A few thoughts on an effective & efficient future freshwater biodiversity monitoring programme

Florian Leese, University of Duisburg-Essen, Germany
EuropaBON WP4/5 meeting Troia, 18.04.2023
Naive wish: biodiversity 'weather stations'

WMO weather stations (access: 29th September 2022)
In terms of spatial resolution WFD is great!

- Long freshwater biomonitoring history in many member states
- Clear water body typology, method intercalibration in place

Perfect to use the structured WFD sampling design as a basis for biodiversity monitoring but the frame needs to be extended

https://water.europa.eu/freshwater/
Extend the representation of freshwater ecosystem types monitored

- Small water bodies (e.g. streams with <10km² catchment size not sampled); e.g. >50% of the river length in Germany not monitored
- Temporary rivers
- Focus atm on impacted sites – biodiversity monitoring of the future should better balance monitoring sites to also better represent pristine freshwater habitats
Extend the temporal resolution

• Typically Biological Quality Elements (BQEs) are monitored every 3-6 years
• Strong annual influence on biodiversity in many freshwater habitats
• More frequent sampling at least at a subset of sites needed

https://water.europa.eu/freshwater/
Extend studied biodiversity components

- Focus of WFD is on indicator taxa
- But with a little more effort this excellent framework can be extended to holistic biodiversity monitoring
- DNA and eDNA based methods are proven to work and would be a cost-effective addition
- Bridge the blue-green biodiversity boundary effectively
Better co-located monitoring of drivers

• Often Ecological Status monitoring and measurement of abiotic parameters is uncoupled
• Limits identification of drivers of change
What are the next steps?

• Improve representativeness of WFD sampling on a grid
• Develop a “who”, “when” and “how” approach beyond WFD
• For small streams – make use of the network structure and modelling (e.g. eDNA transport)
Who and when?

- WFD experts
- Beyond regulatory monitoring citizen science (e.g. small lake / stream / pond stewardships with schools); clear protocols
- At least some sites annual sampling needed!
How?

• Use what we have and extend taxonomic focus
• Novel methods for broad taxonomic profiling

• Some thoughts on that (because this is much more my expertise)
Final Report

Novel technologies for biodiversity monitoring

Deliverable 4.2

Lead beneficiary: European Commission

Report prepared by: Cher Chow, Robert Patchett, Maria Dornelas, Lluís Brotons, Jessica Junker, Ingolf Kühn, Roy van Grunsven

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Also compatible with bioassessments as part of WFD

Beentjes et al. (2018)

Vasselon et al. (2019)

Rivera et al. (2020)

Buchner et al. (2019)

Meyer et al. (2021)
Use existing samples (bulk) and in addition collect some litres of water
“More with less“ actually works for some BQEs

- eDNA analysis in a French stream (Rhône) shows great performance of eDNA for fish biodiversity assessments
- Many such studies reported from many different countries!

![Graph showing species richness over sampled locations](image-url)
Use existing frameworks & extend with (e)DNA

Species Relative Abundance  Longitudinal Profil

JDS4 scientific report (2021)
Data: Didier Pont
Simple and affordable – and (while not perfect) quite comprehensive

Macher et al. (2021)
Use eDNA from water for terrestrial monitoring
Fresh insights into terrestrial diversity via fresh water

“Rainwash eDNA Metabarcoding” – canopy monitoring: Macher, Schütz, et al. (2023)
Biodiversity of a whole country

- About 3800 samples (German insect monitoring LTER-D [Haase, Frenzel]) analysed within ~3 months

Nation-wide insect monitoring

Sometimes over 30,000 specimens per trap

German LTER-D insect monitoring, 75 traps, every 2 weeks (Apr.-Oct), standardised protocols, collaboration with national parks. Coordination: UFZ: Mark Frenzel, SGN: Peter Haase

Lead author: Dominik Buchner (UDE)

Source: Buchner et al. in prep, LTER-D project
~11,000 insect species detected
>20,000 species not assigned yet

Most laboratory steps automated; always replicated analyses (independent days) for each sample
Source: Buchner et al. in prep, LTER-D project
It's not too expensive!

While costs should not drive the discussions we cannot ignore time and cost aspects. Estimating costs precisely is difficult – we tried it.

<<100 € per sample

Source: Buchner et al. in prep, LTER-D project
Consortium: eDNAqua-Plan (Coordinator EMBRC; 18 Partners in total)

“The consortium cooperates with the large EU research projects and infrastructure such as EMODnet, BIOSCAN-Europe, the Ocean and Water knowledge system, LifeWatch, and international systems (ELIXIR/EBI and OBIS), amongst others, to maximise synergies and interoperability internationally. Possible implementation will be demonstrated by use cases from national and transnational water monitoring programs. Based on this, eDNAqua-Plan will deliver a roadmap for harmonised aquatic monitoring using eDNA tools in Europe and beyond.”