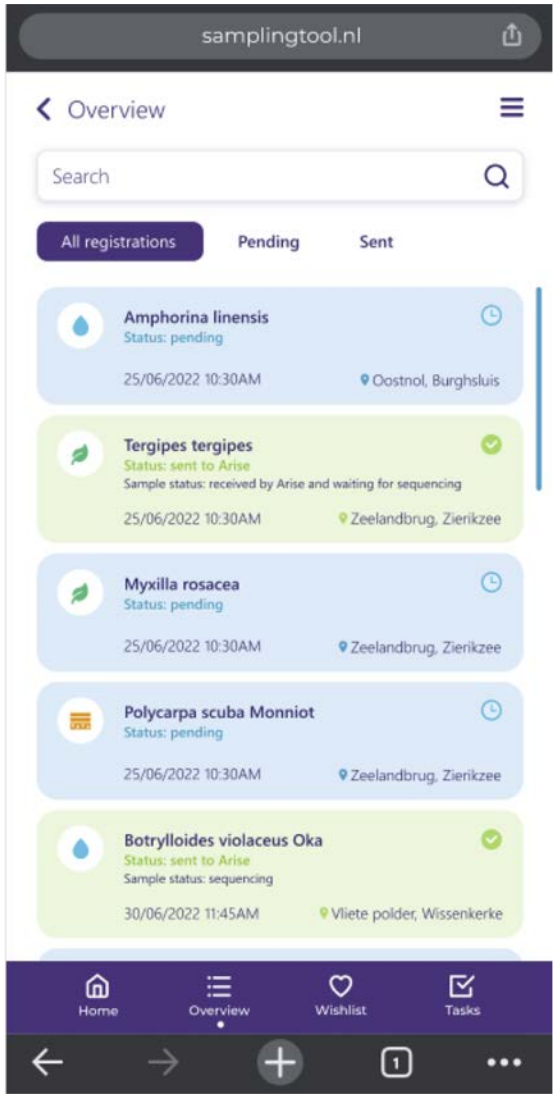
Demo Sampling Tool

[Sampling Tool & Admin]

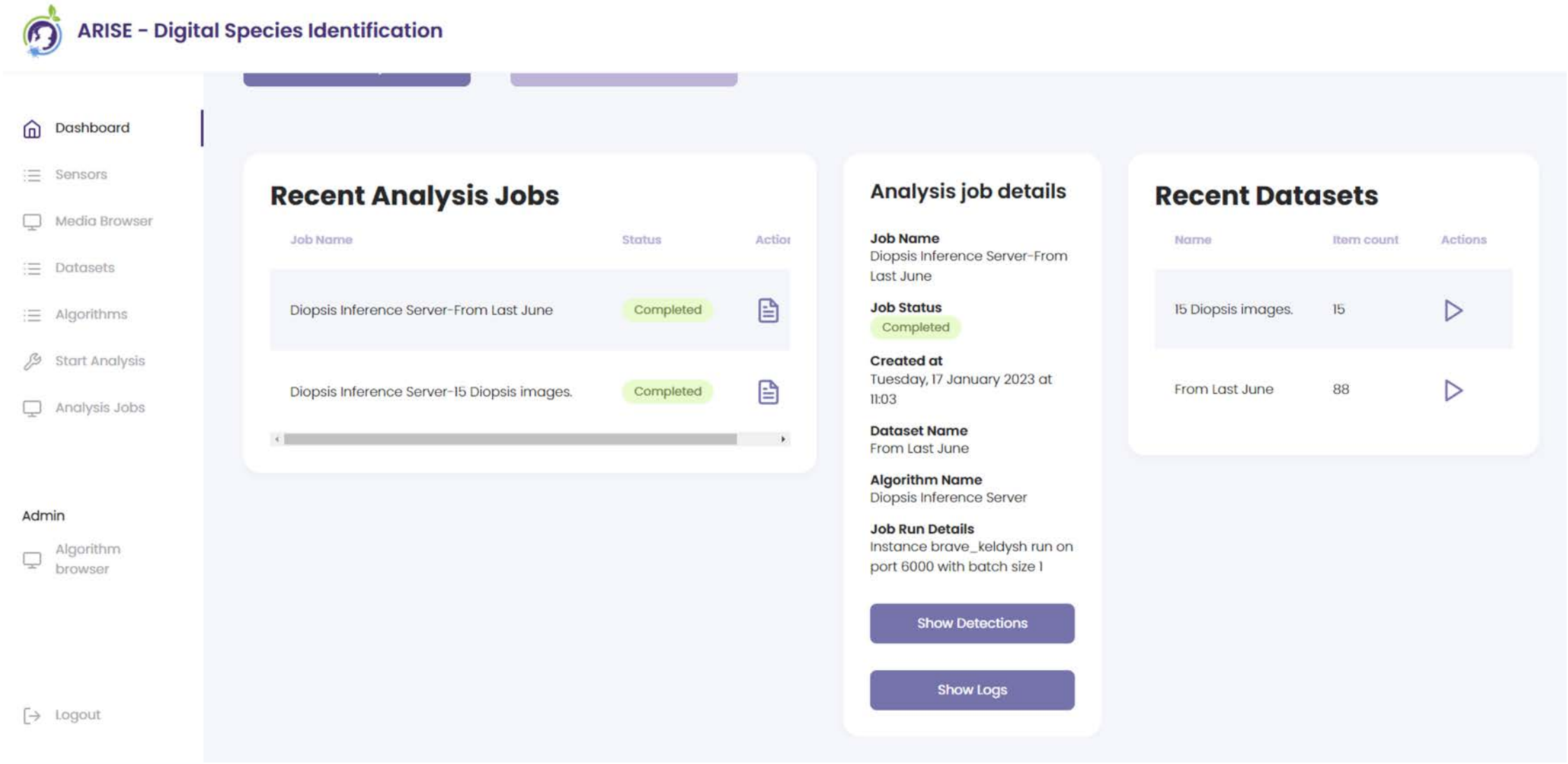




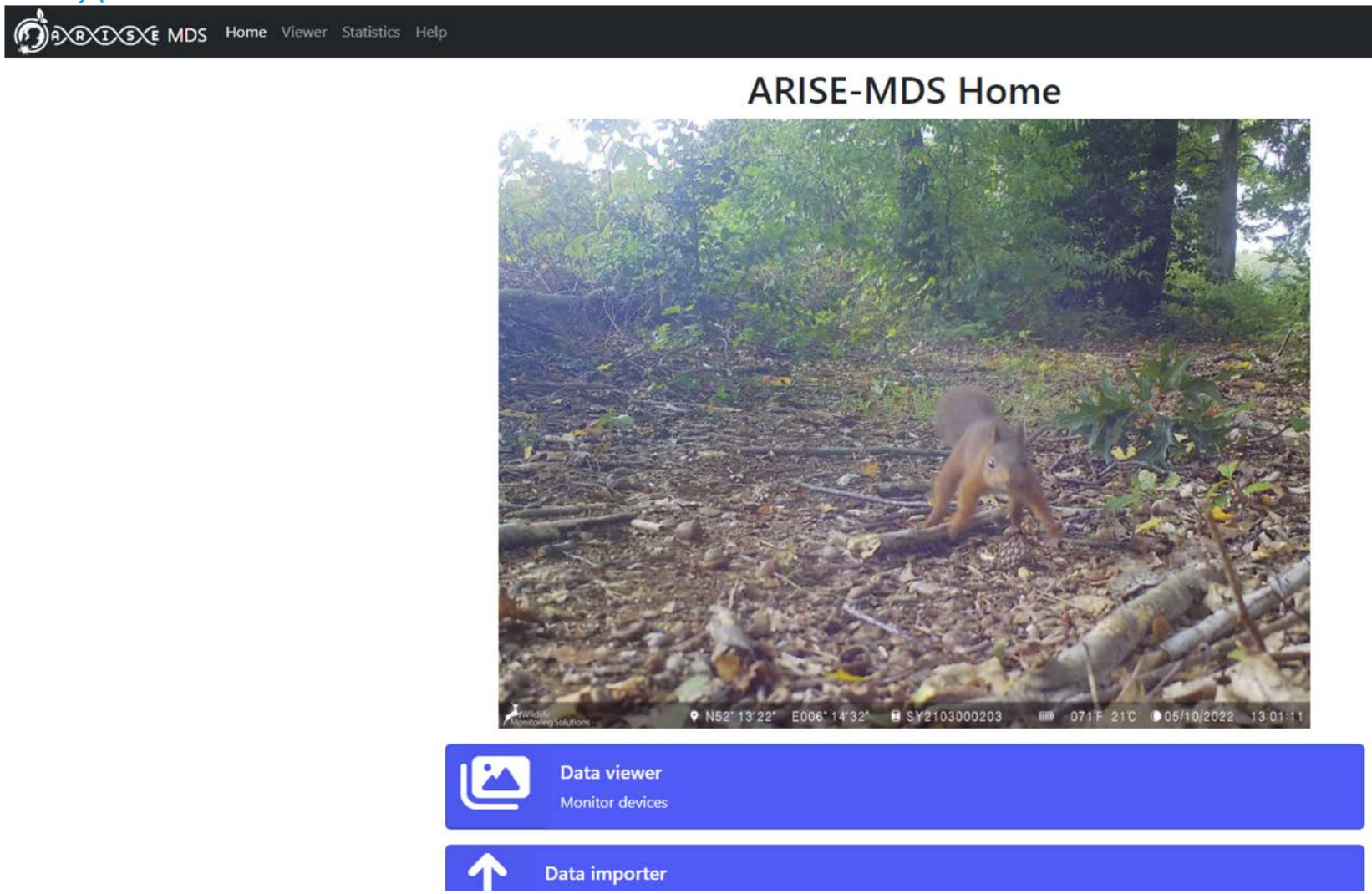




Demo digital species recognition



Demo Sensor dashboard



arisemdsvm.science.uva.nl/

Biocloud

Building the underlying infrastructure of ARISE and an interactive platform for access to data and services

Waarneming.nl
DISSCO
BOLD SYSTEMS
GBIF
DIOPSIS
Catalogue of Life
xeno-canto
LifeWatch ERIC
AGOUTI
SURF

Linked to other infrastructures

ARISE platform
'a one-stop-shop for all your biodiversity data services'

End user services

- Explore / Search data
- Import / Link data
- Annotate data
- Explore algorithms
- Construct and train algorithms
- Run algorithm to identify species
- View algorithm results

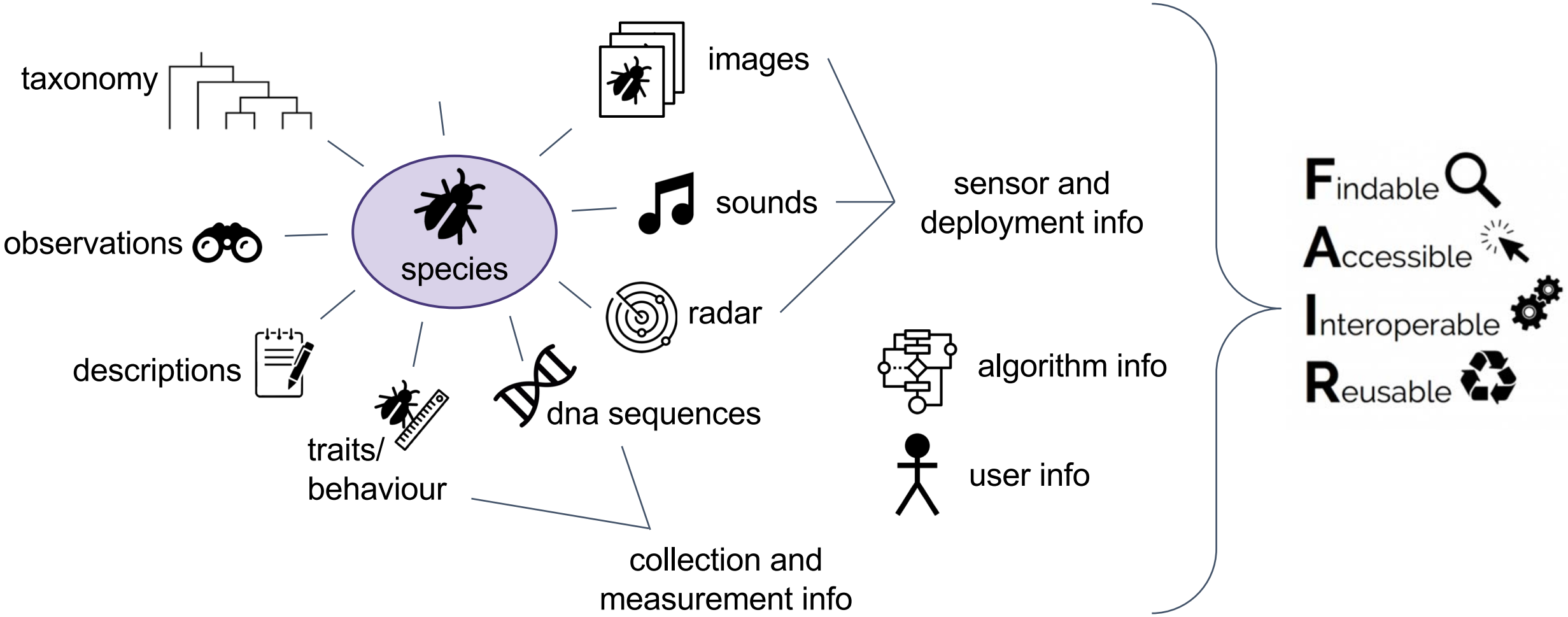
- Linked data
- M2M connections

Back end facilities

- Data management & storage
- Access control
- API services

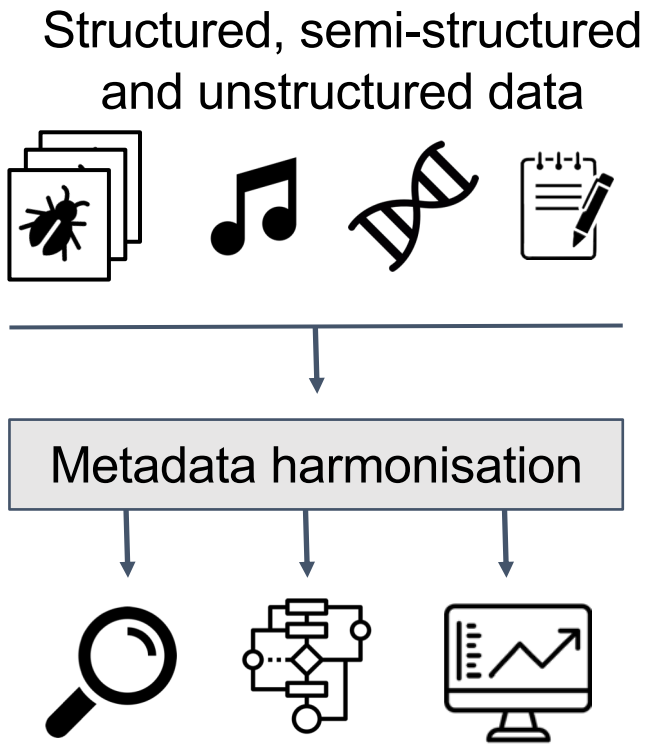
Biocloud

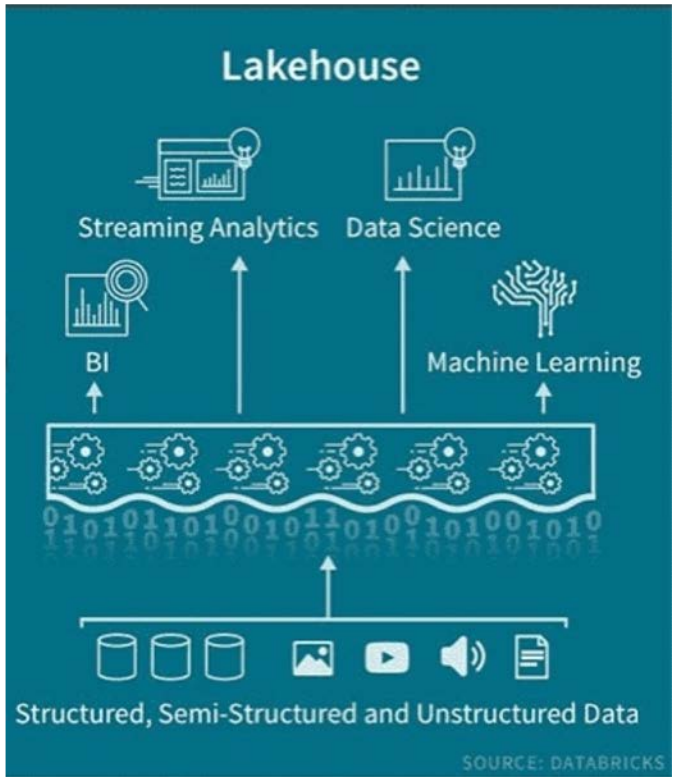
A data management system for petabytes of data of various kinds with linked metadata



Biocloud

Work in progress:
architectural design and development of data management system





DELTA LAKE

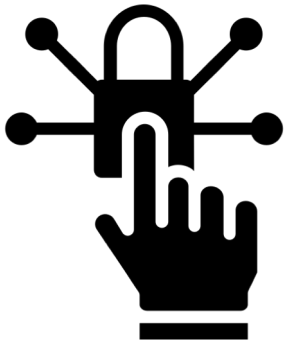
Open-source storage framework that enables building a Lakehouse architecture

> schema evolution: allows changing data structures and adding new use cases

> time travel: keep track of changes (e.g. update of species identification, taxonomic name change) and keep provenance trail

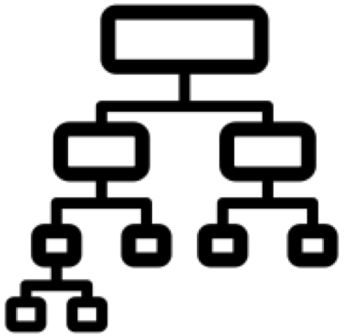
Biocloud

More than ‘just’ data management



Identity and Access Management

- user roles and permissions
- integration with other systems
- GDPR compliance

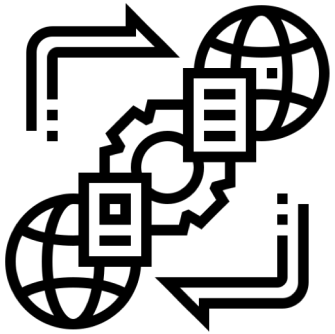


Taxonomic backbone

- all data is linked to a taxon name
- up to date list of taxon names + synonyms needed to link data from different sources

Persistent Identifiers (PID)

- uniquely identifiers for each data object
- identifiers must be persistent



Data strategies

- Data storage: what, where, for how long?
- Data sharing: user agreements
- Data standards: enable interoperability with other infrastructures

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cost
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

Developing standards for molecular biodiversity assessments in [freshwater] ecosystems

By Florian Leese, University of Duisburg-Essen and coordinator of DNAquaNET

Proposition 1: We need biodiversity 'weather stations‘ & DNA methods can help here

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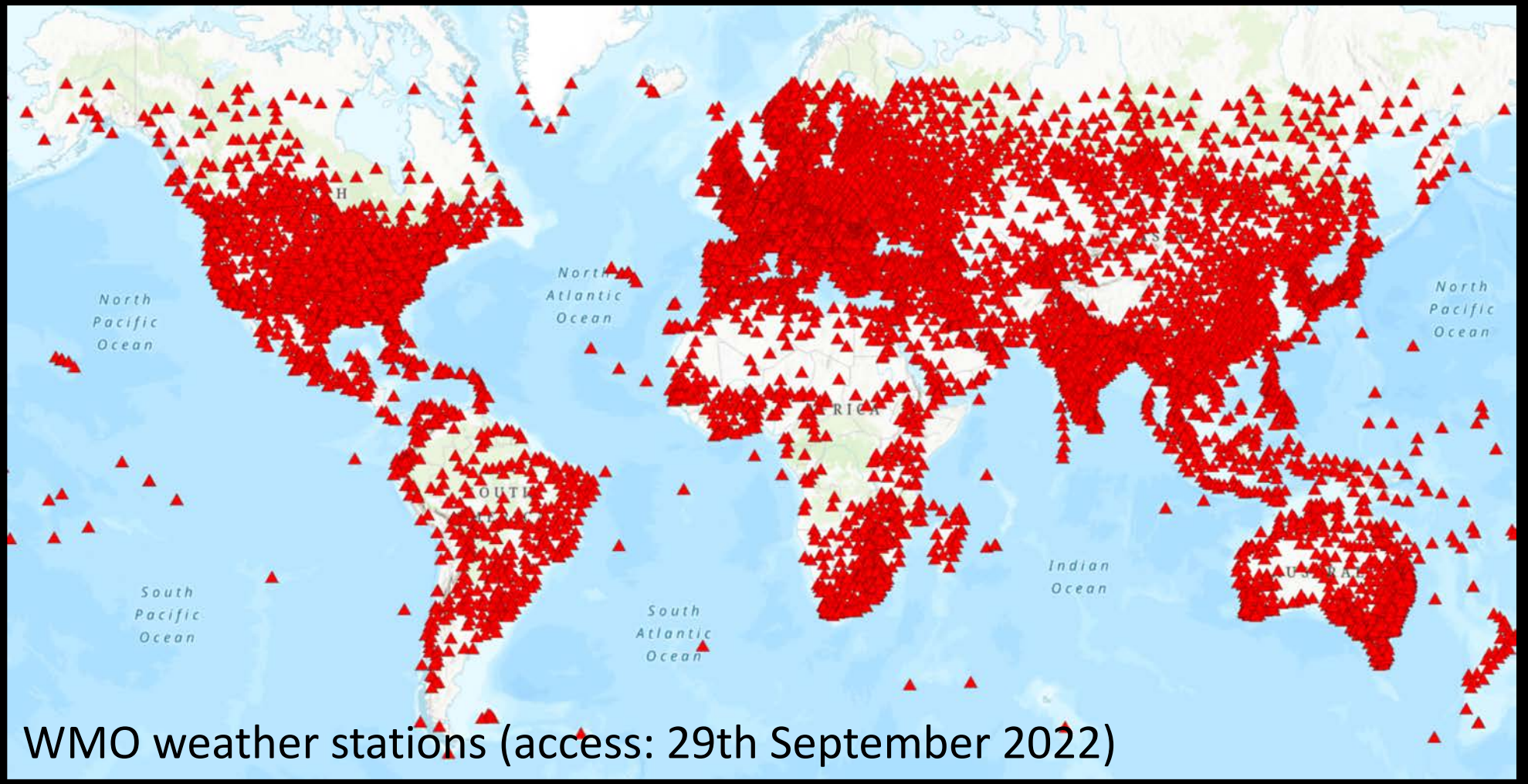


WMO weather stations (access: 29th September 2022)

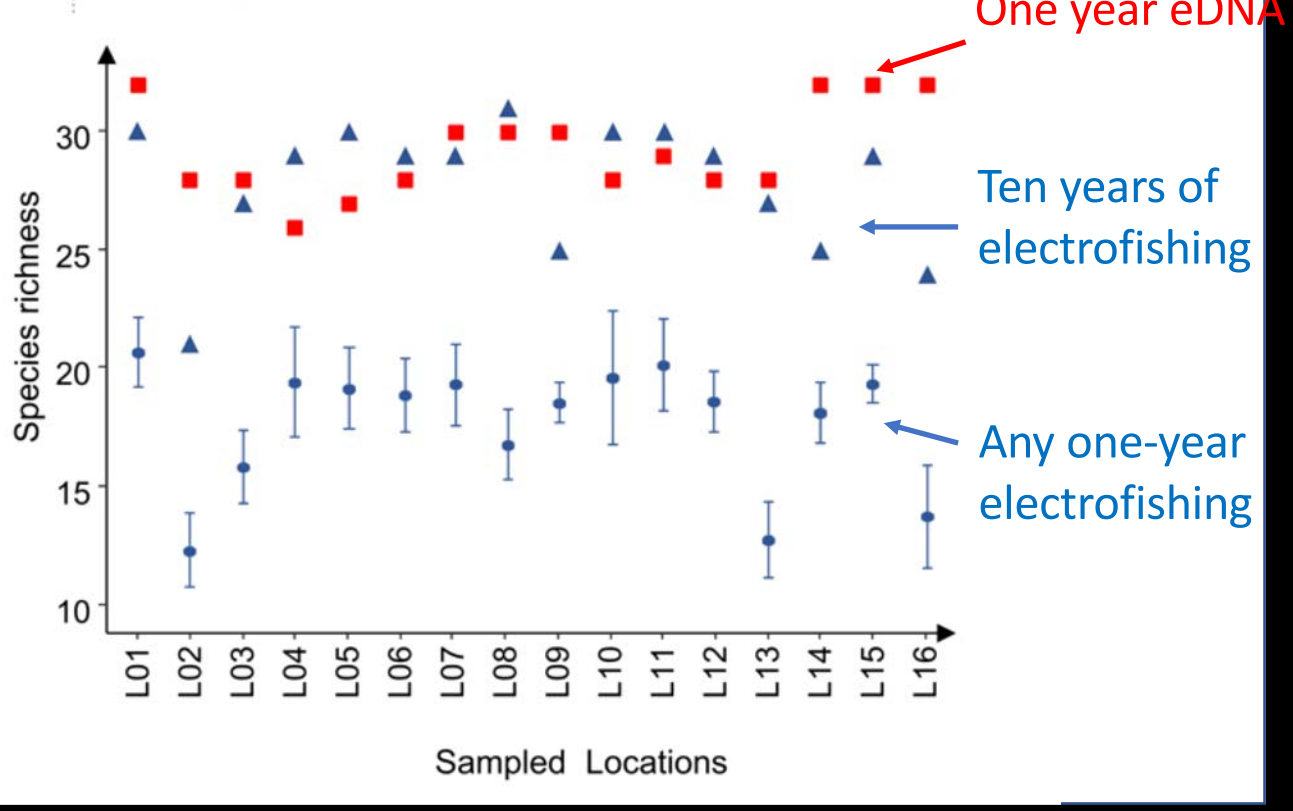
DNA & eDNA based methods: "more with less“

- great performance of eDNA for biodiversity assessments, e.g. fish community detection
- Many such studies reported from many different countries!
- Errors remain (like with all methods)

Environmental DNA reveals quantitative patterns of fish biodiversity in large rivers despite its downstream transportation

Didier Pont[1,2,3], Mathieu Rocle[4], Alice Valentini[1,2], Raphaël Civade[2], Pauline Jean[1], Anthony Maire[5], Nicolas Roset[6], Michael Schabuss[7], Horst Zornig[7] & Tony Dejean[1,2]

DNAqua-Net
EU COST ACTION



Also beyond water applied & capable

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DOI: 10.1002/edn3.372

METHOD

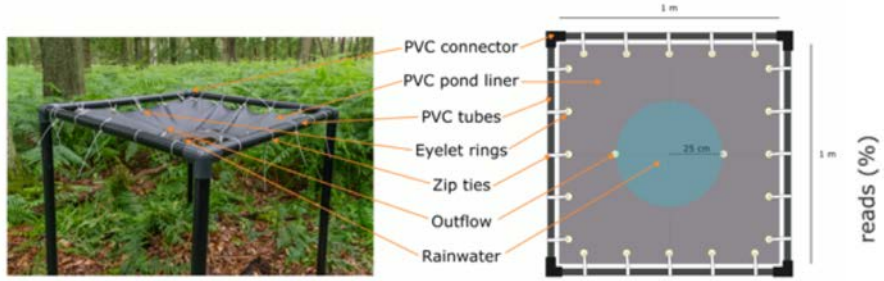
Environmental DNA

WILEY

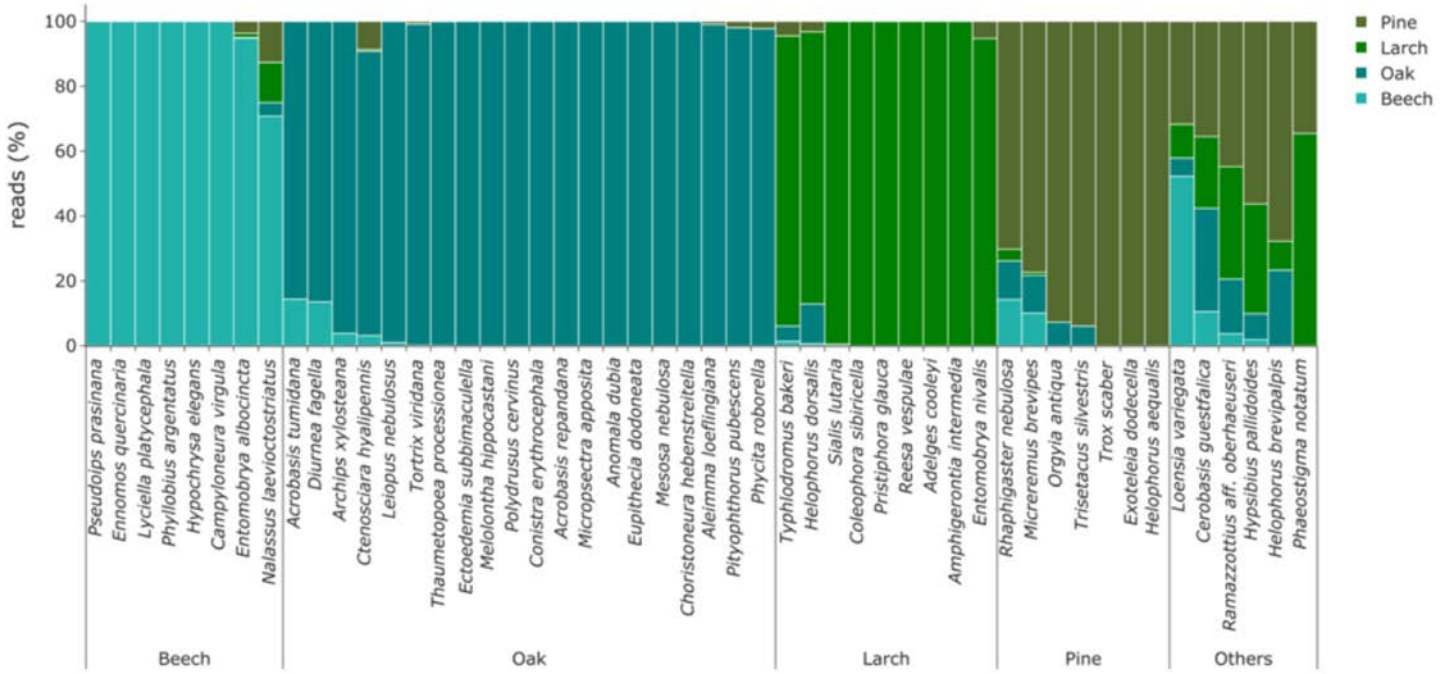
It's raining species: Rainwash eDNA metabarcoding as a minimally invasive method to assess tree canopy invertebrate diversity

Till-Hendrik Macher[1] | Robin Schütz[1] | Thomas Hörren[2,3] | Arne J. Beermann[1,4] | Florian Leese[1,4]

- Rainwash eDNA
- Non-invasive, simple, low-risk biodiversity assessment



Supplementary Figure 1: Schematic overview of the rain sampler prototype.



Also beyond water applied & capable: Airborne eDNA analysis

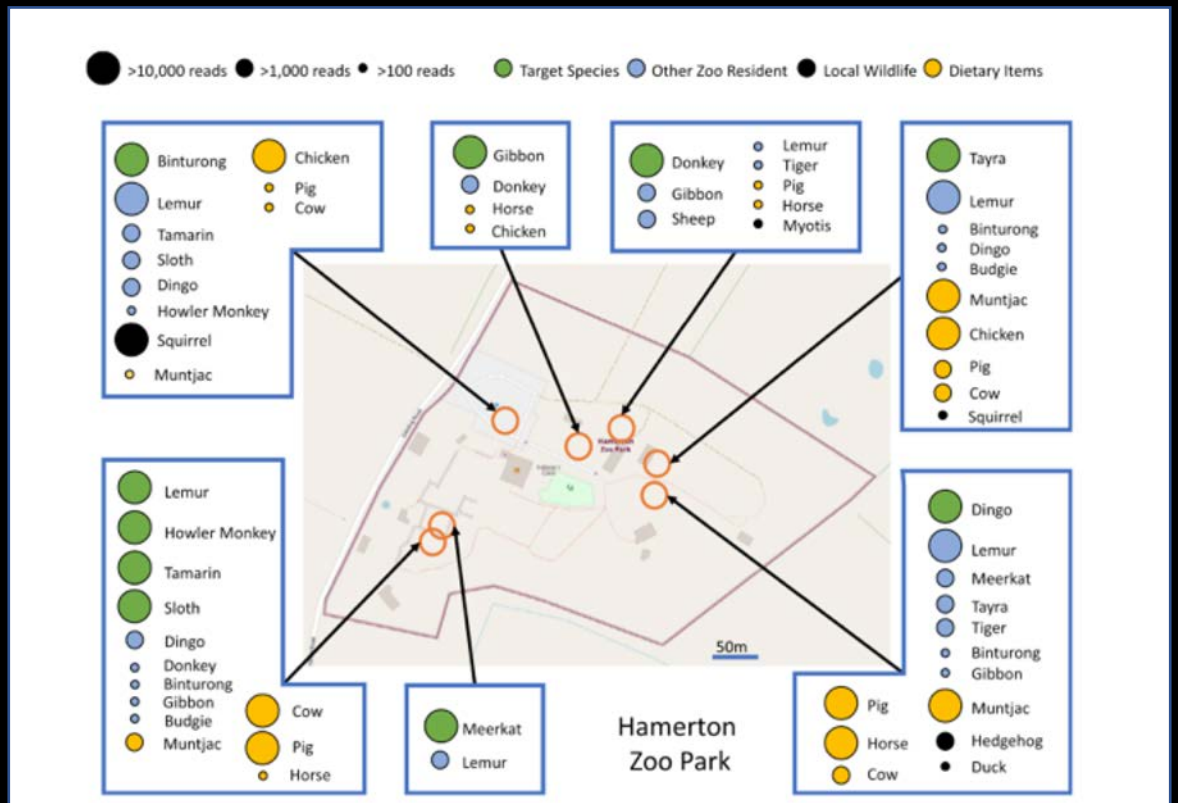
Figure 1. The sampling sites and airborne eDNA detections of vertebrate species

Report

Airborne environmental DNA for terrestrial vertebrate community monitoring

Christina Lynggaard,[1,6,*] Mads Frost Bertelsen,[2] Casper V. Jensen,[3] Matthew S. Johnson,[3,4] Tobias Guldberg Frøslev,[5] Morten Tange Olsen,[1] and Kristine Bohmann[1,7,8,*]

[1]Section for Evolutionary Genomics, Globe Institute, Faculty of Health and Medical Sciences, University of Copenhagen, 1353 Copenhagen, Denmark
[2]Center for Wild Animal Health, Copenhagen Zoo, 2000 Frederiksberg, Denmark
[3]Department of Chemistry, University of Copenhagen, 2100 Copenhagen, Denmark
[4]Airlabs Denmark, 2200 Copenhagen, Denmark
[5]Section for GeoGenetics, Globe Institute, Faculty of Health and Medical Sciences, University of Copenhagen, 1353 Copenhagen, Denmark



Current Biology

CellPress
OPEN ACCESS

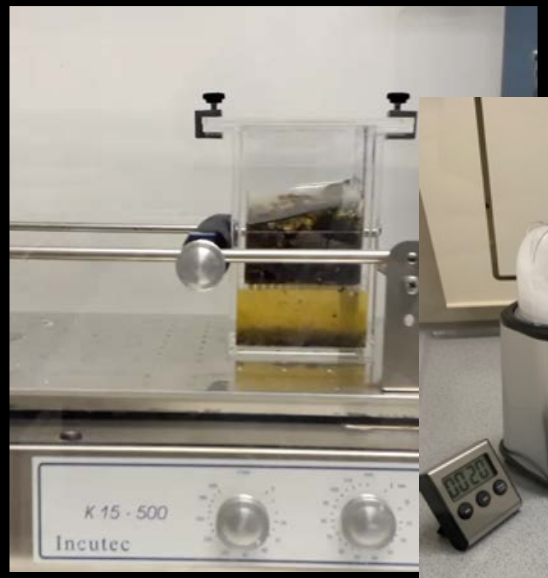
Report

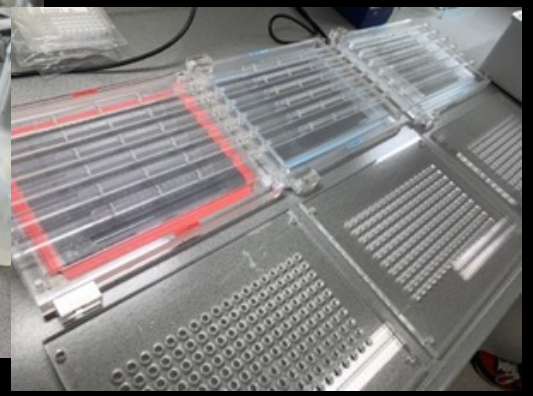
Measuring biodiversity from DNA in the air

Elizabeth L. Clare,[1,2,4,6,*] Chloe K. Economou,[1] Frances J. Bennett,[1] Caitlin E. Dyer,[1] Katherine Adams,[3] Benjamin McRobie,[3] Rosie Drinkwater,[1] and Joanne E. Littlefair[1,5]

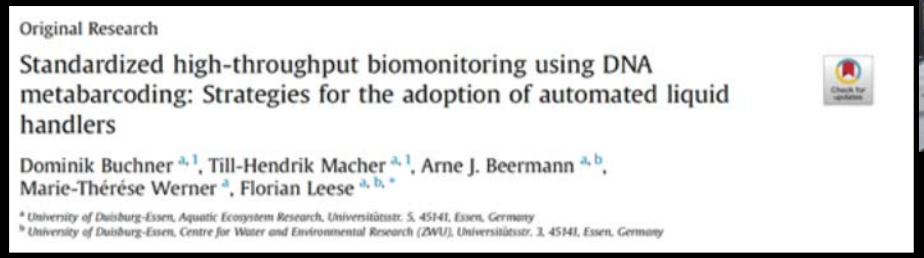
[1]School of Biological and Chemical Sciences, Queen Mary University of London, London E1 4NS, UK
[2]Department of Biology, York University, Toronto, ON M3J 1P3, Canada
[3]Hamerton Zoo Park, Huntingdon PE28 5RE, UK
[4]Twitter: @Dr_bat_girl
[5]Twitter: @JELittlefair
[6]Lead contact

Scalable & affordable





- 4000 samples (whole German insect monitoring LTER-D [Haase, Frenzel]) analysed within ~3 months



Original Research

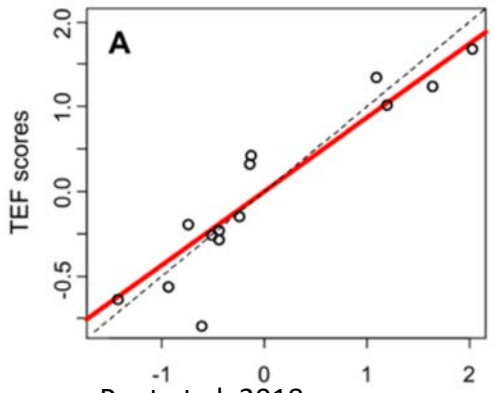
Standardized high-throughput biomonitoring using DNA metabarcoding: Strategies for the adoption of automated liquid handlers

Dominik Buchner [a, 1], Till-Hendrik Macher [a, 1], Arne J. Beermann [a, b], Marie-Thérése Werner [a], Florian Leese [a, b, *]

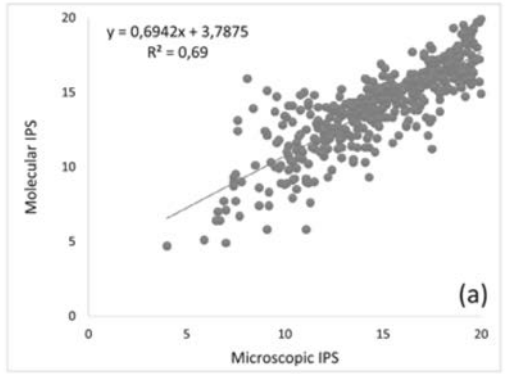
[a] University of Duisburg-Essen, Aquatic Ecosystem Research, Universitätsstr. 5, 45141, Essen, Germany
[b] University of Duisburg-Essen, Centre for Water and Environmental Research (ZWU), Universitätsstr. 3, 45141, Essen, Germany

Elbrecht & Leese (2015) PLoS One, Elbrecht & Leese (2017) Front. Ecol. Env.; Vamos et al. (2017) MBMG; Macher et al. (2018) Mol. Ecol. Res. Buchner et al. (2019) PLoS ONE, Leese et al. (2018) Adv. Ecol. Res.; Buchner et al. 2021 MBMG; Buchner et al. (2021) Ecol & Evol, Buchner et al. (2021) ESE, Macher et al. (2021)….

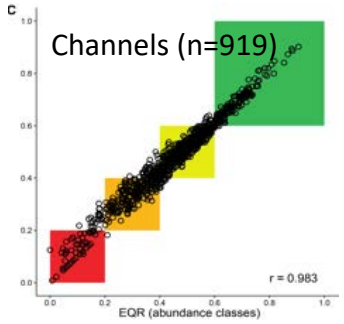
Comparable monitoring data to traditional methods (taxa lists partly)



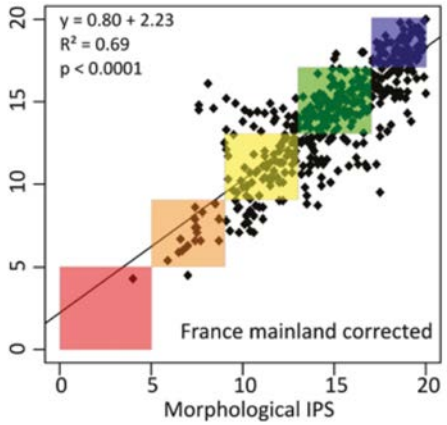
Pont et al. 2018



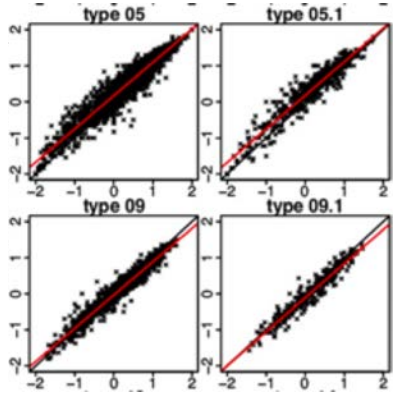
Rivera et al. (2020)



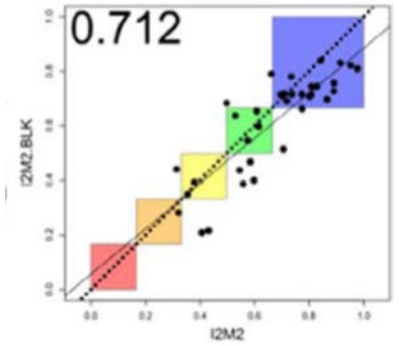
Beentjes et al. (2018)



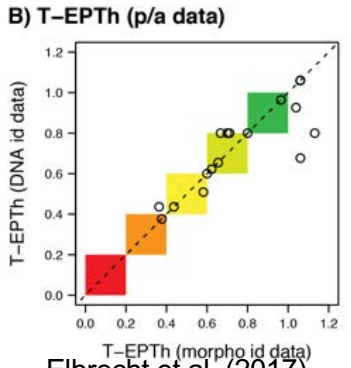
Vasselon et al. (2019)



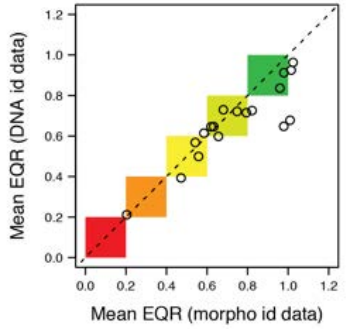
Buchner et al. (2019)



Meyer et al. (2021)



Elbrecht et al. (2017)



Elbrecht et al. (2017)

Methods deliver very comparable results

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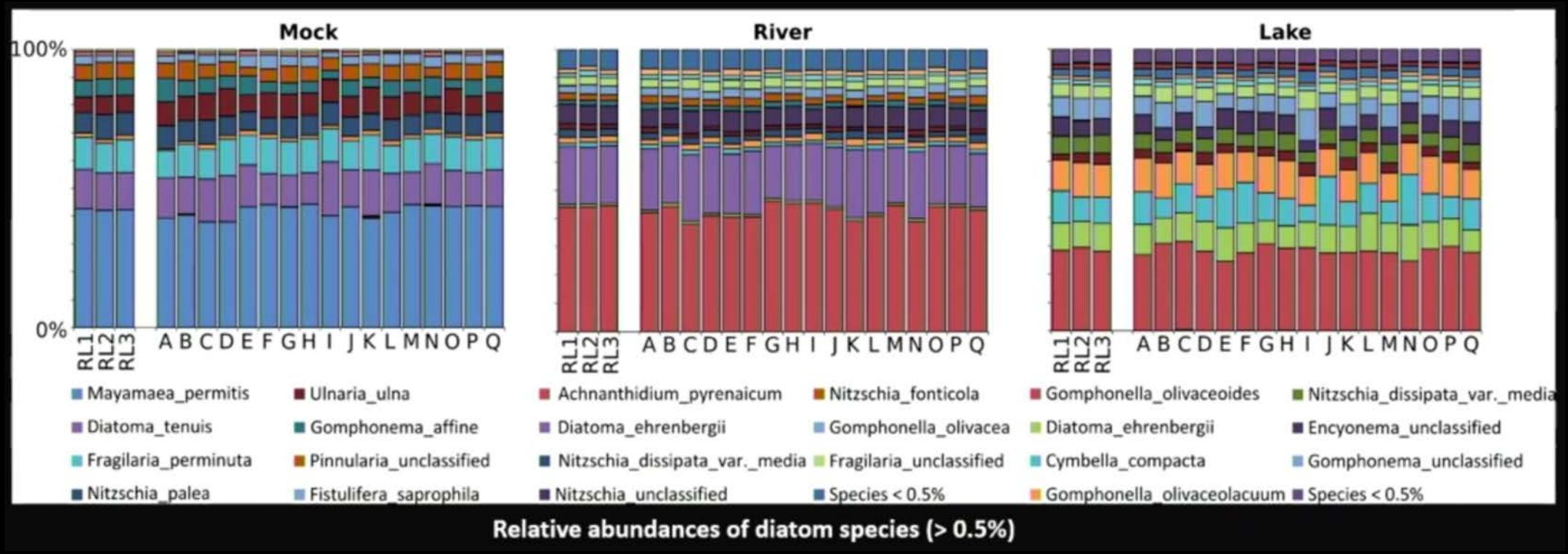
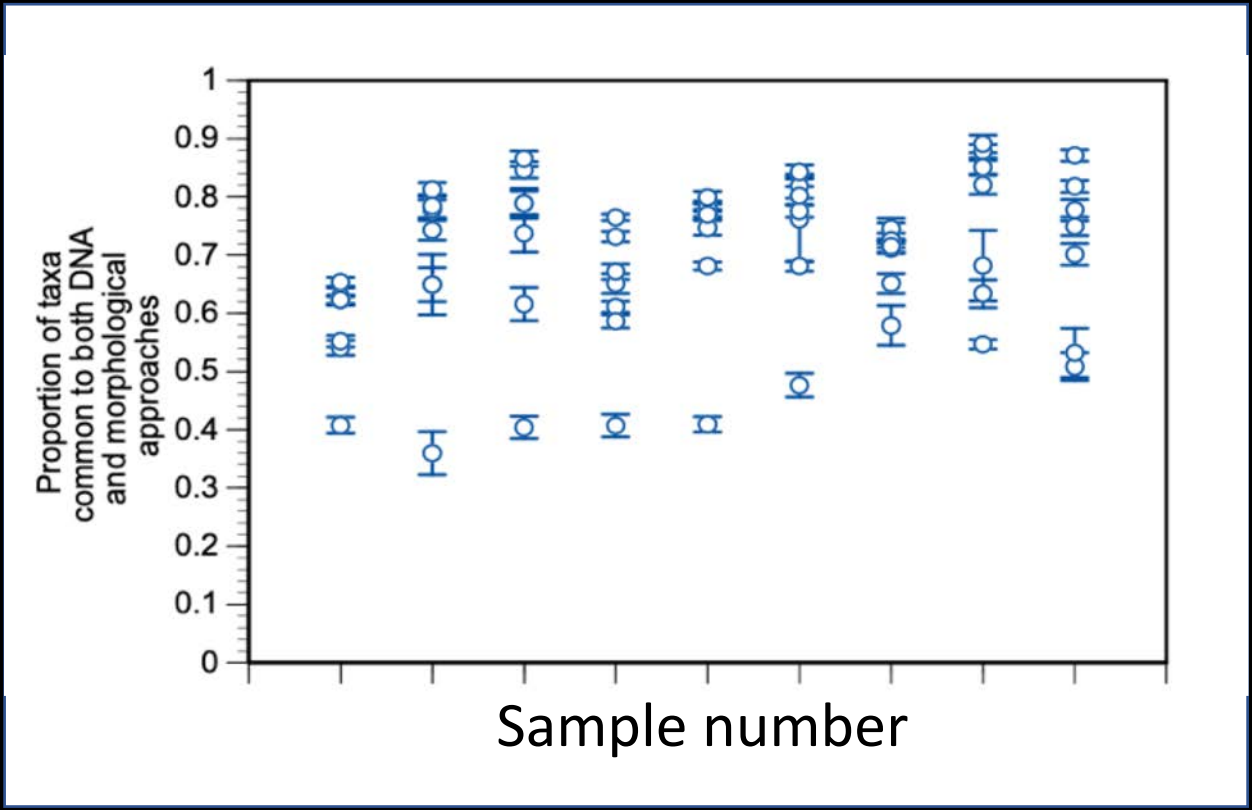
Diatom ring tests



Data: Valentin Vasselon et al. (DNAqua-Net)

But: strong method biases (extraction, primers) & inter-lab variation exist



- Several parameters can have strong impacts on the results
- **They won't vanish if we don't act**

→ **Standards + QA/QC**

Data: DNAqua-Net ring-test MZB, data: Jones, Blackmann, Buchner et al. (in prep.)

Proposition 2: eDNA data can complicate biodiversity monitoring frameworks!

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Contents lists available at SciVerse ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

thousand

Three ~~hundred~~ ways to assess Europe's surface waters: An almost complete overview of biological methods to implement the Water Framework Directive

Sebastian Birk[a,*], Wendy Bonne[b], Angel Borja[c], Sandra Brucet[b], Anne Courrat[d], Sandra Poikane[b], Angelo Solimini[e], Wouter van de Bund[b], Nikolaos Zampoukas[b], Daniel Hering[a]

- We need standards and guidance (revolution -> consitution)
- We need central coordination (e.g. linked to ECOSTAT)
- We need FAIR data and (meta-) data standards

Propositions 3: Solutions exist!

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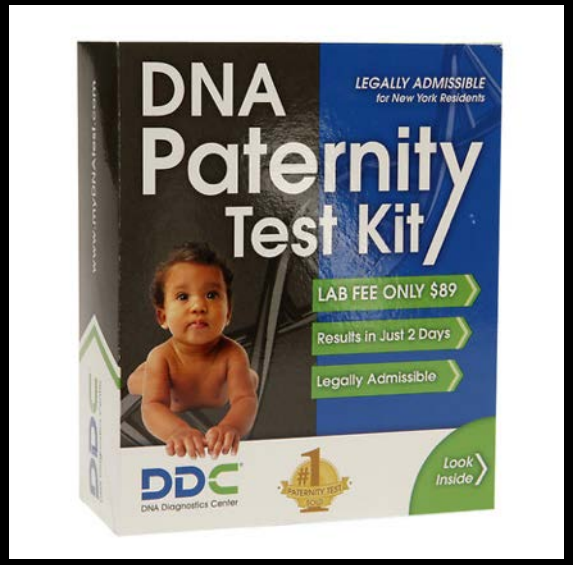
- Standardized assessment of ingredients (species detection)
- References, reference material
- SOPs, QA/QC



https://www.foodnavigator.com/Article/2020/05/12/Beef-fraud-Counterfeit-products-the-biggest-threat-to-supply-chain

Standards: Basis for accurate measurments

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Berlin, Jan 17th, 2020

Diagnostic detection of 2019-nCoV by real-time RT-PCR

-Protocol and preliminary evaluation as of Jan 17, 2020-

Victor Corman, Tobias Bleicker, Sebastian Brünink, Christian Drosten
Charité Virology, Berlin, Germany

Olfert Landt, Tib-Molbiol, Berlin, Germany

Marion Koopmans
Erasmus MC, Rotterdam, The Netherlands

Maria Zambon
Public Health England, London

Additional advice by Malik Peiris, University of Hong Kong

Users looking for a workflow protocol consult the last three pages of this document

All assays can use SARS-CoV genomic RNA as positive control. Synthetic control RNA for 2019-nCoV E gene assay is available via EVAg. Synthetic control for 2019-nCoV RdRp is expected to be available via EVAg from Jan 21st onward.

First line screening assay: E gene assay
Confirmatory assay: RdRp gene assay

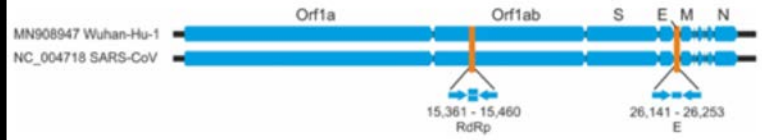


Figure 1 relative positions of amplicon targets on SARS-CoV an 2019-nCoV genome. ORF: open reading frame; RdRp: RNA-dependent RNA polymerase. Numbers below amplicon are genome positions according to SARS-CoV, NC_004718.

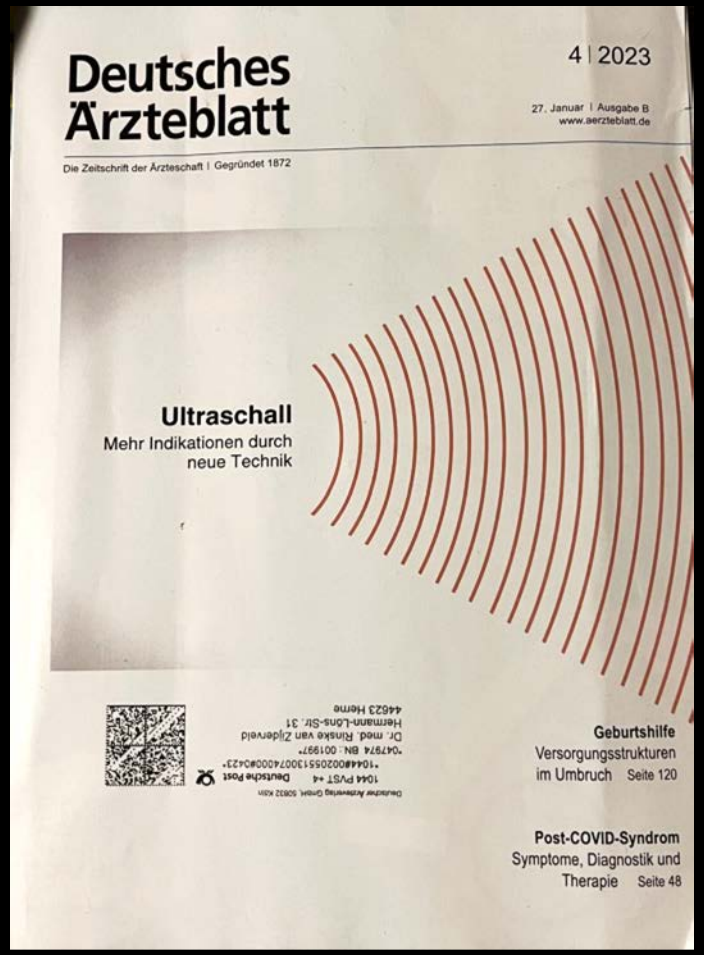
Table 1. Primers and probes
Optimized concentrations are mol per liter of final reaction mix.
(e.g., 1.5 microliters of a 10 micromolar (uM) primer stock solution per 25 microliter (ul) total reaction volume yields a final concentration of 600 nanomol per liter (nM) as indicated in the table)
-note that standard, non-optimized reaction conditions as indicated by suppliers of one-step RT-PCR kits will generally yield sufficient sensitivity-

Assay/ Use	Oligonucleotide ID	Sequence (5'–3')	Comment
RdRP gene	RdRP_SARSr-F2	GTGARATGGTCATGTGTGGCGG	use 600 nM per reaction
	RdRP_SARSr-R1	CARATGTTAAASACACTATTAGCATA	use 800 nM per reaction
	RdRP_SARSr-P2	FAM-CAGGTGGAACCTCATCAGGAGATGC-BBQ	Specific for 2019-nCoV, will not detect SARS-CoV use 100 nM per reaction and mix with P1
	RdRP_SARSr-P1	FAM-CCAGGTGGWACRTCATCMGGTGATGC-BBQ	Pan Sarbeco-Probe, will detect 2019-nCoV, SARS-CoV and bat-SARS-related CoVs use 100 nM per reaction and mix with P2
E gene	E_Sarbeco_F1	ACAGGTACGTTAATAGTTAATAGCGT	use 400 nM per reaction
	E_Sarbeco_R2	ATATTGCAGCAGTACGCACACA	use 400 nM per reaction
	E_Sarbeco_P1	FAM-ACACTAGCCATCCTTACTGCGCTTCG-BBQ	use 200 nM per reaction

W is A/T; R is G/A; M is A/C ; FAM, 6-carboxyfluorescein; BBQ, blackberry quencher

https://www.who.int/docs/default-source/coronaviruse/protocol-v2-1.pdf

Standards don’t hinder innovation, they enable these

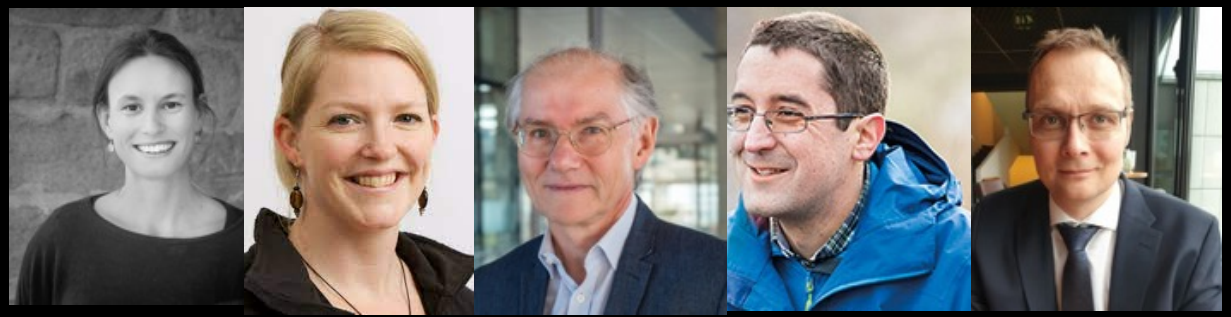


Example:
In the medical sector many devices are not perfect (x-ray devices, ultrasonication etc.) and undergo constant improvments. Still they are very successfully applied for medical diagnoses.

“Ultrasonication – more indications through new techniques”

Minimum standards, reporting standards

→ DNAqua-Net WG3 (2021)



Pawlowski et al. 2020: Available in 3 languages!

Help eDNA monitoring tools to bridge the science x policy gap!

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Offen im Denken

CEN
CEN/TR 17244:2018 (MAIN)
SIST-TP CEN/TR 17244:2019
Water quality - Technical report for the management of diatom barcodes

This technical report specifies the data and metadata necessary to validate the identity of a diatom barcode used for ecological assessment along with recommendations for storage of the barcode and metadata to ensure access to this information.

Technical report 11 pages
English language
sale 10% off
€ 45.98

e-Library read for 1 day
€ 5.00

12-Sep-2018 # 13.060.70 CEN/TC 230

CEN
CEN/TR 17245:2018 (MAIN)
SIST-TP CEN/TR 17245:2019
Water quality - Technical report for the routine sampling of benthic diatoms from rivers and lakes adapted for metabarcoding analyses

This technical report specifies a method for the field sampling of benthic diatoms which will be then analysed by subsequent metabarcoding techniques for ecological status and water quality assessments. Data produced by this method are suitable for production of taxonomical diatom lists.

Technical report 8 pages
English language
sale 10% off
€ 38.72

e-Library read for 1 day
€ 5.00

12-Sep-2018 # 13.060.70 CEN/TC 230

CEN
FprEN 17805 (MAIN)
kSIST FprEN 17805:2022
Water quality - Sampling, capture and preservation of environmental DNA from water

Water sampling for capture of environmental DNA (eDNA) in aquatic environments. eDNA stems from organisms which are or have recently been living in the water body and does not include eDNA found in sediments or similar sample types. Covers procedures for avoiding sample contamination and ensuring DNA quality, key properties of the filtering procedure and equipment, and reporting standards.

Draft 15 pages
English language
sale 10% off
€ 53.24

e-Library read for 1 day
€ 5.32

30-Sep-2023 # 13.060.70 2000/60/EC CEN/TC 230

CEN
CEN/TC 230/WG 28 - DNA AND EDNA METHODS

ABSTRACT | SLOVENIAN

GENERAL INFORMATION

Status	Active
Work Field	Information technology
Parent	CEN/TC 230 - Water analysis

SYKE

cen

Harmonized intern. biomonitoring 2.0

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- Mostly academic sector at international level, but academic intern. networks!

CSIRO
UKEOF ENVIRONMENTAL OBSERVATION FRAMEWORK
Umwelt Bundesamt
BIOSCAN EUROPE
EUROPABON Europa Biodiversity Observation Network: integrating data streams to support policy
iTrackDNA
international BARCODE OF LIFE
eBioAtlas
vigilife GLOBAL LIFE OBSERVATORY
GeDNA
VDI
USGS science for a changing world
GenomeCanada
GBWG - Environmental Samples and eDNA
This group has been established to develop a data standard and usage guidelines for sharing environmental sample and environmental DNA data.
task group
TDWG
eDNA The eDNA Society
stowa
CSA W214:21
Environmental DNA (eDNA) reporting requirements and terminology
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Bundesamt für Umwelt BAFU
SYKE
Interreg North Sea Region GEANS
European Regional Development Fund
EUROPEAN UNION
Interreg Alpine Space Eco-AlpsWater
European Regional Development Fund
cen

Harmonized biomonitoring 2.0…

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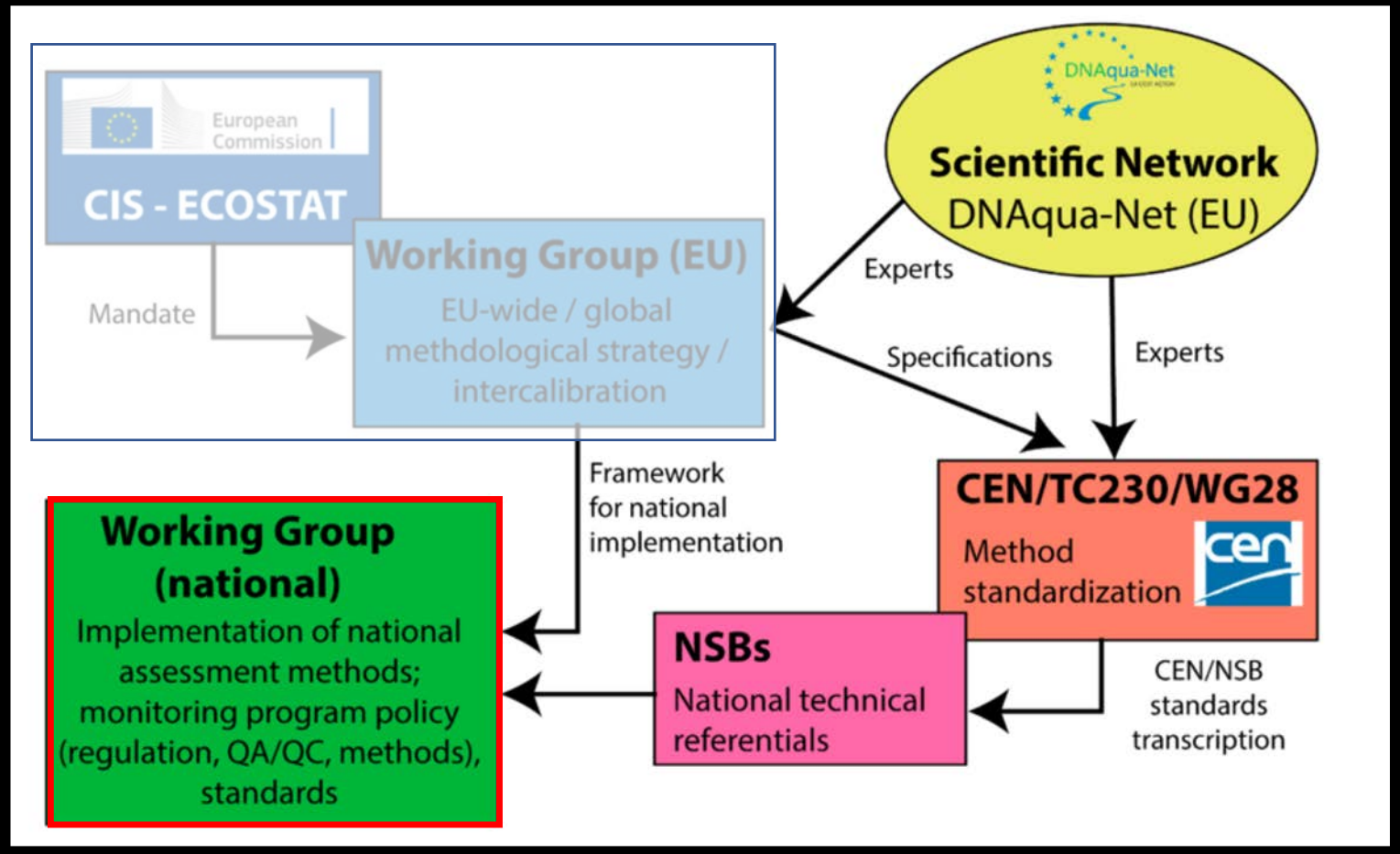
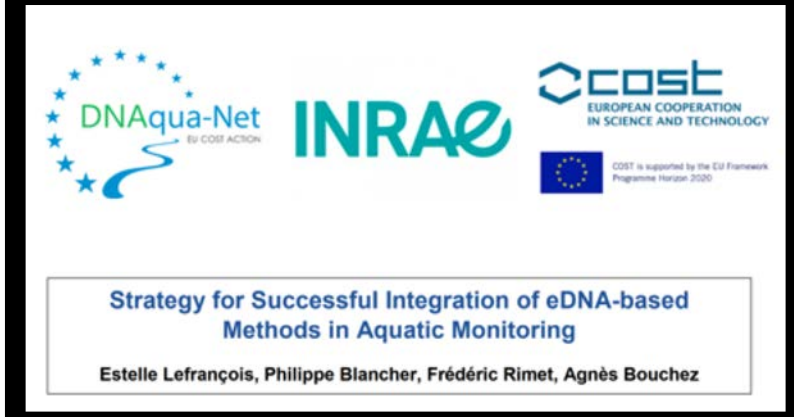
- At the moment: National level discussions, no EU JCR mandate group
- KCBD monitoring group, int. networks, projects (eDNAqua-Plan)





Beyond Europe

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Key messages:

The necessity of creating minimum requirement standards

First, we need to internationally agree on minimum requirements for frontend methods to collect, handle and store samples for molecular analysis. This is a matter of high urgency, as many countries are already developing their national approaches. Due to the sensitivity of molecular methods, a lack of common frontend standards will result in a plethora of different national approaches, varying results and incompatible data. Only international molecular method standards will enable global assessments of biodiversity or genetic diversity and stimulate markets and industry to produce products to do so. ***We recommend to decide on the inclusion of method standards into the CBD policy frameworks and its work programme.***

The need to create standards inclusively

Second, to be effective, standards need to be developed inclusively, taking into consideration the requirements of the methods themselves as well as the need and possibilities of developing countries. Currently participation from developing countries in standardization is minimal. ***We recommend that developing countries are actively involved in the standardization work and that the international standardization bodies CEN and ISO formally conduct the standardization process.***

The need for dedicated funding

Third, in both developed and developing countries there is no separate funding available to facilitate the production of standards. ***We recommend that dedicated funding is available to encourage participation in inclusive method standardization especially by developing countries.***

Expert opinion

To be considered at COP 15 and the UN Summit of the Future 2023

September 2022

We, the experts representing contributing organizations from 4 continents of the side-event "The key for a successful UN's Post-2020 Global Biodiversity Framework - standards for measuring biodiversity with molecular tools" organized by the Science Summit at the UN general Assembly 77 in New York propose the following key messages to be considered in the preparation of the COP 15 and UN Summit of the Future, 2023 meetings.

The observed global loss of biodiversity has serious implications for human wellbeing and can amplify several of the negative aspects of climate change and impact adversely on achieving several of the SDG's. **We need international standards to enable the use of novel molecular techniques to extend and improve current biodiversity and genetic monitoring in all types of habitats.** Standards are needed because data from biological monitoring is the primary source of information to quantify biodiversity loss, as well as to evaluate the effectiveness of biodiversity management actions such as ecological restorations. The current motivation to standardize biodiversity methods stems mainly from policy demands of mandatory national legislation. This approach is ineffective in producing internationally agreed upon standards quickly. Continuing as usual will lead to long delays in the reporting of genetic diversity, reduce the intercomparability of country-wise reports and delay urgently needed management action to secure biodiversity. **Standardization of both backend (data standards), but especially frontend molecular method minimun requirements (sampling, laboratory procedures) is paramount to avoid error propagation and ensure global comparability of results.**

https://feosuomi.fi/en/finnish-environment-institute-coordinated-a-un-science-summit-session-on-standardising-the-use-of-edna-methods-in-biological-monitoring/

Conclusion: (e)DNA biodiversity monitoring is not / will never be is not perfect, but…

- great chances to extend / scale-up biodiversity monitoring
- highly complementary to other monitoring approaches
- an option we should not miss

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biodiversa+
European Biodiversity Partnership

THANK YOU! Let‘s identify next steps

RESIST
Collaborative Research Centre (CRC) 1439

GeDNA

DNAqua-Net
EU COST ACTION

GeneStream

TrendDNA

GBOL
German Barcode of Life

NFDI4
BIODIVERSITY

biodiversa+
European Biodiversity Partnership

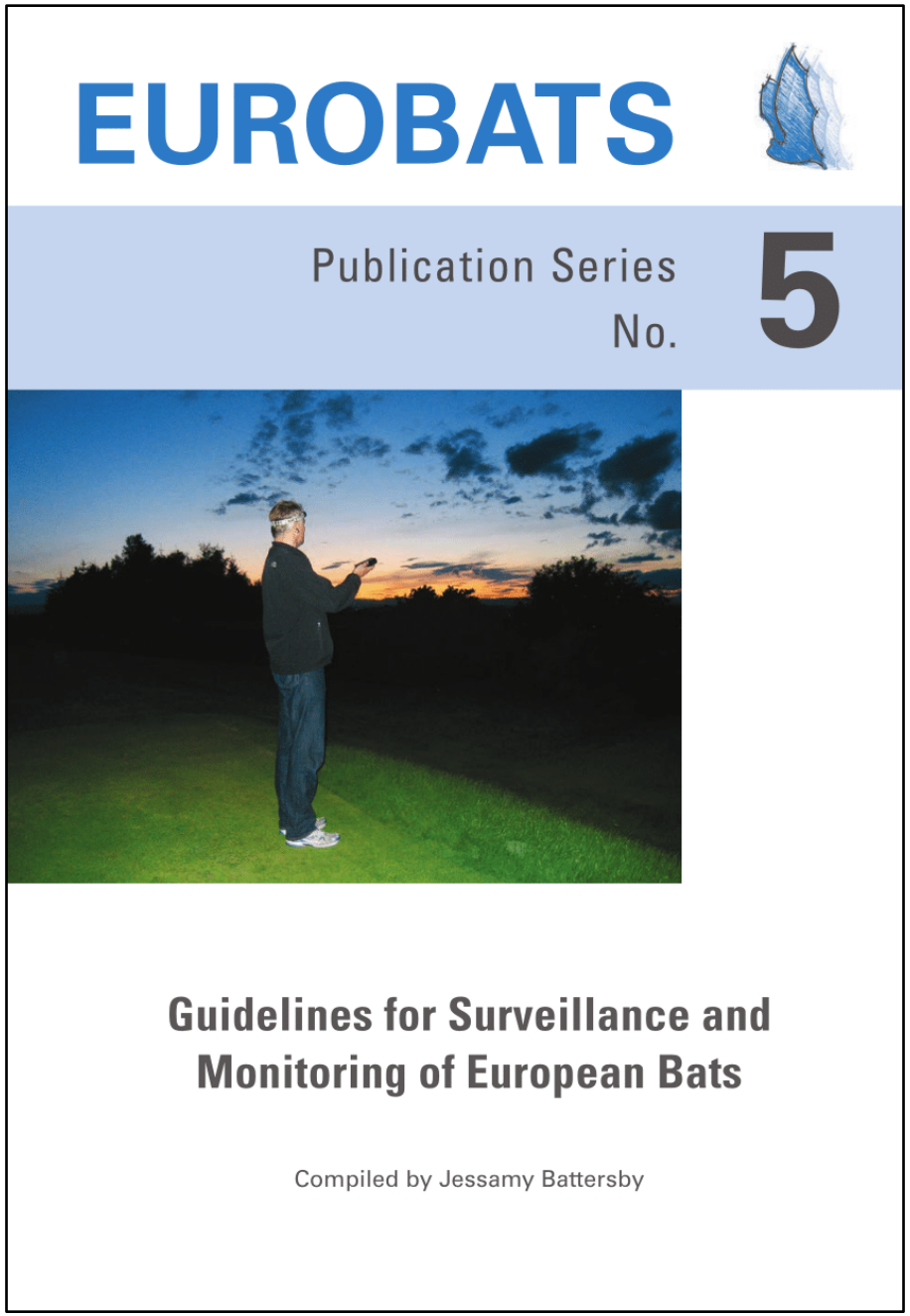
Acoustic monitoring of bats – a showcase of implementation

By Adrià López-Baucells and Charlotte Roemer

Passive
Remote
Automatic
Non-invasive
Relatively economic
Appropriate for +habitats +seasons

Standardization???
Repositories???

Passive
Remote
Automatic
Non-invasive
Relatively economic
Appropriate for +habitats +seasons



Monitoring protocols database:
shorturl.at/yLT09

UNEP EUROBATS

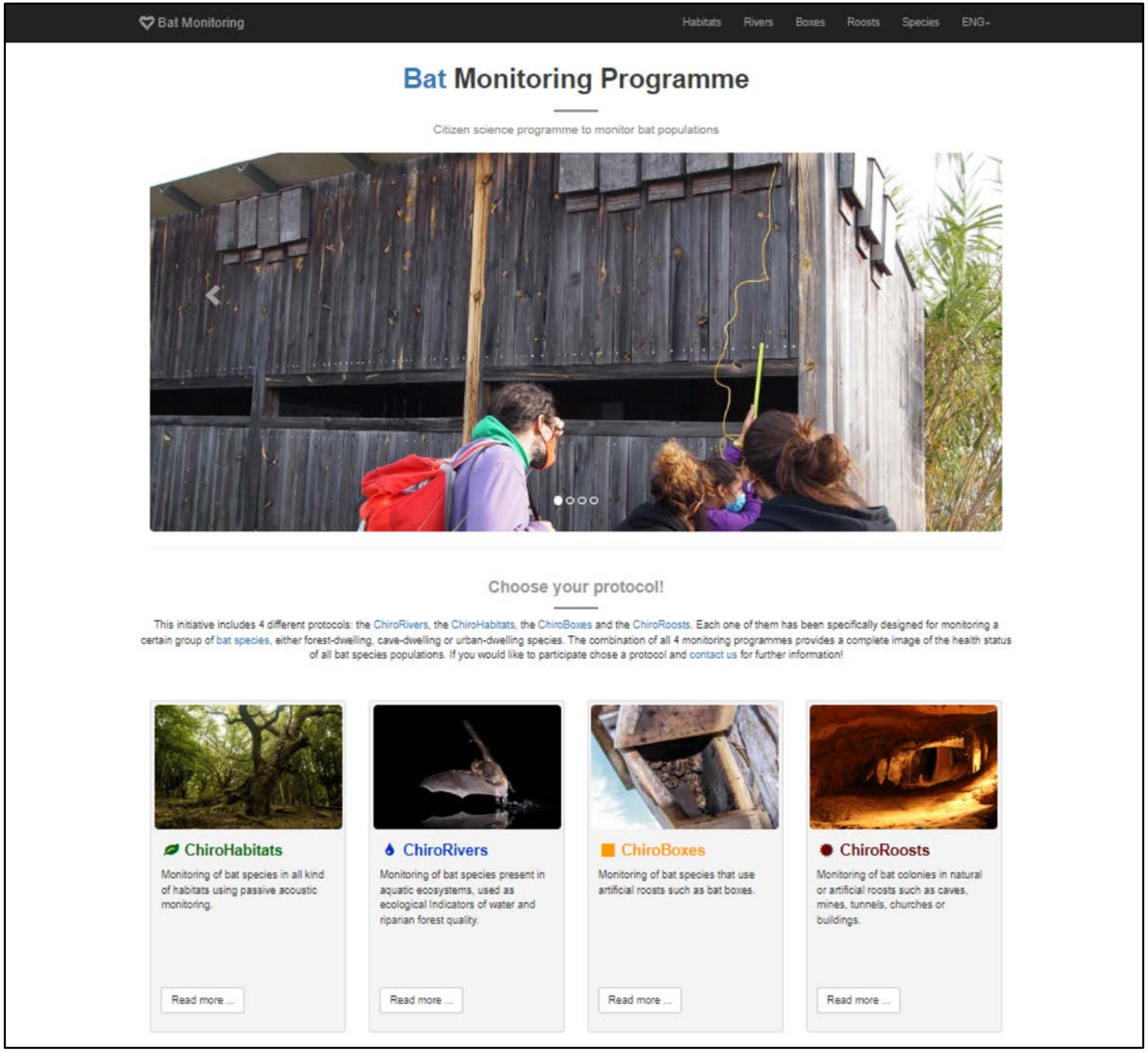
Bat Monitoring protocols

Fitxer Edita Mostra Insereix Format Dades Eines Extensions Ajuda La darrera modificació es va fer el dia 20 de novembre de 2022

Comparteix

D9 March 1st - October 30th

Country	Bat cycle period	Method	Period	Periodicity	Video camera model	Acoustic
Spain (Catalonia)	Hibernation	Visual / Photography	15 November - 28 February	1 survey/yr roost		
Spain (Catalonia)	Migration	Visual / Photography	September 1st - November 1st & February 1st - May 15th	1 survey every 15 days		
Spain (Catalonia)	Migration	Emergence with infrared video / Acoustic	September 1st - November 1st & February 1st - May 15th	1 survey every 15 days		AudioMc
Spain (Catalonia)	Migration	Clicker + handheld detector	September 1st - November 1st & February 1st - May 15th	1 survey every 15 days		Echome
Spain (Catalonia)	Maternity	Visual / Photography	May 16th - August 31st	1 survey		
Spain (Catalonia)	Maternity	Emergence with infrared video / Acoustic	May 16th - August 31st	1 survey		AudioMc
Algeria	Hibernation	Visual / Photography	November 1st to March 1st	1 survey/yr roost	Canon D600	
Algeria	Maternity	Visual / Photography / Acoustic	March 1st - October 30th	Survey	Canon D600	Petterss
Slovakia	Maternity	Visual / Emergence	May 15th - June 30th	1 survey		
Slovakia	Hibernation	Visual / Photography	January 15th - February 28th			
Slovakia	Swarming	Mist-netting	August 15th - October 15th			
Slovakia	Maternity	Emergence with infrared video / Acoustic	May 15th - June 15th	1 survey		
Ireland	Hibernation	Visual / Photography	January - February ±1week	1 survey/yr roost		
Ireland	Maternity	Visual / Photography or Visual / Emergence	May 23rd - July 7th	1 survey	Sony HandyCam FDR-AX33 and FDR-AX53	Various
Ireland	Maternity	Visual / Photography or Visual / Emergence	16 May to 15 June / 16 June to 31 July / August to 30 Augus	3 surveys	Sony HandyCam FDR-AX33 and FDR-AX53	Various
Basque Country	Hibernation	Visual / Photography	January	1 survey/yr roost		
Basque Country	Migration	Emergence with infrared video / Acoustic	01-31 May	1 survey/yr roost		Petterss
Basque Country	Maternity	Emergence with infrared video / Acoustic	June 25th - July 15th	1 survey/yr roost		Petterss
Germany	maternity	manual bat box checking	10th July until mid August	once per site		
Germany	hibernation	Visual / Photography	January	1 survey/yr roost		
Bulgaria	Maternity	Visual / Photography or Visual / Emergence	15 May - 15 June	once per site	Canon	Petterss
Bulgaria	Hibernation	Visual / Photography	January, February, March	1 survey/yr roost	Canon	Petterss
Romania	Maternity	Visual / Photography, at one site Emergence	June - July	once per site	Nikon D7000 mostly	-
Romania	Hibernation	Visual / Photography	January - March	1 survey/yr roost	Nikon D7000 mostly	-
Romania	Swarming	Mistnetting, harptraping	Autumn	once per area (always includes the two standard caves)	-	-
United Kingdom	Hibernation	Visual / Photography	December - March	2 survey/yr roost		
United Kingdom	Maternity	Visual / Acoustic	June - July	twice per site		



www.batmonitoring.org

Bat Monitoring

Home | Protocol | Explore data | My data | ENG-

Pallerols Obert

GENERAL DATA	
Sun	Sunrise at 07:08 and sunset at 17:08 (UTC)
Geographic coordinates	42.391, 1.273
UTM coordinates	31T 4694585 357823
Elevation	1624
Municipality	Montferrer i Castellbò
Habitat	Coniferous forest
Typology	Permanent
Open/Closed	Open
Sessions	5
Species and sonotypes	15
Pictures	2
Atlas of mammals of Catalonia	No
User	Maria Mas
Data de creació	2019-01-01 00:00:00

Sessions 5 | Pictures 2 | Resultats públics

Pictures

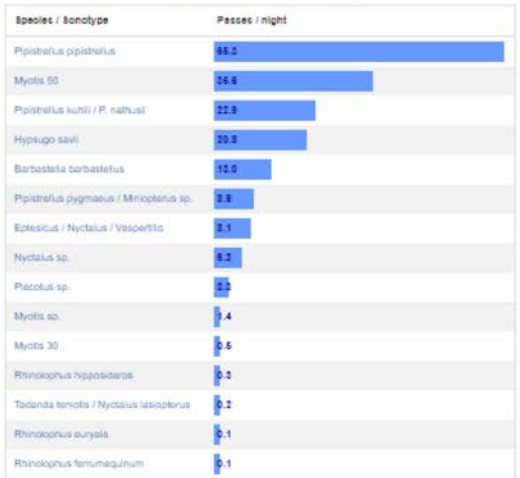

Resultats per sessió (5)

Period	Start	End	Days	Detector	Passes / night	Tags
Summer	2022-07-08	2022-07-21	13	SM4 (02)	4900	Hypsav-m, NycSp-m, Myo50-m, Barbar-m, Pippip-m, Pkuhnat-m, EptNycVes-m, PleSp-m, PpygMin-m, Rhihip-m, Myo30-m, Rhifer-m, TadNyc-m
Summer	2021-07-02	2021-07-14	12	SM4 (14)	827	Pippip-m, Myo50-m, EptNycVes-m, Hypsav-m, PpygMin-m, Pkuhnat-m, PleSp-m, Barbar-m, NycSp-m, Myo30-m, MyoSp-m, Rhihip-m
Summer	2020-07-09	2020-07-21	12	SM4 (07)	1138	Myo50-m, Hypsav-m, Pippip-m, PpygMin-m, PleSp-m, Barbar-m, Pkuhnat-m, MyoSp-m, EptNycVes-m, Myo30-m, TadNyc-m, Rhieur-m, Rhihip-m
Summer	2019-07-01	2019-07-09	8	SM4 (02)	1803	Barbar-m, EptNycVes-m, EptNycVes-m, Hypsav-m, Myo30-m, Myo50-m, MyoSp-m, NycSp-m, Pkuhnat-m, Pippip-m, PpygMin-m, PleSp-m, Rhihip-m, TadNyc-m
Summer	2018-07-04	2018-07-13	9	SM4 (10)	1236	Hypsav-m, MyoSp-m, Barbar-m, PpygMin-m, Myo50-m, Pippip-m, Pkuhnat-m, EptNycVes-m, PleSp-m, MyoSp-m

Evolution of counts of All bat species

Each bar represents the average of counts (or *bat passes*) detected per night in each sampling point. A *bat pass* is defined as a recording of a maximum of 5 seconds with a minimum of 2 bat calls identified to species level or as a phonic group. Through the menu, it is possible to visualize the average of total bat activity (including all bat species) or the total count for each species.The bar colours correspond to each season.

Summary of accumulated bat activity



Summary of accumulated bat activity for each bat species on the sampling locality. The bars indicate the average of contacts (or *bat passes*) detected per night, including all samplings carried out within the year.

Species and/or phonic group identified in this locality

Common pipistrelle bat
Pipistrellus pipistrellus
Vespertilionidae

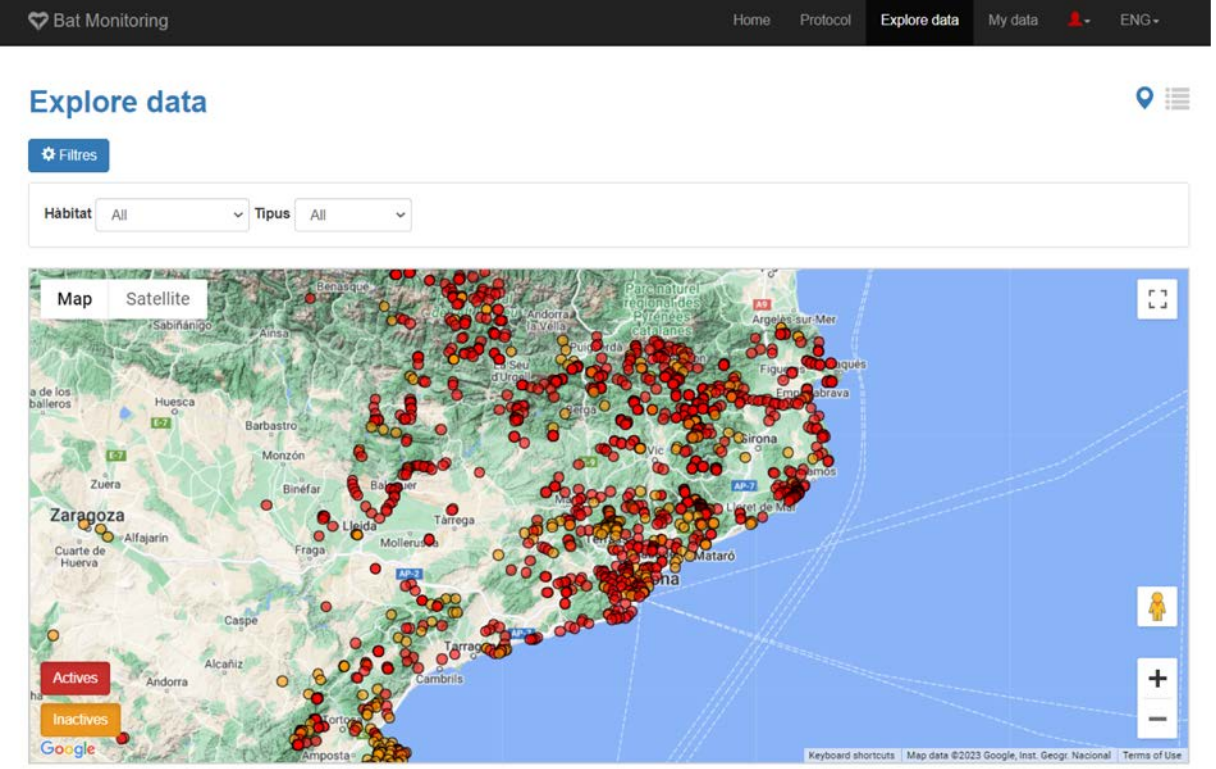
Myotis 50
Vespertilionidae

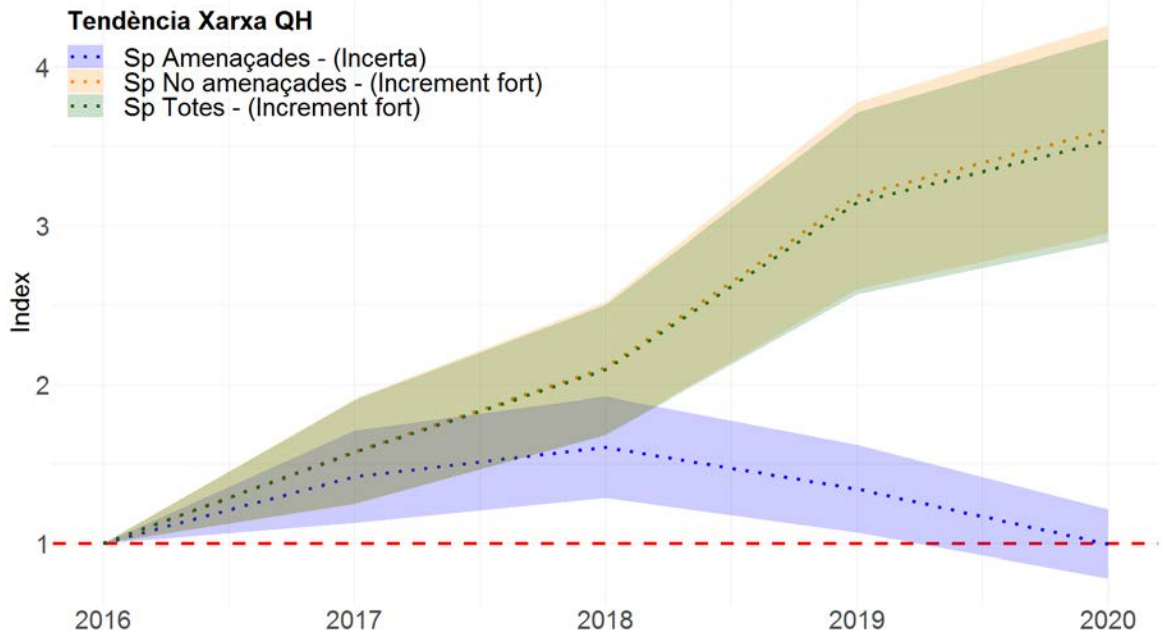
Pipistrellus kuhlii / P nathusii
Vespertilionidae

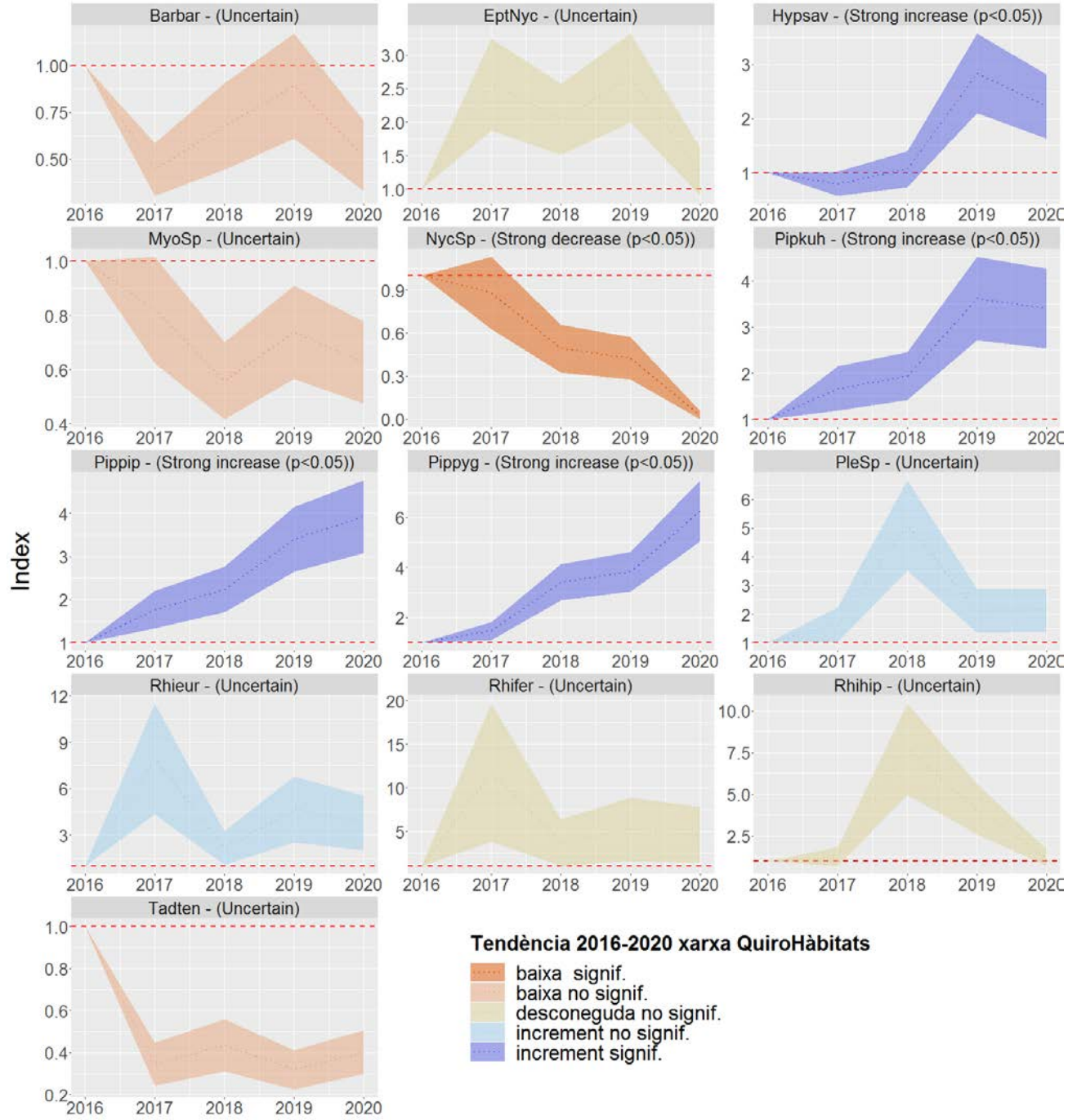
Savi's pipistrelle bat
Hypsugo savii
Vespertilionidae

Barbastelle bat
Barbastella barbastellus
Vespertilionidae

Pipistrellus pygmaeus / Miniopterus sp.
Vespertilionidae


Bat Monitoring
Home
Protocol
Explore data
My data
ENG
Explore data
Filtres
Hàbitat
All
Tipus
All
Map
Satellite
Actives
Inactives
Google
Keyboard shortcuts
Map data ©2023 Google, Inst. Geogr. Nacional
Terms of Use


Tendència Xarxa QH
Sp Amenaçades - (Incerta)
Sp No amenaçades - (Increment fort)
Sp Totes - (Increment fort)
Index
1
2
3
4
2016
2017
2018
2019
2020


Barbar - (Uncertain)
EptNyc - (Uncertain)
Hypsav - (Strong increase (p<0.05))
MyoSp - (Uncertain)
NycSp - (Strong decrease (p<0.05))
Pipkuh - (Strong increase (p<0.05))
Pippip - (Strong increase (p<0.05))
Pippyg - (Strong increase (p<0.05))
PleSp - (Uncertain)
Rhieur - (Uncertain)
Rhifer - (Uncertain)
Rhihip - (Uncertain)
Tadten - (Uncertain)
Index
2016
2017
2018
2019
2020
Tendència 2016-2020 xarxa QuiroHàbitats
baixa signif.
baixa no signif.
desconeguda no signif.
increment no signif.
increment signif.

ChiroRoosts

Bat monitoring in natural and artificial roosts

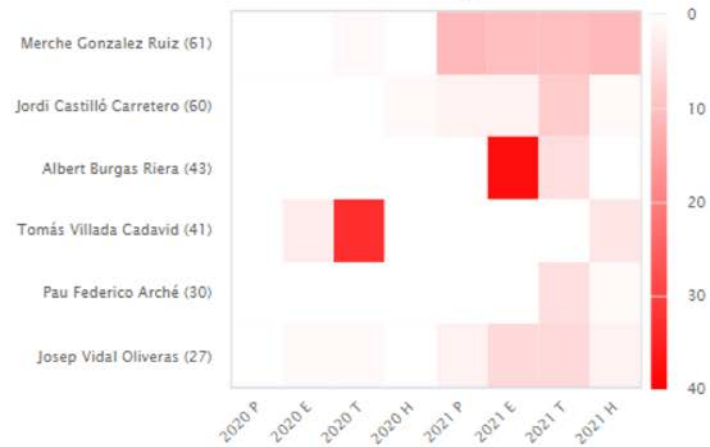
Bat roost monitoring protocol, including natural roosts (such as caves, rock shelters, trees etc.) as well as artificial roosts (mines, tunnels, roofs, stone cabins etc.). It is the simple protocol for following bat populations, mainly cave-dwelling, such as rhinolophid bats (*Rhinolophus* sp.), the Schreiber's Bent-winged bat (*Miniopterus schreibersii*) and (*Myotis sp.*), that are otherwise difficult to detect.

Throughout the monitoring of bat populations in roosts, we can extrapolate the population trends of these species, and thus prevent the local extinctions caused by negative effects of human activities on the landscape. For this monitoring, the Natural Science Museum of Granollers adapts the protocol to the specific characteristics of each roost.

Roosts: **567**

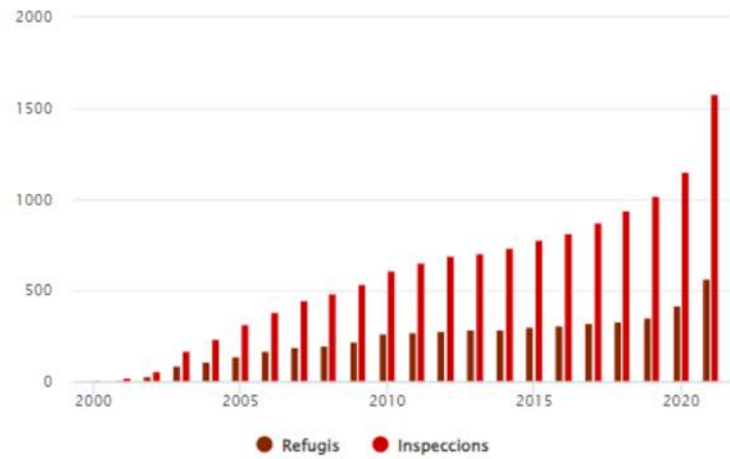
Inspecctions: **1583**

Volunteer ranking



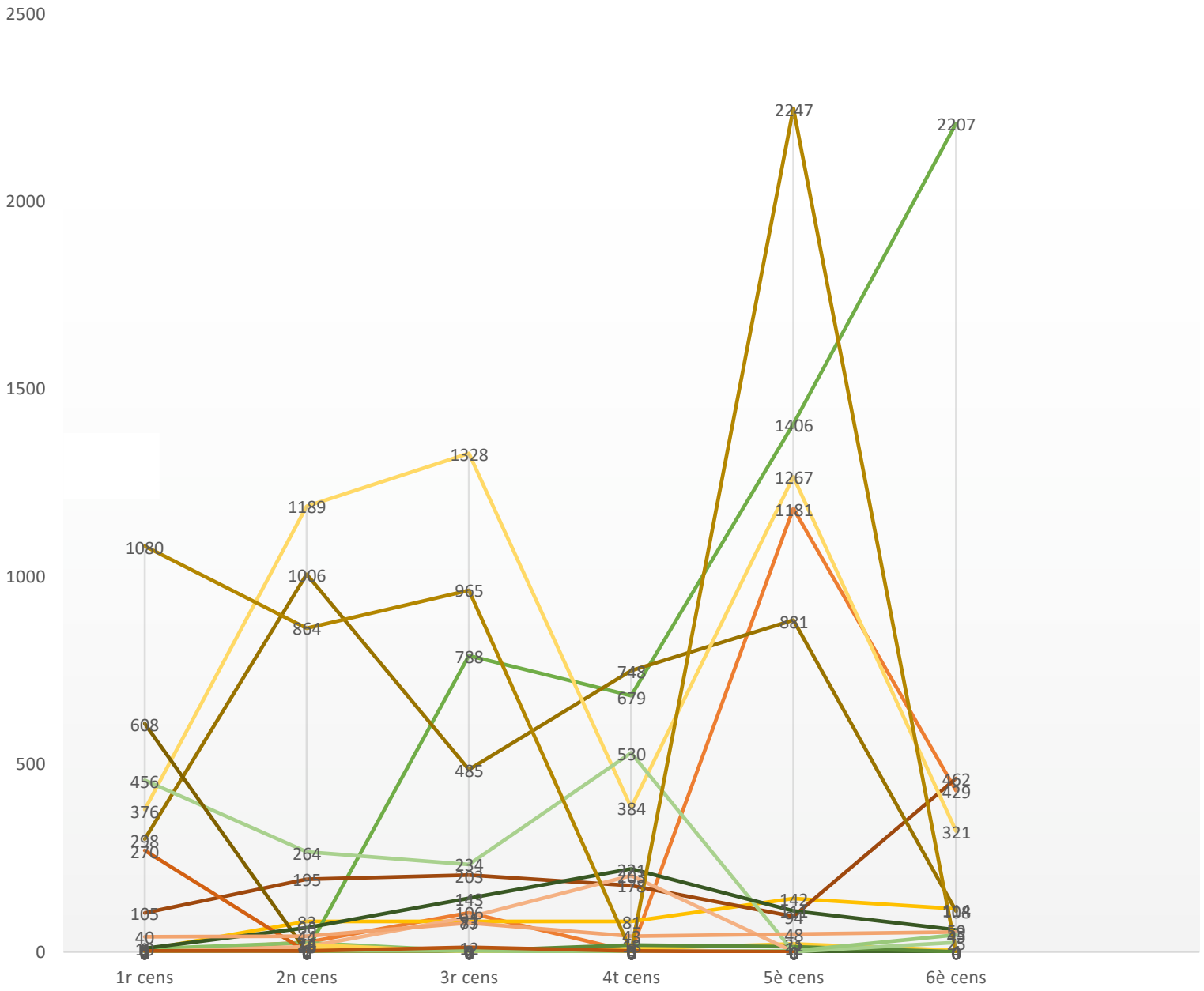
Volunteer ranking with the maximum number of roosts' inspections per year and season. (P=spring, E=summer, T=autumn, H=winter)

Evolution in the number of roosts and inspections

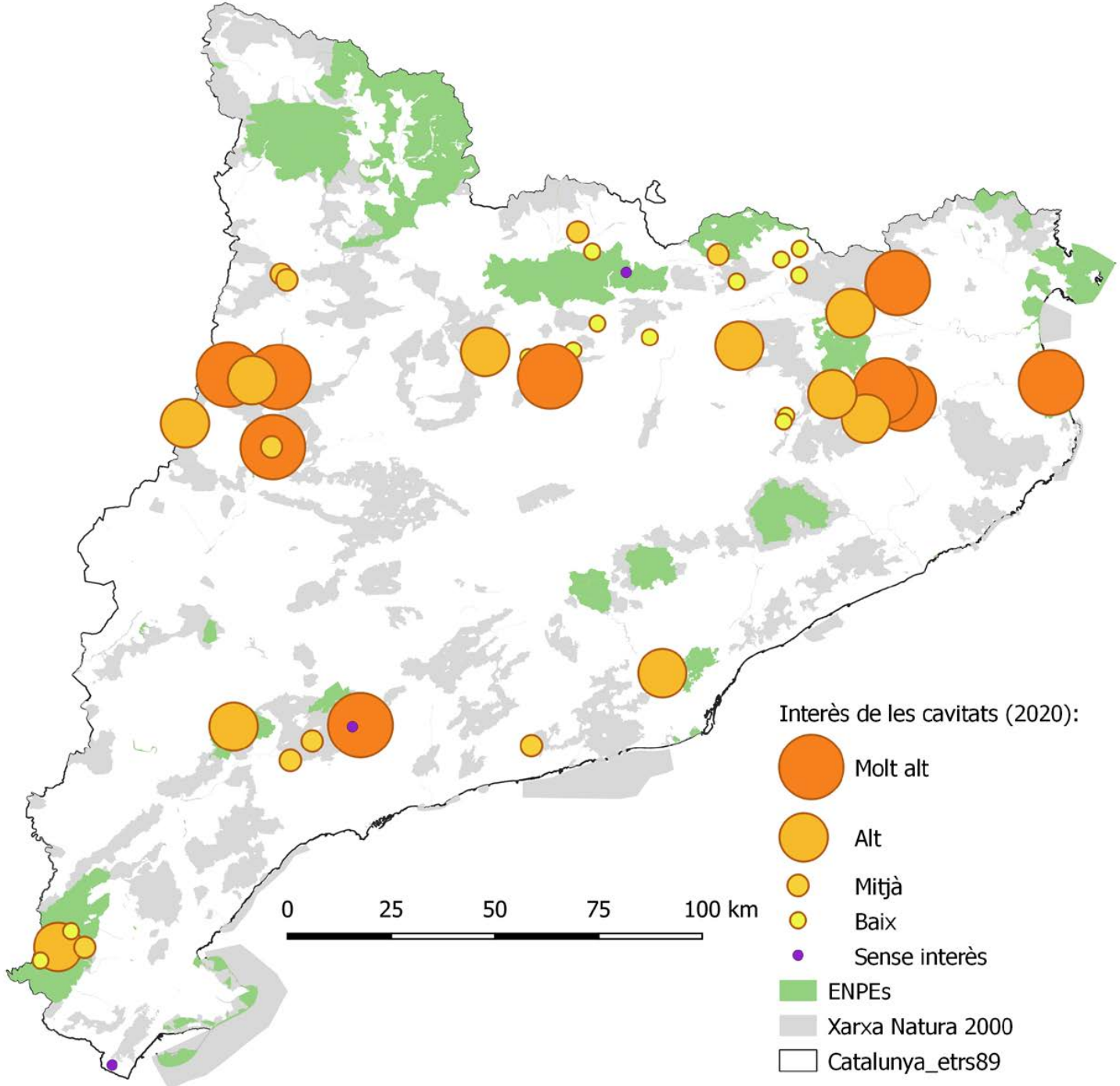


Evolution of the number of roosts and inspections acumulated through the years


www.adriabaucells.com


2500
2000
1500
1000
500
0
1r cens
2n cens
3r cens
4t cens
5è cens
6è cens
2247
2207
1406
1328
1267
1189
1181
1080
1006
965
864
881
788
748
679
608
530
485
462
456
429
384
376
321
298
270
264
234
203
195
178
165
142
143
106
105
94
83
81
48
40


NO PASSEU


0
25
50
75
100 km
Interès de les cavitats (2020):
Molt alt
Alt
Mitjà
Baix
Sense interès
ENPEs
Xarxa Natura 2000
Catalunya_etrs89

Bat Migration routes in Europe

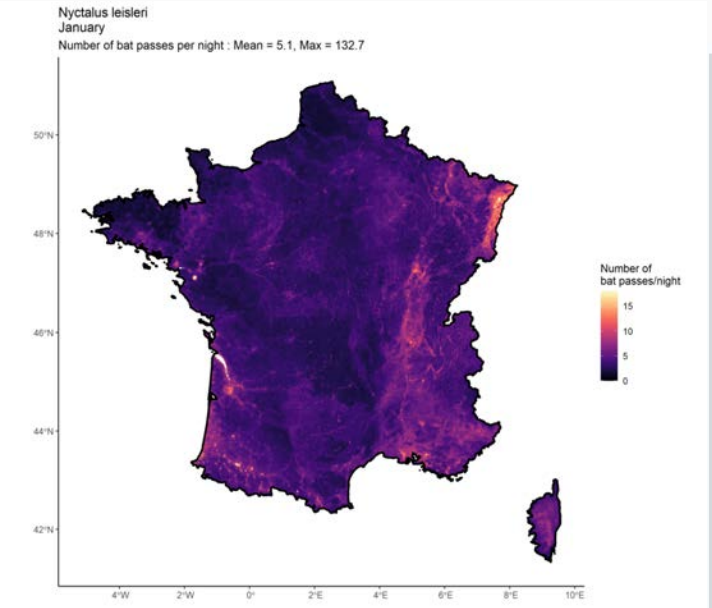
Get involved! Apply for an Audiomoth!

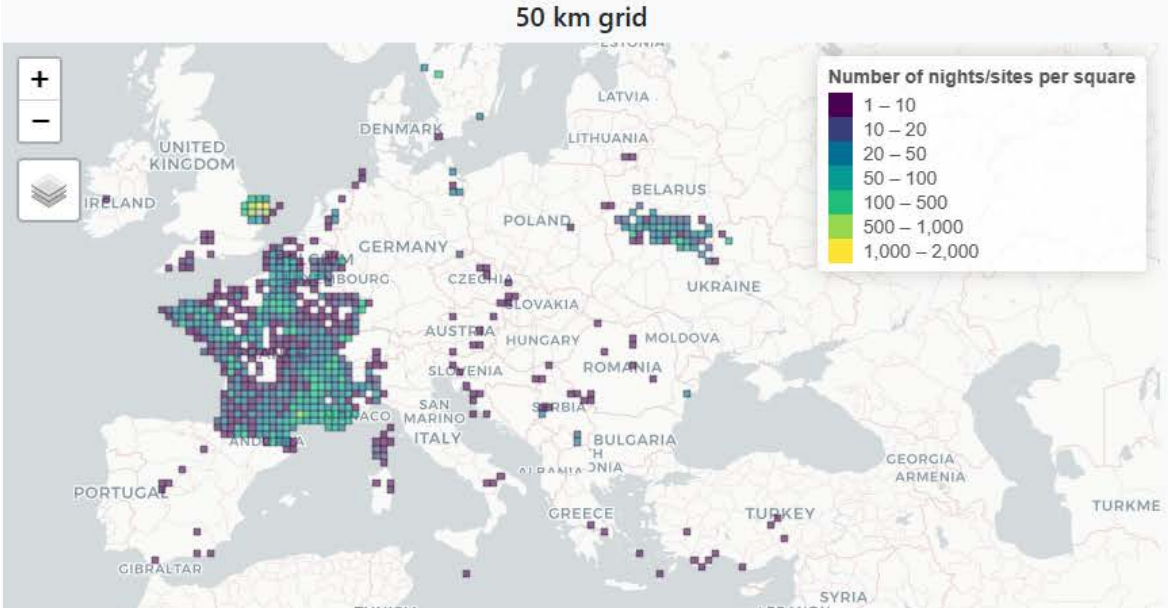
CESCO Centre d'Écologie et des Sciences de la Conservation
MUSÉUM NAT. HIST. NATURELLE
Centre d'Écologie Fonctionnelle & Évolutive
cnrs
BEES UMS 3468

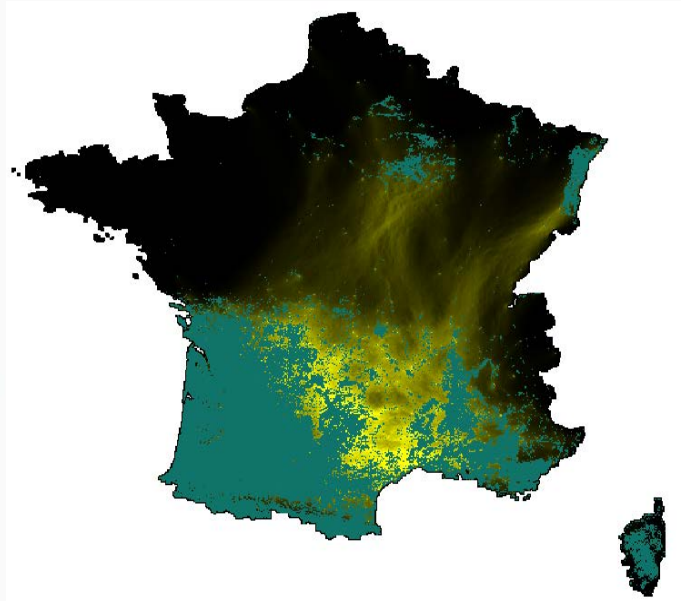
Funding and support

OFB Office Français de la Biodiversité
NATURALIA ingénierie en écologie
EUROBATS

Participation map







- **Opportunity: first review of the most common uses of settings and machines in Europe**

- **Define which possibilities exist to aggregate data from different machines/settings**
  - Field tests to define which settings/machines give similar results
  - Larger time interval to count bat passes (e.g. positive minute of activity, Miller 2001, Haquart 2012)
    → eliminates a lot of variability due to material used
  - Use setting and machine as input in models to take the variability into account

A European database for full-night recordings of bats?

- Secured and standard storage
- Confidentiality management
- Remote access for:
  - Raw data processing
  - Download of processed data
  - Dynamic tools for results

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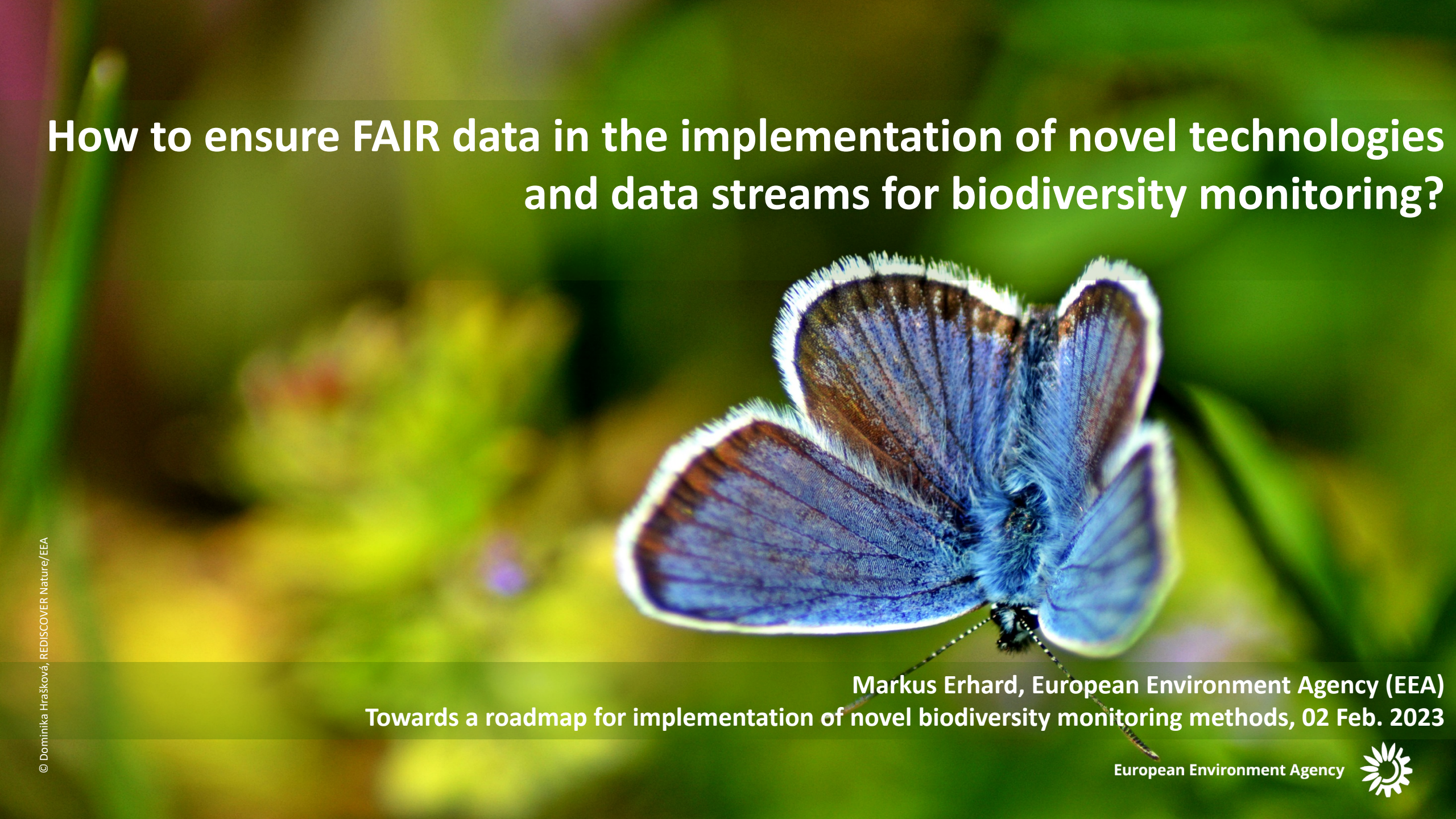
How to ensure FAIR data in the implementation of novel technologies and data streams for biodiversity monitoring?

By Markus Erhaard, EEA

How to ensure FAIR data in the implementation of novel technologies and data streams for biodiversity monitoring?

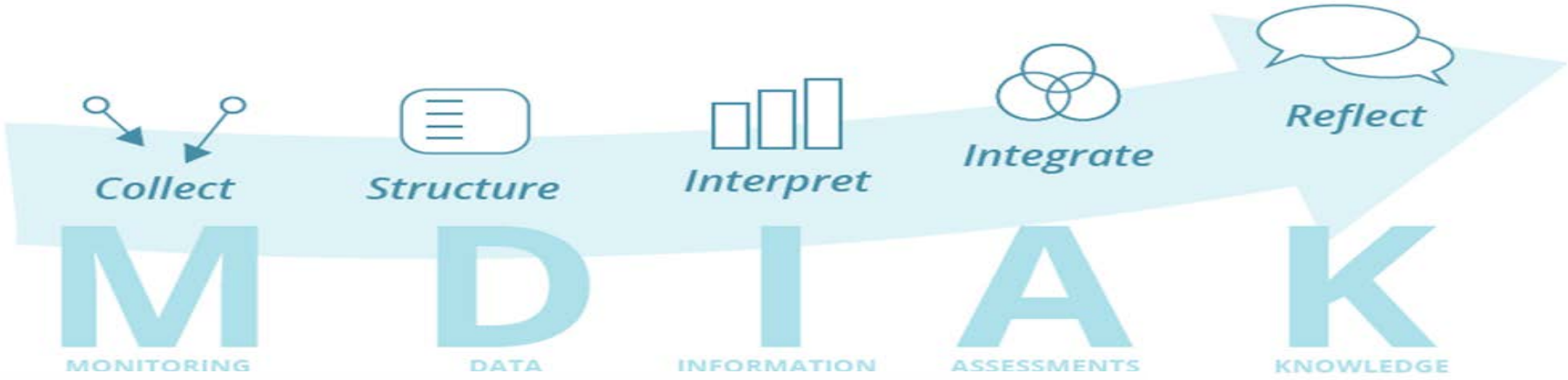


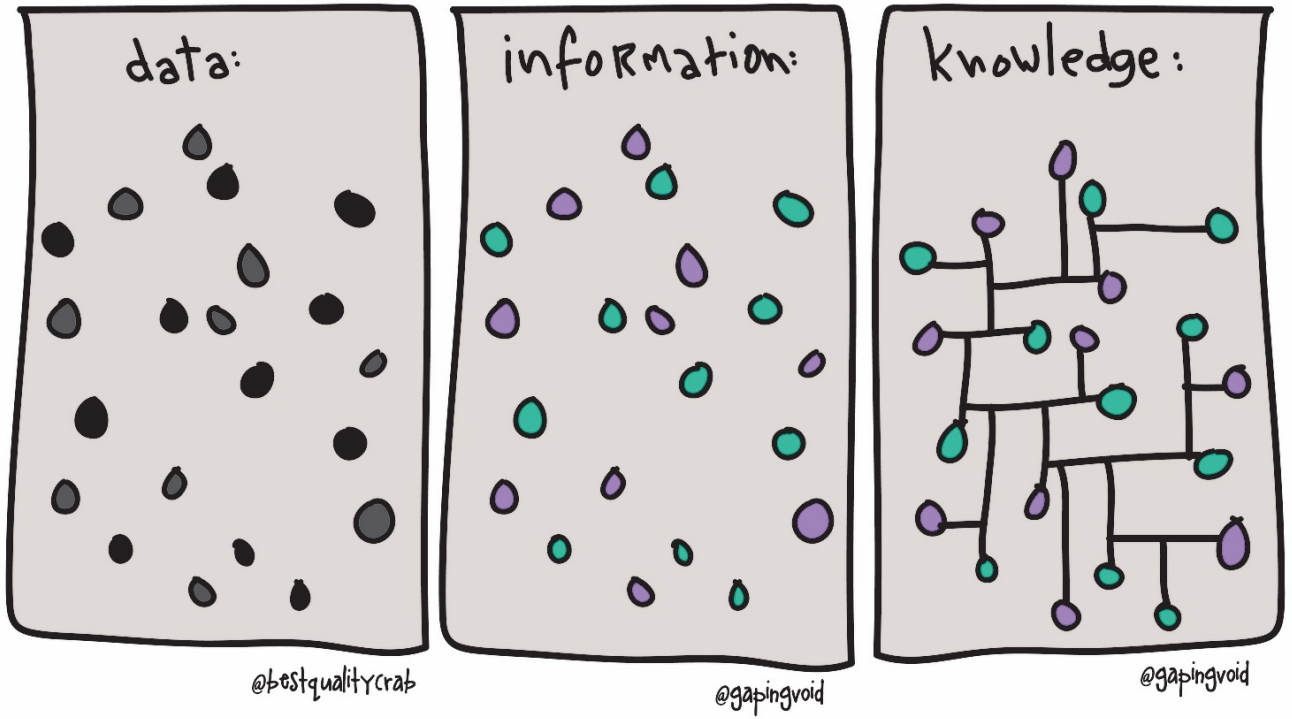
Markus Erhard, European Environment Agency (EEA)

Towards a roadmap for implementation of novel biodiversity monitoring methods, 02 Feb. 2023

European Environment Agency

Knowledge integration



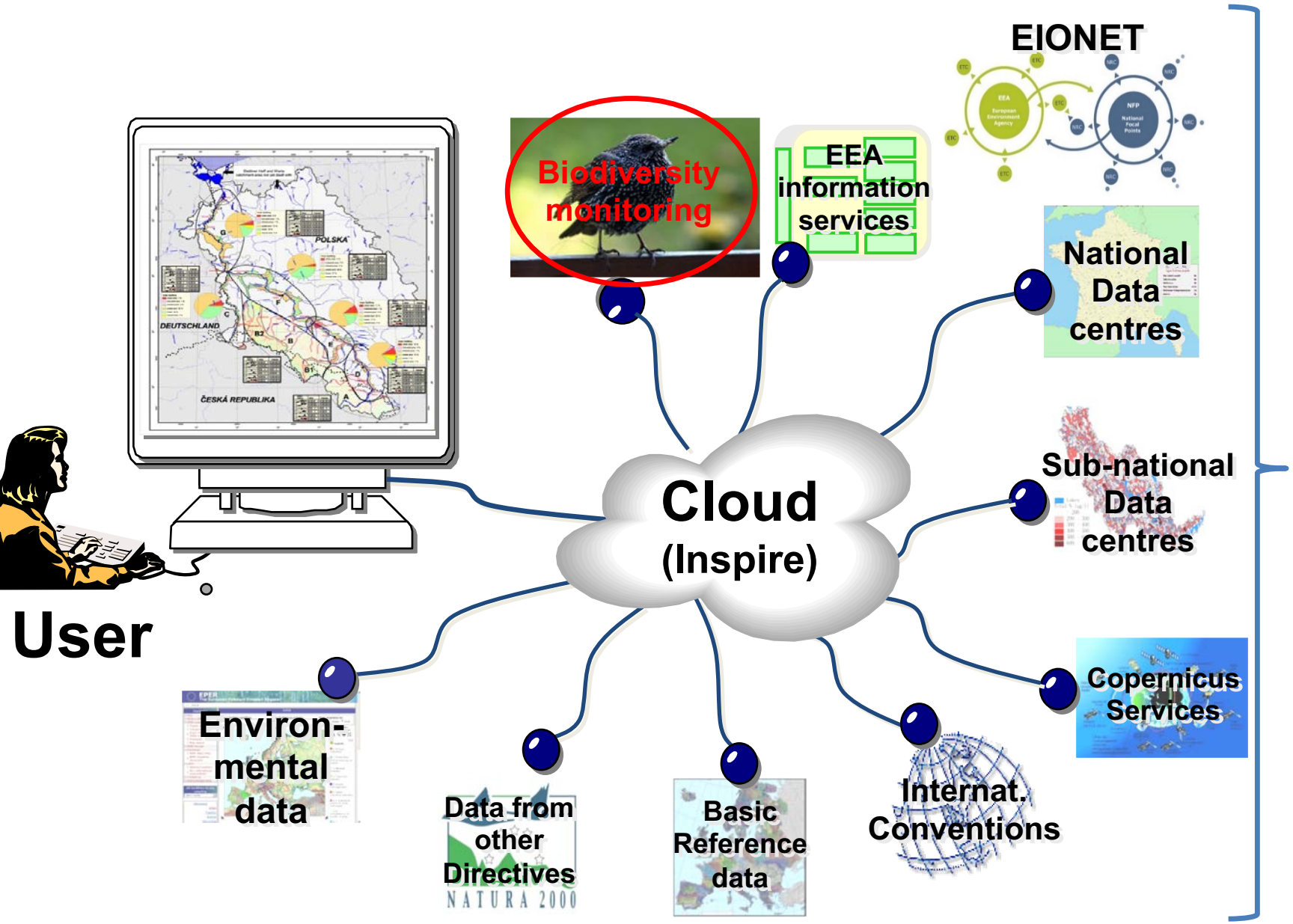


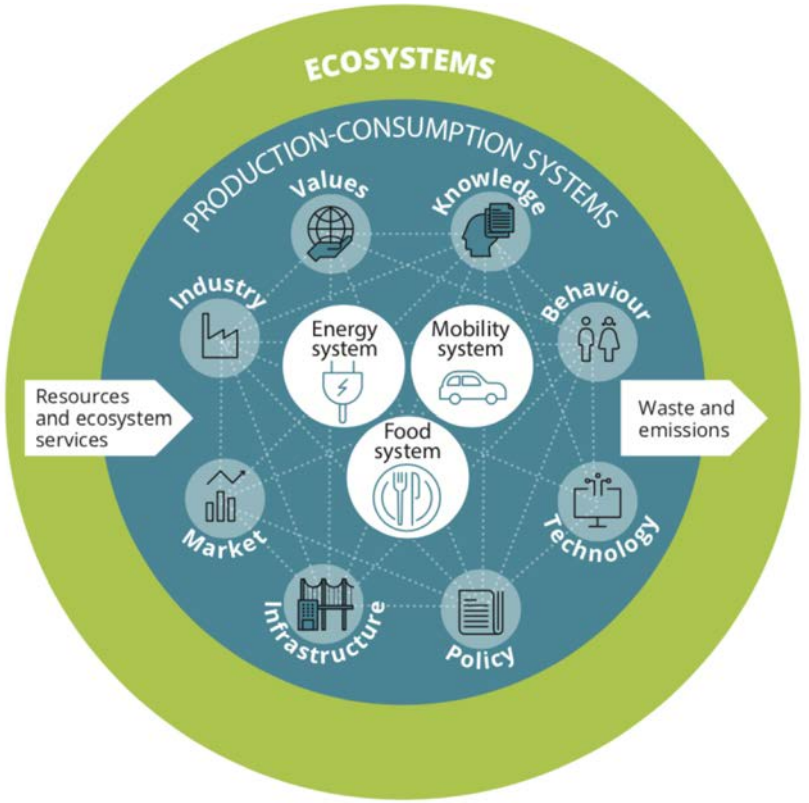
https://www.youtube.com/watch?v=mUgEgkV16Bw

Policy Targets

European Environment Agency

Data integration for assessments





Review of knowledge chain for ecosystem asssessment

Numerical knowledge base

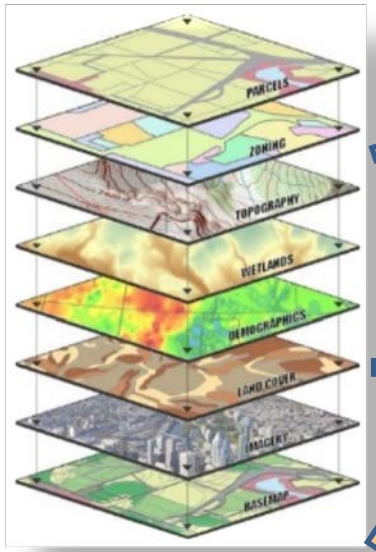
Analytical knowledge base

Basic input data sets:

Hosting organisation/ Geospatial database:

Analytical approach:

Policy support & applications:



Which ones do we need?
Which ones do we have?
At ecosystem scale, regular?
Based on stable source?
How to fill gaps?

How to structure?
Who to host?
What resources required? Etc.

Synthetic reviews

- EU Semester
- Env. Impl. Review
- BDS 2030 targets review

Ecosystem accounts + MAES

- Ecosystem Extent + condition
- Ecosystem service flows

Policy-focused analysis

- Agriculture
- WFD
- Natura 2000
- Other policies

Well-managed and healthy European eco-systems

European Environment Agency

Courtesy: Jan-Erik Petersen, EEA

Biodiversity data – the challenge

- Biodiversity data tend to be limited and biased
  - taxonomically
  - spatially
  - temporally
  - ecologically
- Not representative for overall biodiversity – biased towards charismatic species and presence/absence, lack of data on abundance
- Not fit for purpose, skewing management decisions and policy
- Policy making needs aggregated indicators – how to monitor, indicate and aggregate?
- There is an institutional gap at EU level for gathering, compiling and hosting (biodiversity) data.

➢ Urgent need for more and better data to enhance our knowledge base

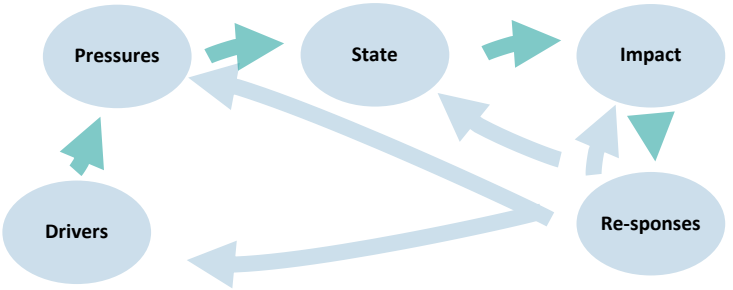
Courtesy: Ian Donohue, EEA Scientific Committee

Way forward with FAIR data

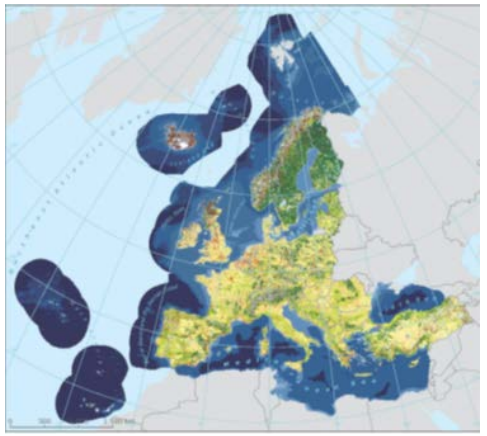
- Novel technologies provide new opportunities to improve
- Harmonise and standardise methods of monitoring, data storage and architecture also for re-calculation of time series and integration of existing monitoring schemes
- Robust change detection needed, not single data point inventories
- Towards ecosystem monitoring - contextualisation of biodiversity monitoring with environmental conditions in appropriate temporal and spatial scales
  drivers, pressures, condition, impacts to provide knowledge for adequate responses (policy decision)

➢ **Co-development** with respective institutions to develop joint capacities no simple handing over of data bases / platforms / products / websites etc. without prior agreement and follow-up resourcing

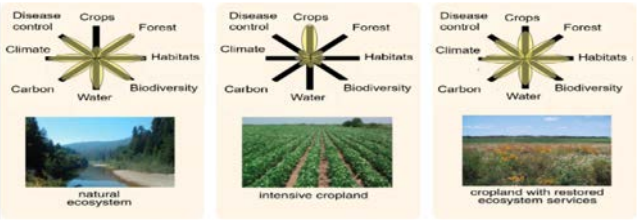
Ecosystem condition and functioning



Spatial explicit assessments



Smart use of ecosystems for nature based solutions



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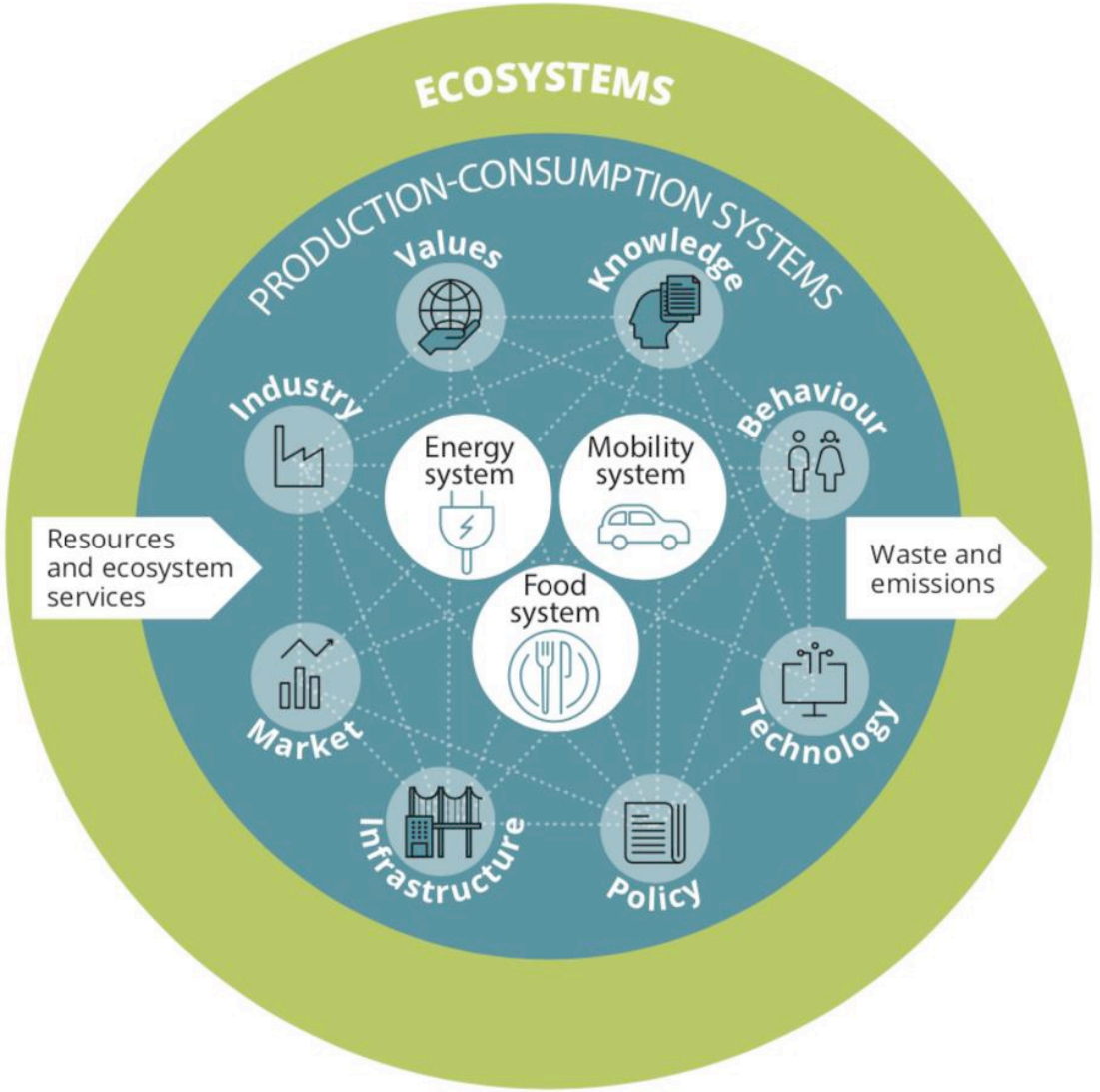
Thank you

“We can only manage

what we have measured”

Virginijus Sinkevičius

Commissioner for Environment, Oceans and Fisheries, European Commission



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Any questions?

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Split in sub-groups

By Lars Dinesen, IFD and Cécile Mandon, FRB

4 sub-groups

GROUP 1: Remote sensing

(Satellites, Lidar, and drones for habitat status and condition)

Facilitator: Petteri Vihervaara
Support: Cécile Mandon

GROUP 2: Image-based approaches

(Species monitoring such as camera trapping, drones and thermal cameras)

Facilitator: Toke Høye
Support: Lars Dinesen

GROUP 3: Acoustic sensors (Permanently deployed for birds, bats, some marine mammals and terrestrial insects)

Facilitator: Hilde Eggermont
Support: Daniela Hamidovic

GROUP 4: Molecular methods (species and communities)

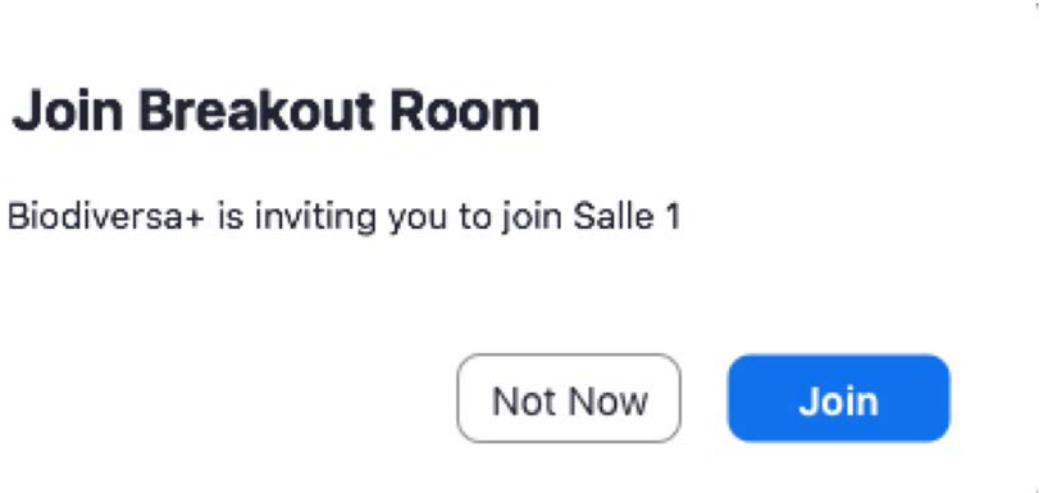
Facilitator: Florian Leese
Support: Ola Inghe and Guillaume Body

Potential cross-cutting topics which can be considered in the breakout groups

- What are the barriers (anchors) and opportunities (winds) for *implementation* (sail boat)
- Need for standardisation
- How to do this in practice (spatial and temporal sampling regimes)
- Need for reference libraries and training data
- Make sure to capture synergies among technologies
- Link to EU monitoring requirements for business and financial sectors?
- Use of Artificial Intelligence to improve monitoring

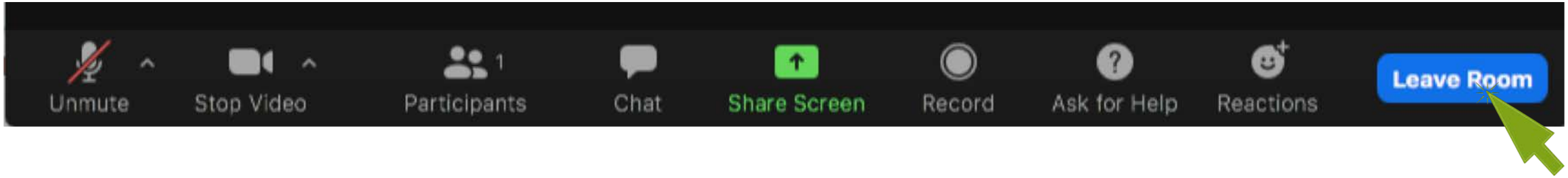
How to join your sub-group?

You will automatically join your sub-group and be invited to click on join



At the end of the sub-group discussions

You will either be automatically brought back in plenary or you will have the possibility to click on leave room



Let’s take a break!

Be back at 10.50am in sub-groups

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Welcome back!

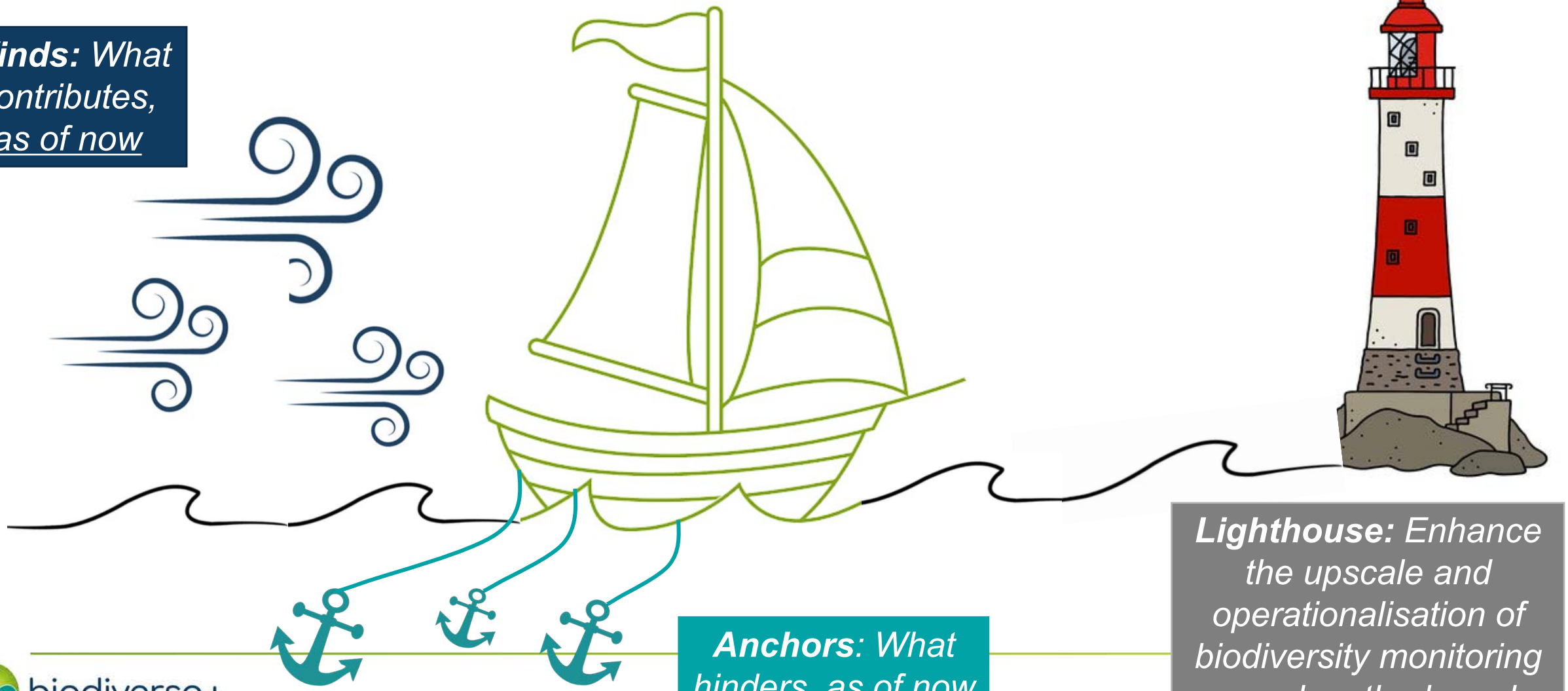
Sub-group objectives

- Quick round table
- Sailboat brainstorming session

SailBoat

Boat = *our group/ Biodiversa+*

Winds: *What contributes, as of now*



Anchors*: What hinders, as of now*

Lighthouse: *Enhance the upscale and operationalisation of biodiversity monitoring novel methods and approaches in Europe*

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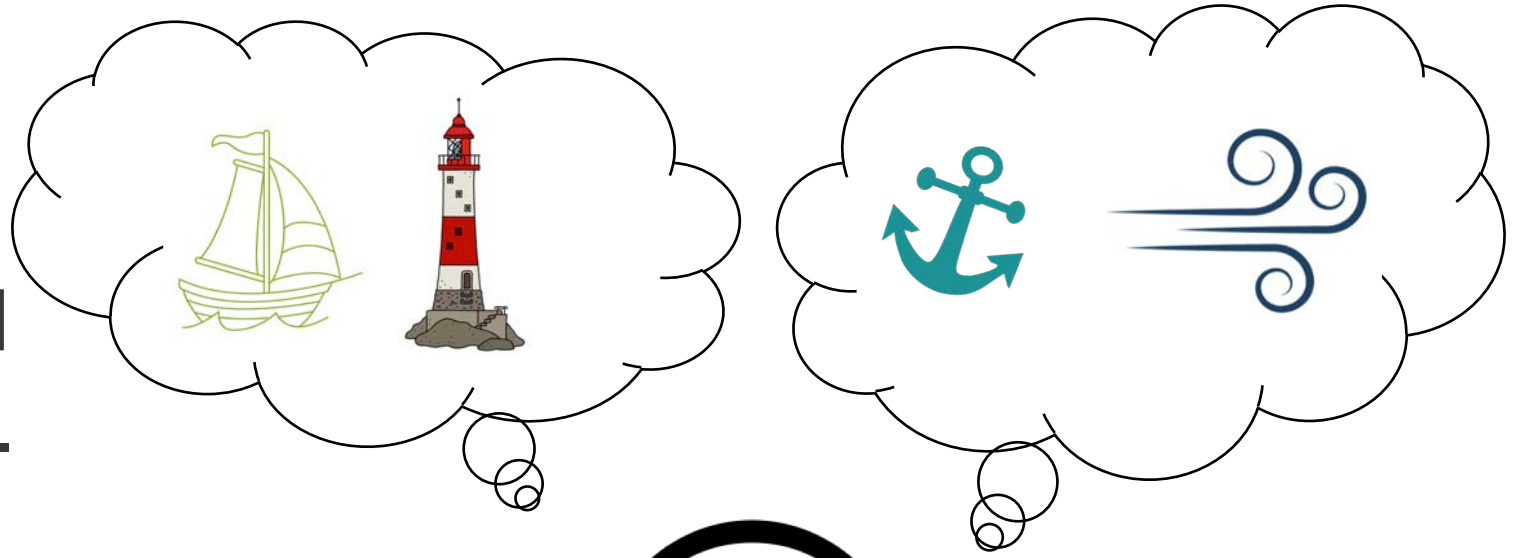
First Step : Individual Work

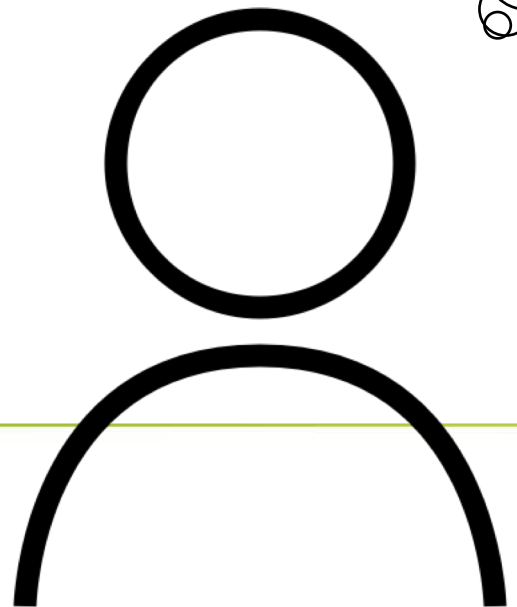
During 10 minutes :

→ Identify « winds » and « anchors » in Jamboard.



Winds: blue post-its

Anchors: yellow post-its



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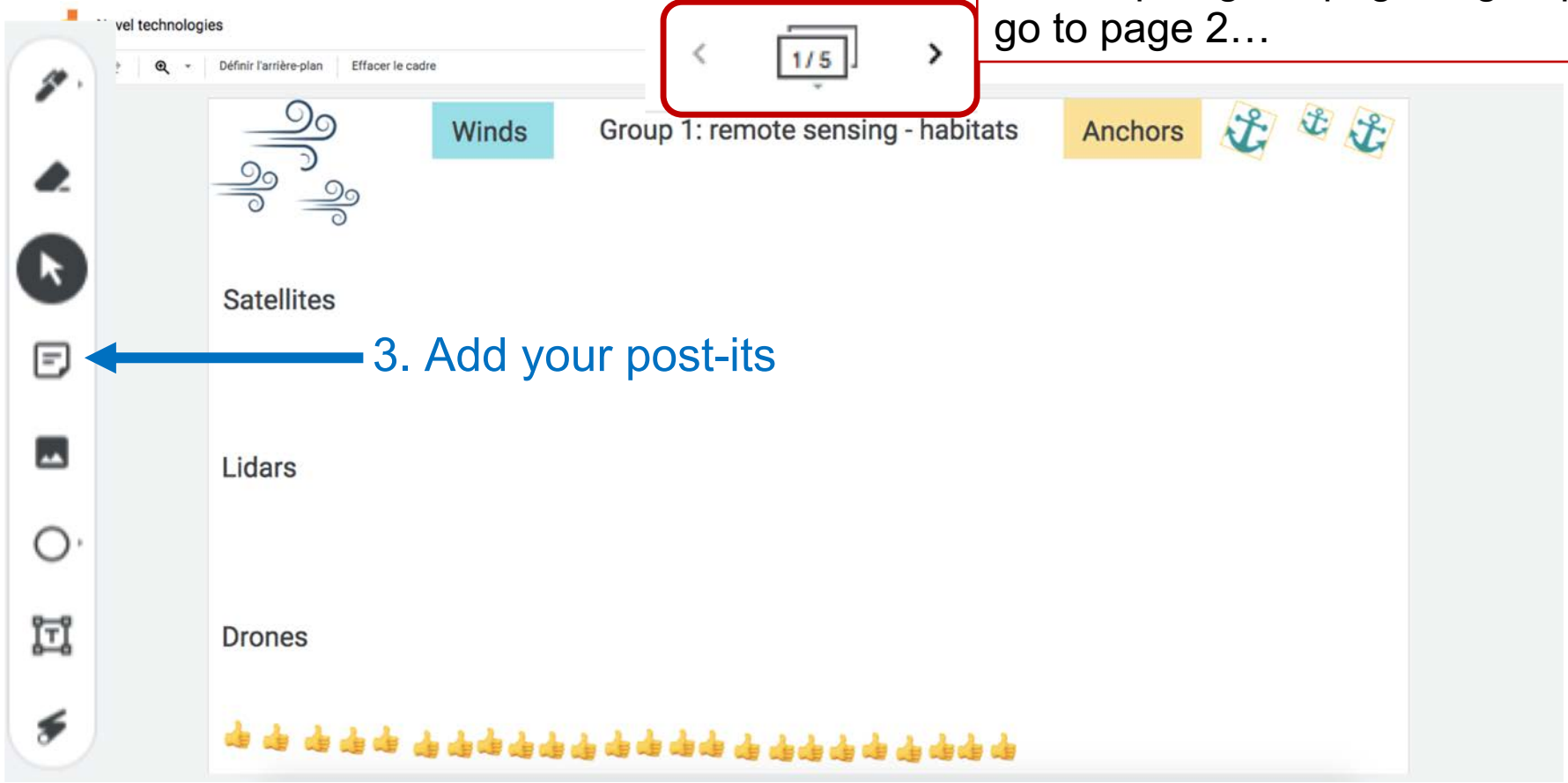
First step: on Jamboard, how does it work?

1. Click on the link: https://jamboard.google.com/d/1i32YNdLOwzQ0raibx4PYx--ppwd37Aor8vJ5PC7Peyg/edit?usp=sharing

2. Group 1: go to page 1, group 2 go to page 2…



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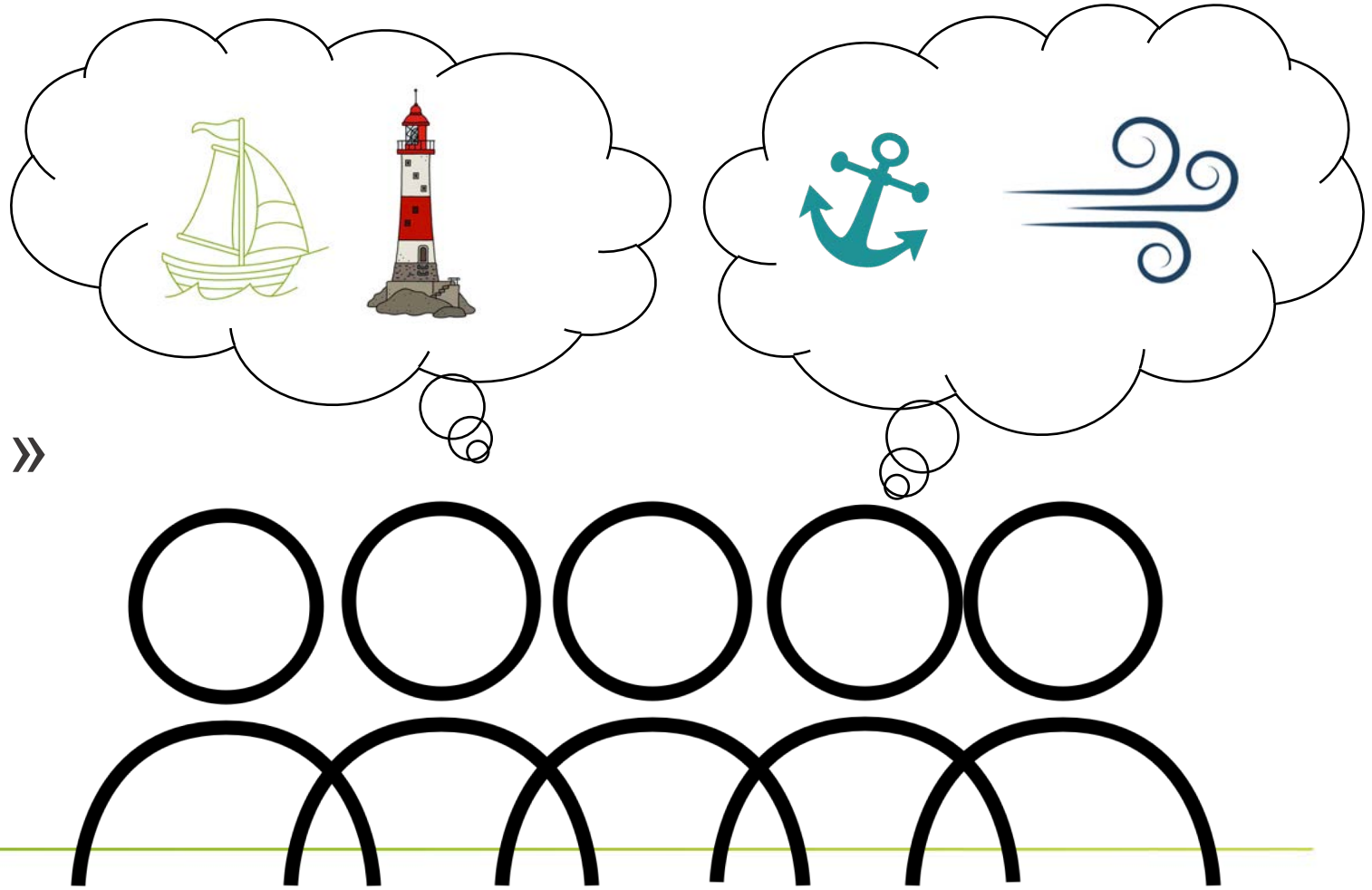
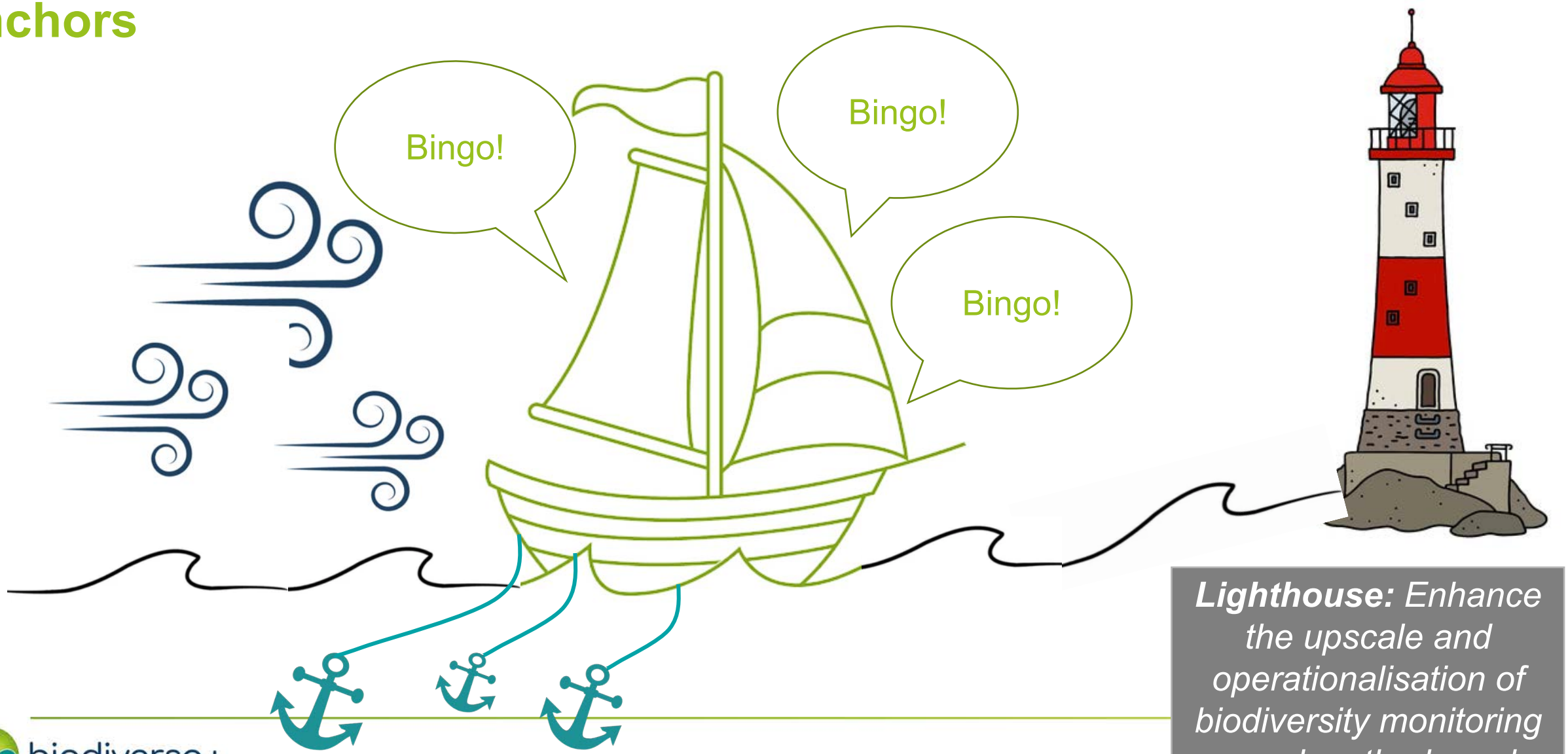
Second Step : Group Work

During 30 minutes :

→ **Share and pool** the « winds » and « anchors » individually identified



Third step: present and articulate groups' winds and anchors



Lighthouse: *Enhance the upscale and operationalisation of biodiversity monitoring novel methods and approaches in Europe*

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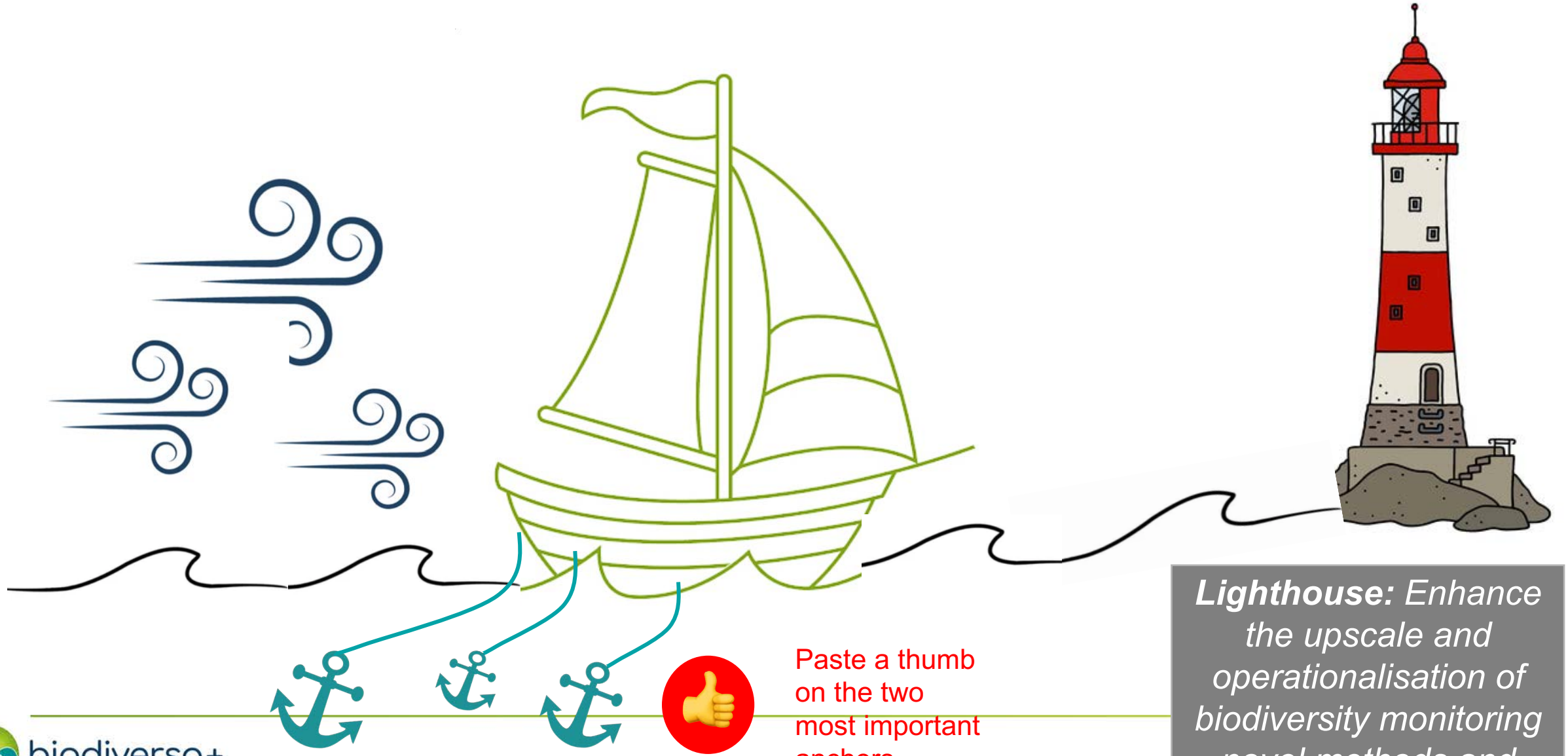
Fourth steps: Prioritize the anchors: what are the biggest anchors?



Paste a thumb on the two most important anchors

Lighthouse: *Enhance the upscale and operationalisation of biodiversity monitoring novel methods and approaches in Europe*

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Fifth step: dig into the anchors in groups

Guidelines :

- **For the biggest anchor**

- **15 min**

> Discuss **3 first steps** that could help to address the anchor
> Discuss **how Biodiversa+ could help** in achieving these steps
> Discuss **who else** needs to “be on the boat”.

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Plenary wrap-up

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Conclusion of the workshop and next steps

Follow-up of the workshop

- Development of a roadmap guiding the Biodiversa+ activities (by Biodiversa+)

- The experts attending the workshop will have an opportunity to provide feedback

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EUROPEAN PARTNERSHIP

Co-funded by the European Union

Thank you for your participation!

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contact@biodiversa.eu

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