

# Activities in new monitoring, methods and technologies

Sweden



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for Marine and  
Water Management

# SwAM responsibilities

- » develop regulations and guides for the water authorities
- » report under the Water Framework Directive to the European Commission
- » the Habitats directive and the Marine Strategy Framework Directive
- » allocate state funds for environmental monitoring
- » national environmental monitoring



## Activities in "new" monitoring

- » "New" methods or techniques are not routinely used for monitoring of water. With the exception of:
  - DNA method for detection and identification alien invasive species
  - genetic intraspecies variation
  - satellite data for presentation of algae situation and temperature in coastal waters and
  - sensors for physico-chemical measurements.
- » Currently revising monitoring programmes, focus traditional methods.

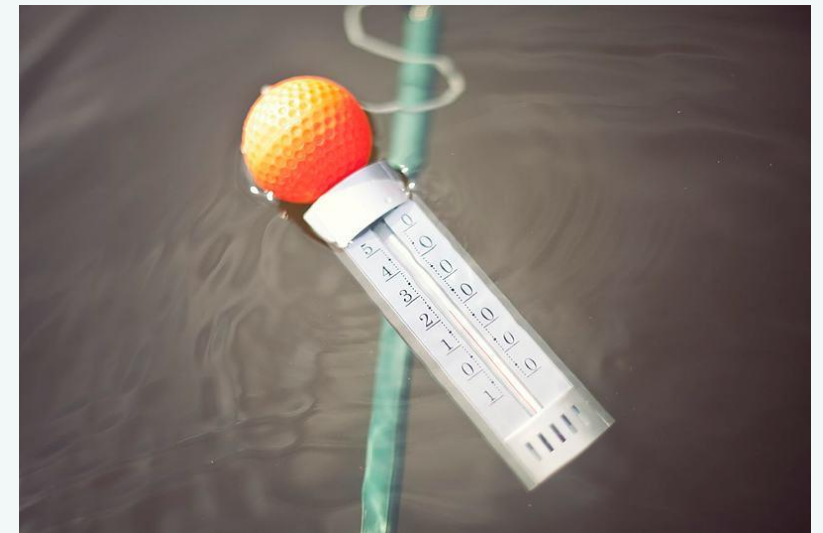





Photo: Maja Kristin Nylander

# Examples of applications of new techniques

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	<div>L A K E</div> 	<div>R I V E R</div> 	<div>C O A S T</div> 
Satellite	Phytoplankton Transparency		Phytoplankton (Chlorophyll a) Transparency (Secchi depth), Thermal conditions, Aquatic flora (macrophytes), Physical impact
Drones	Aquatic flora (macrophytes), Water sampling		Aquatic flora (macrophytes)
Sensors	Phytoplankton (Chlorophyll and phycocyanin)	Nutrient condition (turbidity and NO3), Oxygen condition, Soil erosion (turbidity)	Thermal condition, Oxygen condition
DNA	Aquatic flora (Diatoms), Benthic invertebrates, Fish	Aquatic flora (Diatoms), Benthic invertebrates, Fish	Phytoplankton DNA (Baltic Sea species SAMBAH II)
Hydroacoustics	Structure lake bed, Fish	Structure river bed	Pelagic fish (BIAS, SPRAS, SAMBAH II)

# SEPA Research call

## – Environmental monitoring of the future

- » Focus on new methodologies and technologies for:
  - **obtaining data from the environment**
  - **data processing and**
  - **data analysis**
- » Project time 2025 – 2027
- » Total budget 30 million Swedish kronor



Photo: Mats Svensson, SwAM

# DNA based methods for aquatic monitoring

Sweden



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# Use of DNA in environmental monitoring

- » Alien invasive species, intraspecific variation
- » Ongoing research
- » Currently no standard national methods
- » Soon method for genetic intraspecies variation

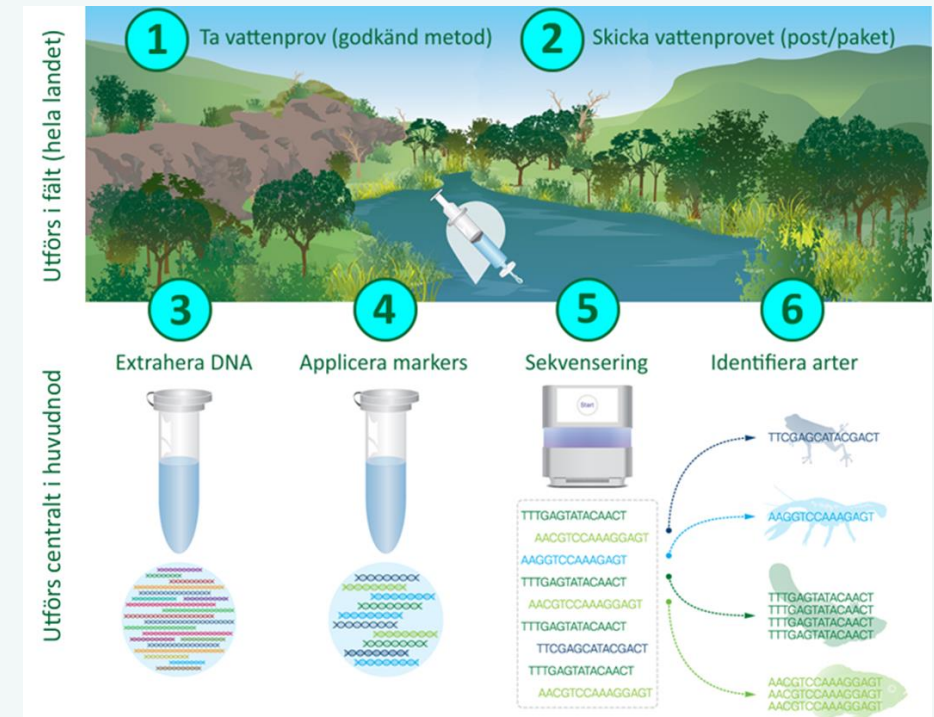


Photo: Maja Kristin Nylander

# Research call 2018 - DNA methods in environmental monitoring

» Total 8 projects, run for 2019-2021 (2022-2023), eg:

- eDNA in environmental monitoring and the analysis of biodiversity – questions remaining
- DNA-metabarcoding of marine phytoplankton
- Life-DNAquatic
- FRESHBAR – Barcoding of freshwater organisms for improved assessment of biodiversity
- NEMAtode BARCODing: Improved environmental monitoring of the Baltic Sea's benthic ecosystem
- Evaluation of eDNA for environmental monitoring of pike stocks in Sweden



# FRESHBAR

- » Benthic diatoms and benthic macroinvertebrates.
- » Three main foci:
  - completing reference libraries
  - addressing the efficacy of using DNA methods in species identifications
  - affect on biological indices and status classifications
- » Conclusion: possible to use DNA methods for ecological status assessments of lakes and watercourses
- » Work remains:
  - the development and validation of DNA barcoding techniques for routine use
  - improvement of the DNA reference libraries
  - development of indices
  - ecological thresholds
  - reference conditions



# FRESHBAR - Diatoms

- » > 300 Swedish diatom barcodes now completing the Central European list developed for monitoring
- » Index based on genetic data need to be developed

Eunotia ? Maybe a new species!

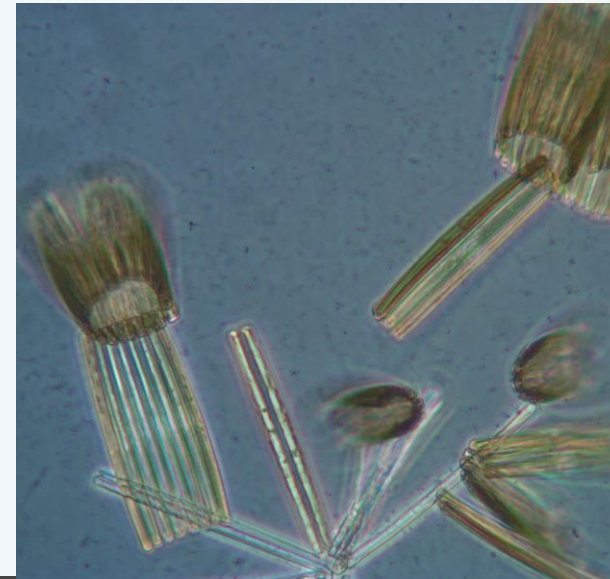


Photo: Maria Kahlert, SLU

# FRESHBAR - Macroinvertebrates

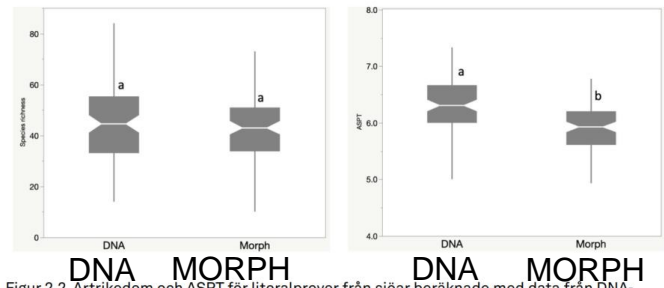
- » DNA barcoding yielded more species than morphological identification.
- » Through inclusion of more species, assessment of environmental quality can improve.



Photo: Niclas Eigrell

## Species diversity

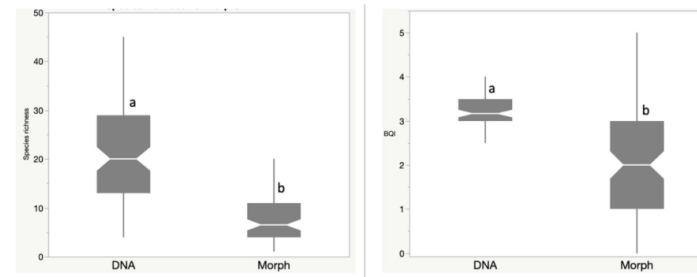
## ASPT



Figur 2.2. Artrikedom och ASPT för littoralprover från sjöar beräknade med data från DNA-streckkodning (DNA, P/A data) och med traditionell morfologisk identifiering (Morph, abundans data). Skilda bokstäver indikerar signifikanta skillnader.

## Species diversity

## BQI



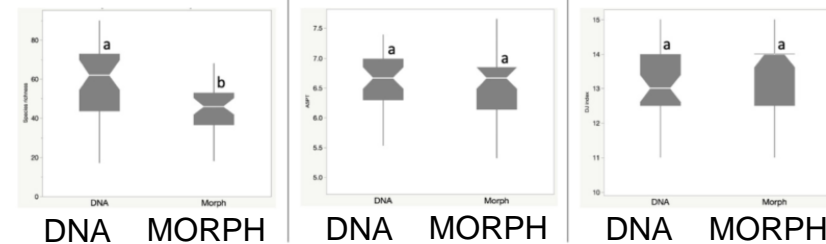
Figur 2.3. Artrikedom (vänster) och BQI (höger) beräknade med data från DNA-streckkodning (DNA, P/A data) och med traditionell morfologisk identifiering (Morph, abundans data) för profundalprover. Skilda bokstäver indikerar signifikanta skillnader.



## Species diversity

## ASPT

## DJ



Figur 2.4. Artrikedom (vänster), ASPT (mitten) och DJ-index (höger) för vattendrag beräknade med data från DNA-streckkodning (DNA, P/A data) och med traditionell morfologisk identifiering (Morph, abundans data). Skilda bokstäver indikerar signifikanta skillnader.

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# DNA - metabarcoding of marine phytoplankton

- » Twice as high biodiversity measures with DNA than microscopy.
- » The reference databases have shortcomings.
- » Suggests Nordic or global cooperation to improve
  - reference databases
  - evaluation of sequencing of whole or large portions of rDNA (18S, ITS and 28S)



# eDNA in environmental monitoring and biodiversity assessment – remaining issues

DNA suitable for:

- » mapping the occurrence and distribution of species with known identity e.g. alien invasive species,
- » multi-species analysis for general estimates of biodiversity and genetic diversity
- » to track and identify unknown species
- » measure intraspecies variation

Do not work for all species, groups and issues.



## Ongoing project

- » Swedish University of Agricultural Sciences (SLU) – financed by SwAM
- » Aim: eDNA-based monitoring of lakes and streams to start-up in 2026/2027.
- » Includes planning and quantification of:
  - infrastructure
  - a national system for sampling
  - sequencing of eDNA
  - classification of conditions
  - storage of data

Main focus: Habitats Directive  
and Nature Restoration Law  
Can also be used for the  
Water Framework Directive.



Photo: Viktor Johannessen, SLU



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