Roadmap for implementing environmental DNA (eDNA) and other molecular monitoring methods in Finland

© Tiina Laamanen

Veera Norros

Finnish Environment Institute SYKE

eDNA and other molecular methods in environmental monitoring Workshop 11 Nov 2021

SYKE

Need for national coordination of monitoring efforts – Finnish Ecosystem Observatory (FEO)

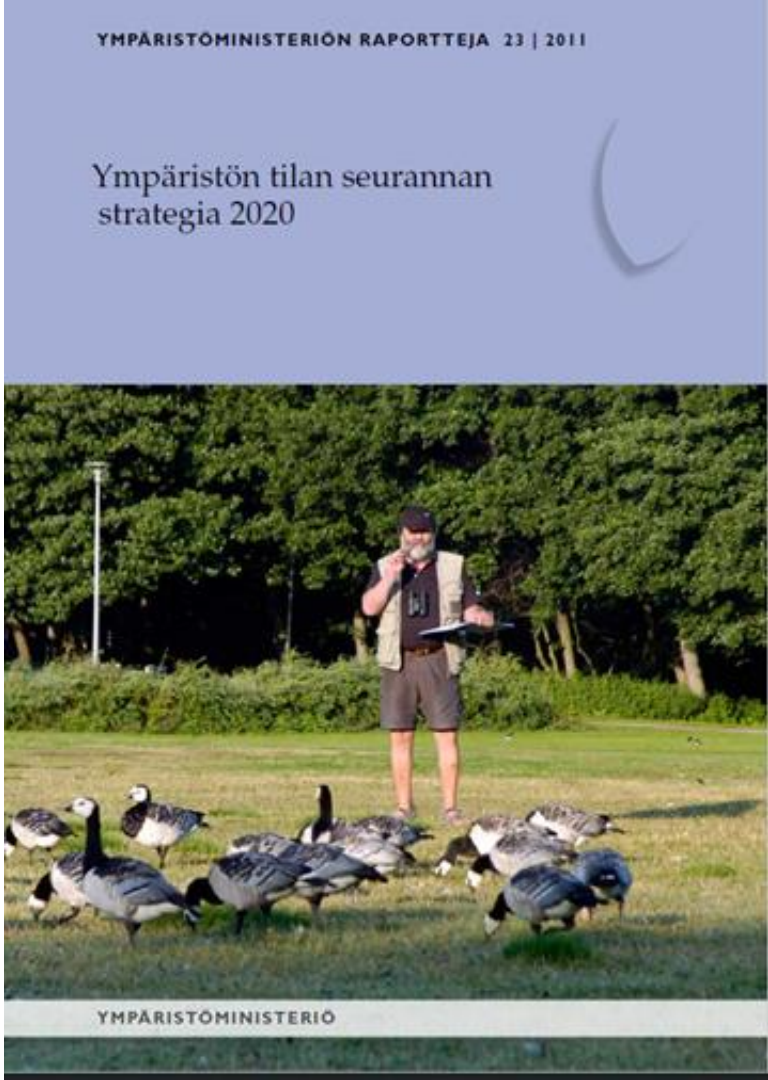
- FEO brings together data on nature and develops new monitoring methods and data processing tools.

- FEO supports the use of data on nature in decision-making and research.

- FEO creates a national cooperation model and develops data management solutions to support monitoring and research into the state of ecosystems.

SYKE

Need for national coordination of monitoring efforts – Environmental monitoring strategy



SYKE

Why do we need national and international coordination of MoMM implementation?

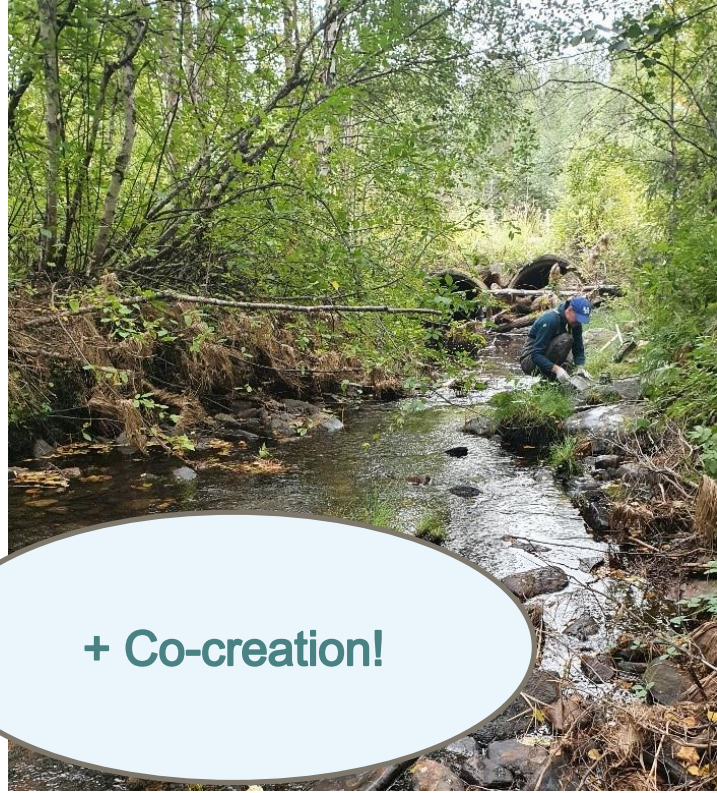
- MoMM = molecular monitoring methods

- Methods have reached the critical maturity – implementation in routine monitoring has started worldwide
- The field is fragmented, with different organizations fast developing their own methodologies – risk of unnecessary duplication of efforts and incompatibility of the end results
- If we wish not only to jump on the train but also co-steer it, now is the time to act!

SYKE

The roadmap project

- Funded for 2021 by the Finnish Ministry of the Environment (YM)
- SYKE team: Veera Norros, Tiina Laamanen, Kristian Meissner, Sirpa Lehtinen, Katileena Lohtander-Buckbee, Henrik Nygård, Marja Ruohonen-Lehto, Päivi Sirkiä, Sanna Suikkanen, Mikko Tolkkinen, Kristiina Vuorio and **Petteri Vihervaara**
- Collaboration with FEO and eDNA pilot projects at SYKE
- Natural Resources Institute (LUKE) contribution

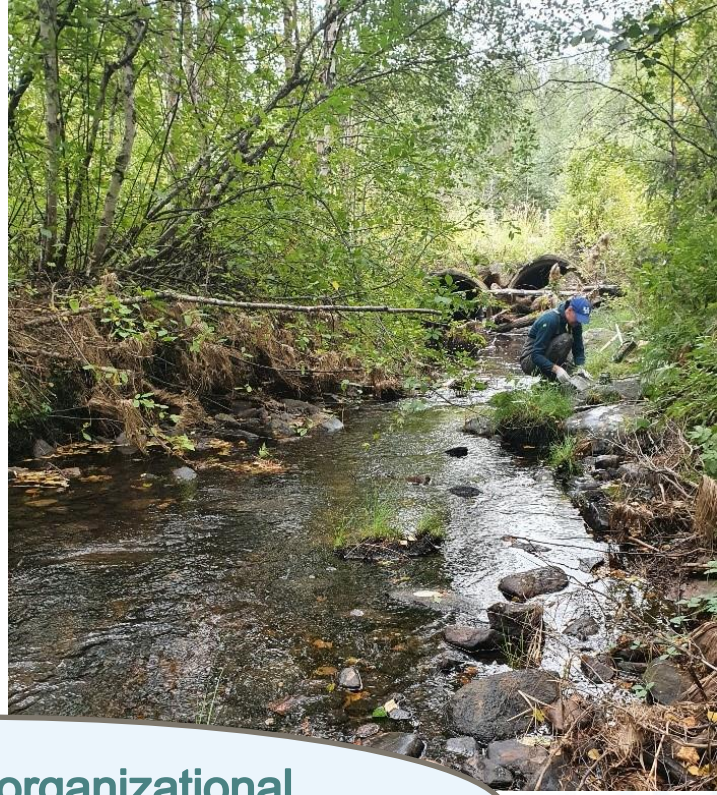


© Tiina Laamanen

SYKE

Project aims

- Describe the national state-of-the-art in MoMM
- Identify the main possibilities and challenges and development needs
- Formulate medium- and short-term aims
- Provide a concrete action plan for the next four years



+ Promote cross-organizational interaction in practice!

na Laamanen

SYKE

The eDNA Roadmap

SYKE

https://www.visitsaimaa.fi/en/scenic-roads-saimaa/

For whom is this report written?

- Diverse expert community (environmental monitoring, biodiversity research etc.)
- Governmental officials (particularly YM)
- Policy makers
- Stakeholders
- Anyone with an interest in environmental monitoring strategy

Report structure

- Executive Summary
- Introduction
- Status assessment
- Vision
- General development plan
- Concrete action plan
- Monitoring implementation progress

SYKE

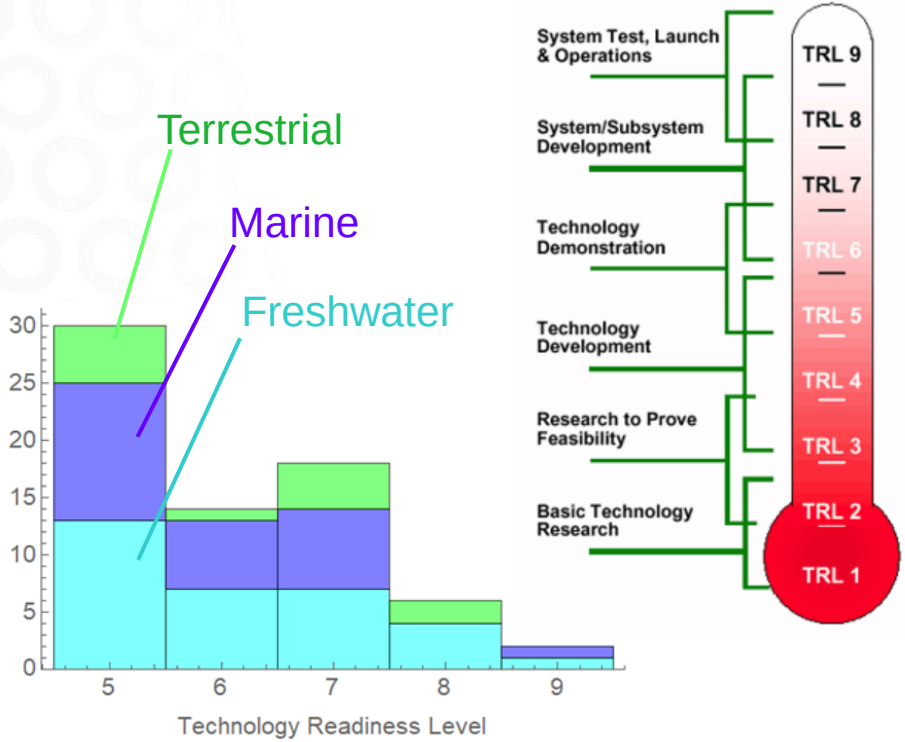
Status assessment - where are we now?

- International sources:
  - Scientific literature
  - Webropol survey
- National sources:
  - Enquiries and interviews
  - National workshop

- Three statements…

SYKE

Statement 1: The methodology is mature but not yet implemented on a large scale



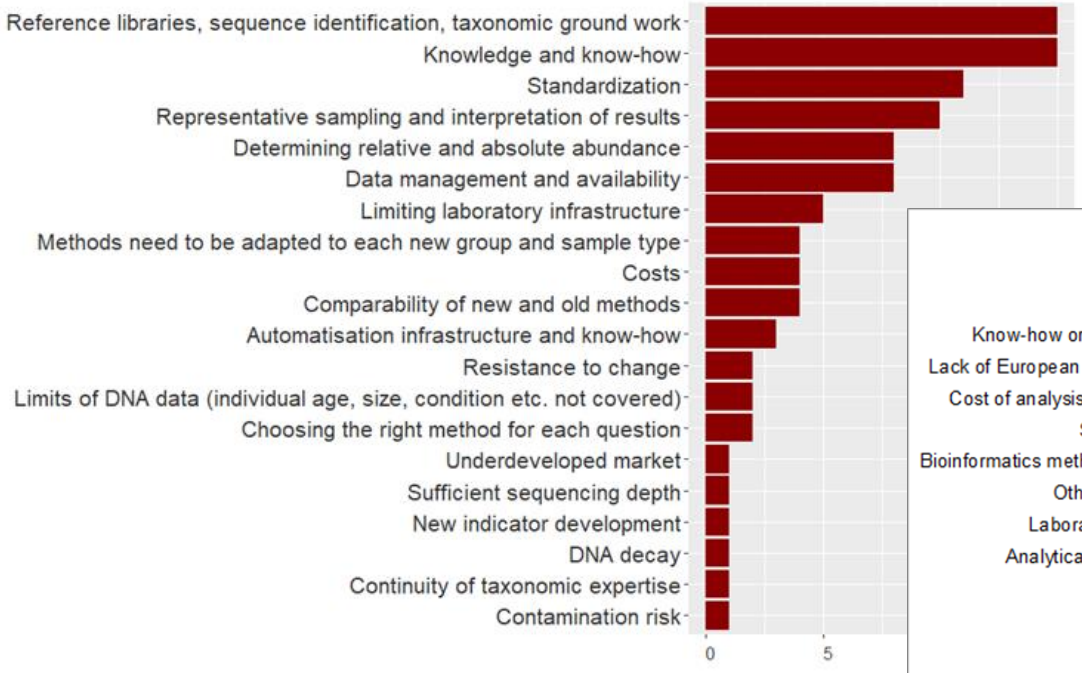
Statement 2: National efforts are diverse but scattered and largely in the testing/piloting stages

Species/group	System	Methods	Stage	Conducted by
Viruses	terrestrial, freshwater, marine	eDNA metabarcoding, qPCR (water, air, wastewater, ticks)	Pilot	THL, SYKE, FMI, universities
Bacteria	terrestrial, freshwater, marine	eDNA metabarcoding, qPCR (soil, water, air, wastewater, ticks)	Pilot	LUKE, SYKE, FMI, THL, Finnish Food Authority, universities
Phytoplankton	freshwater, marine	eDNA metabarcoding	Pilot	SYKE
Liverworts	terrestrial	Bulk DNA metabarcoding	Pilot	Univ. Turku, Metsähallitus, SYKE
Vascular plants	terrestrial	eDNA metabarcoding/metagenomics (airborne pollen)	Pilot	FMI
Fungi	terrestrial, freshwater	eDNA metabarcoding/metagenomics (soil, water, air)	Pilot	LUKE, SYKE, FMI, Finnish Food Authority, universities
Freshwater pearl mussel (EN)	freshwater	eDNA + qPCR?	Pilot	Univ. Jyväskylä, Metsähallitus
Zoobenthos	freshwater, marine	Bulk DNA metabarcoding	Pilot	SYKE
Soil invertebrates	terrestrial	eDNA metabarcoding	Pilot	LUKE
Arthropods	terrestrial	Bulk DNA metabarcoding	Pilot	Universities
Noble crayfish (EN), signal crayfish (IAS)	freshwater	eDNA + qPCR	Pilot	LUKE
Fish	freshwater, marine (coastal)	eDNA + qPCR, eDNA metabarcoding	Pilot	LUKE, MMM
Common frog, moor frog	freshwater	eDNA + qPCR?	Pilot?	LUKE, Luomus, MMM
Lesser white fronted goose (CR)	freshwater	eDNA + qPCR?	Pilot	Kiljuhanhi LIFE, Metsähallitus, Univ. Oulu
Bats	terrestrial	Single-sp-sequencing?	Pilot	Luomus
Brown bear (NT)	terrestrial	?	Pilot	LUKE
European beaver (NT), Canadian beaver (IAS)	terrestrial	eDNA (wood chips) + PCR assays	Routine	LUKE
European lynx	terrestrial	?	Pilot	LUKE
White-tailed deer (IAS)	terrestrial	eDNA + ?	Pilot	LUKE
Wolf (EN) and wolf-dog hybrids	terrestrial	96 Single Nucleotide Polymorphism (SNP) panel (excrement, urine)	Routine 2022-	LUKE
Wolverine (EN)	terrestrial	14 microsatellites and mtDNA control region (579 bp)	Routine?	LUKE

SYKE

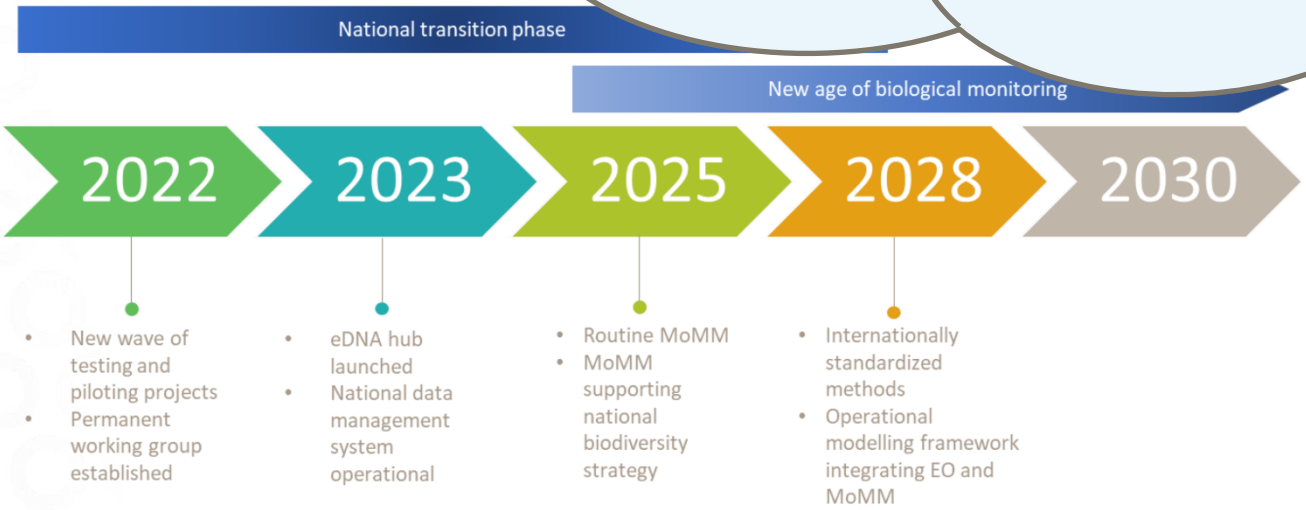
Statement 3: The chief limiting factors are funding, expertise and method standards

- In addition: reference sequence libraries, abundance information, interpretation of data and results



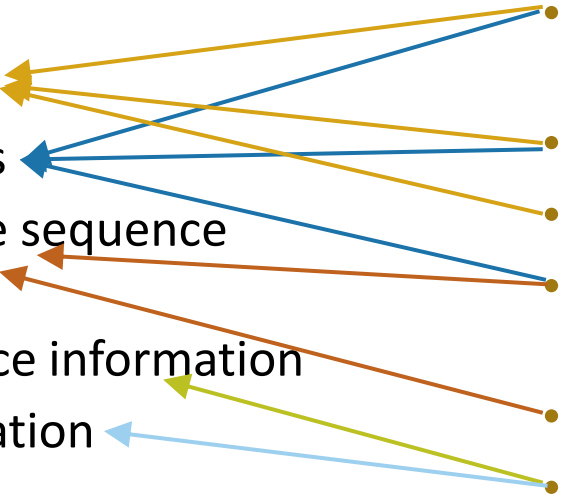
Vision - where would we like to go?

- MoMM in routine use, complementing traditional methods → increasingly complete picture of different facets of biodiversity (taxonomic, functional, genetic)
- International method and data standards
- Highly valued citizen science: improved coverage of traditional observations, MoMM sampling campaigns
- MoMM + EO + modelling → maps, understanding, predictions



Development areas – what do we need?

- Limiting factors:
  - Funding
  - Expertise
  - Standards
  - Reference sequence libraries
  - Abundance information
  - Interpretation

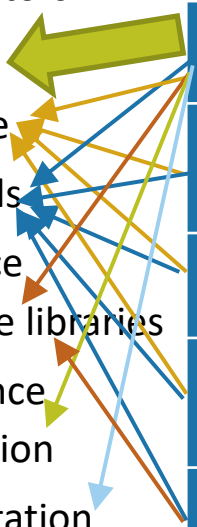


- Development areas:
  - International coordination and standard development
  - Networking across sectors
  - Education
  - Infrastructure and data management
  - Reference sequence libraries
  - Modelling and analysis tools

SYKE

Action plan – what should we do?

- Limiting factors:
  - Funding
  - Expertise
  - Standards
  - Reference sequence libraries
  - Abundance information
  - Interpretation



Action	Coordination responsibility	Suggested timing	Cost estimate
A1: Directed R&D funding for transition to MoMM	YM, MMM (VM, TEM, STM)	2022-2025	1 M€ yearly
A2: Establishing a permanent working group (eDNA embassy)	YM	2022	50 k€ yearly
A3: Expanding and promoting the eDNA network	SYKE	2022	30 k€
A4: Launching an online interaction platform (eDNA hub)	SYKE	2022-2023	100 k€
A5: Developing a national data management system	SYKE	2022-2024	500 k€

What happens next?

- The roadmap is open for feedback until **26 Nov 2021**
- We will discuss the future of MoMM in Finland in more detail this afternoon
- We will prepare the final version of the roadmap based on the feedback and discussions → published in early 2022
- Brief leaflet-like publication in Finnish prepared by SYKE
- And then the actual work begins!

SYKE

Thank you!

© Tiina Laamanen

SYKE