TYPE Editorial
PUBLISHED 23 October 2023
DOI 10.3389/fenvs.2023.1304545

Check for updates

OPEN ACCESS

EDITED AND REVIEWED BY
Angela Helen Arthington,
Griffith University, Australia

*CORRESPONDENCE
Caterina Bergami,
caterina.bergami@ismar.cnr.it

RECEIVED 29 September 2023
ACCEPTED 12 October 2023
PUBLISHED 23 October 2023

CITATION
Manea E, Bergami C and Ptacnik R (2023), Editorial: Advances in marine and freshwater monitoring to support aquatic ecosystem conservation and restoration. *Front. Environ. Sci.* 11:1304545. doi: 10.3389/fenvs.2023.1304545

Editorial: Advances in marine and freshwater monitoring to support aquatic ecosystem conservation and restoration

Elisabetta Manea[1,2], Caterina Bergami[3]* and Robert Ptacnik[4]

[1]Laboratoire d'Ecogeochimie des Environnements Benthiques (LECOB), Sorbonne Université, Centre National de la Recherche Scientifique (CNRS), Banyuls-Sur-Mer, France, [2]National Research Council, Institute of Marine Sciences, CNR-ISMAR, Venice, Italy, [3]National Research Council, Institute of Marine Sciences, CNR-ISMAR, Milan, Italy, [4]WasserCluster Lunz—Biologische Station, Lunz am See, Austria

KEYWORDS

monitoring networks, monitoring data, freshwater, marine, transitional, aquatic ecosystems, restoration, conservation

Editorial on the Research Topic
Advances in marine and freshwater monitoring to support aquatic ecosystem conservation and restoration

Monitoring, conserving, and restoring aquatic ecosystems are priorities addressed by European and global initiatives, put in place to achieve declared national and global conservation and sustainability goals. These initiatives are dictated by both legally binding EU frameworks (e.g., Water and Marine Strategy Framework directives, WFD and MSFD, respectively; EC, 2000; EC, 2008), and global initiatives—i.e., Essential Ocean and Biodiversity Variables frameworks (EOVs and EBVs) under the Global Ocean Observing System (GOOS), and the Group on Earth Observations Biodiversity Observation Network (GEO BON), respectively (Pereira et al., 2013; Miloslavich et al., 2018). Nonetheless, the extent to which all these initiatives can provide lasting positive effects on conservation and restoration targets is often limited by the lack of robust baseline data and systematic monitoring and protocols, which in turn are constrained by the limited number of long-term monitoring programs and limited dedicated funding. Harmonization of methods, data structure, and handling is a further limitation when it comes to providing a comprehensive assessment of aquatic habitats in times of global change.

This Research Topic provides an overview of important advancements in the research field of monitoring as a supporting tool for the conservation/restoration of aquatic ecosystems (freshwater, marine, and transitional), and of innovative and under-development monitoring practices and approaches at both local and large scales (i.e., local, national, transnational).

This Research Topic contains sixteen articles that address encompassing all major aquatic domains: freshwater (7), marine (5), and transitional (4) ecosystems, and are focused on different habitats and groups of organisms (e.g., benthic and pelagic habitats, fishes, benthic organisms, algae, and seagrasses) and environmental parameters (e.g., oxygen, chlorophyll). Despite their heterogeneity, they possess the common scope of exploring, developing, and testing different monitoring approaches with the aim of favoring conservation and restoration strategies.

Podda et al. use long-term data from river systems in Sardinia to assess the effect of dams on the population dynamics of the European Eel. Using boosted regression trees, they show that especially time of dam construction, as well as dam height, impair mobility and dispersal of Eel into the catchments, and make a strong case for de-regulation of rivers.

Some studies are more methodological. For instance, Di Muri et al. present a case study focused on the biogeography of two invasive crustaceans and describe the procedures, resources, and analytical web services implemented to investigate the trophic habits of these taxa by using carbon and nitrogen stable isotope data. They offer a number of analytical tools to determine the variability of the trophic position of invasive crustaceans in a spatially explicit context and to model it as a function of relevant environmental predictors. Moe et al. provide information on the Water Information System for Europe (WISE) biology data, their accessibility, and re-usability, and illustrate current or planned applications and indicator development for European-scale assessments.

Three methodological papers assess the adoption of (semi-) automated methods for sampling Chlorophyll-a (Chl-a) in coastal waters and lakes (Rogora et al. Alikas et al., and Farinha et al.). In the study of Alikas et al. *in vitro*, fluorescence, and spectral approaches to measure Chl-a are compared in two distinct lakes in Estonia, characterized by diverse trophic conditions. They explore the potential to combine the different methods for improving Chl-a measurement accuracy. Rogora et al. focus on Chl-a data, with the aim to test whether *in situ* fluorescence measurements may provide an estimate of lake phytoplankton biovolume and its seasonal dynamic. Their results confirm the use of *in situ* sensors as a reliable approach to measure algal pigments, especially to assess their variability in the short-term, but also to describe the seasonal pattern of phytoplankton biovolume. Farinha et al. present and validate the use of MEDUSA, an Unmanned Aerial-Aquatic Vehicle capable of performing underwater sampling and inspection. This system is successful in acquiring samples from shore and at high precision in depth and filtered water volume, enabling the acquisition of accurate Chl-a measurements that are on par with manual sampling methods.

Leoni et al. investigate another important environmental parameter, focusing on the role of sediments in Dissolved Oxygen (DO) consumption in the Venice Lagoon (Italy), and measuring the Sediment Oxygen Demand (SOD) rate in four test areas with benthic chambers. They assess how the presence of the MOSE infrastructure, which protects the lagoon from high tide-derived flooding, will affect DO concentration and the functioning of the waterbody during its closures.

Mackin-Mclaughlin et al. and Tesfaye et al. proposed approaches to improve the assessment and monitoring of aquatic habitats and associated species. Mackin-Mclaughlin et al. test the performance of predictive modeling approaches to enable marine coastal habitats monitoring. The authors employ habitat mapping techniques to spatially characterize the distribution of benthic organisms along the western coast of Placentia Bay, an Ecologically and Biologically Significant Area (EBSA) in Newfoundland, Canada. They find the use of fine-scale environmental information from benthic videos to consistently improve model accuracy, highlighting the need for in-field data Research Topic. They provide valuable knowledge on marine epifaunal association, distributions, and richness in the case study area, thus strongly supporting the current and future monitoring of Placentia Bay habitats. Tesfaye et al. focus on the Římov Reservoir (Czech Republic) lake's pelagic habitat and compare the consolidated CEN (European Committee for Standardization) protocol to assess fish abundance and biomass, with alternative approaches, which turned out to be effective. These incorporate information on pelagic habitats volume avoiding under-representation of any habitat in the assessment. They additionally evaluate the composition and trend changes of fish populations over time.

Transitional waters and coastal wetlands are the areas of interest in the papers from Petrocelli et al. and Duan et al., respectively. Duan et al. use shorebird survey and land-use data to characterize the effects of long-term habitat change (1995–2020) on shorebird populations in the Yellow River Delta (China). They hypothesize that habitat changes pose a more serious threat to threatened, large-bodied, and coastal specialist species than to non-threatened, small-bodied, and generalist/inland specialist species. Their findings provide useful insights to conserve and manage key shorebird habitats in the area. Petrocelli et al. analyze the 11-year monitoring data on non-indigenous species (NIS) of seaweeds in the Mar Piccolo of Taranto (Italy). To investigate spatial and temporal differences in seaweed assemblages, multivariate analyses are performed considering the NIS and the most important native species in terms of temporal occurrence. The Mar Piccolo seems not particularly suitable for NIS settlement and development, especially if coming from cold-temperate zones.

Two papers are specifically dedicated to the identification of gaps in the current conservation networks and related monitoring efforts (Gianni et al. and Castellan et al.). Gianni et al. develop and apply a conceptual model to some selected Adriatic Natura 2000 (N2K) sites to review and assess the management and monitoring effectiveness of the sites, and to suggest possible improvements. They aim to inform the management of N2K sites by providing a knowledge baseline to support the implementation of the Adriatic Sea ecological observing system. Castellan et al. assess the effectiveness of the current legislative framework in providing instruments to protect mesophotic ecosystems in the Mediterranean Sea, through literature revision, highlighting a heterogeneous coverage of information related to mesophotic habitats and associated taxa and a lack of conservation efforts towards mesophotic zones. They provide suggestions to improve the management regime of these ecosystems starting from the setting up of routine and *ad hoc* monitoring of mesophotic and deep-sea habitats to advance the knowledge needed to inform their conservation.

Radwan et al. and Vieira et al. test the use of indicators to favor consistency in monitoring efforts worldwide. In particular, the first study explores the host-parasite-metals interactions and the potential to use the parasites' presence as a bio-indicator of the health status of Nile tilapia (*Oreochromis niloticus*), an important source of protein for local people. After characterizing the accumulation dynamics of heavy metals in the fish tissue, the authors observe significant relationships between parasite presence and heavy metal concentration. Meanwhile, the potential to adopt an interspecific boundary line (IBL) as an indicator of the health status of seagrass meadows is explored by

Veira and colleagues. The IBL is adopted to define the maximum possible efficiency in space occupation of 18 species of seagrasses in Costa Rica, and its efficiency as an indicator is tested against 5,052 observations from 78 studies. The authors prove the effectiveness of IBL for monitoring the health of seagrass populations.

Finally, Orlando-Bonaca et al. highlight the importance of monitoring environmental conditions for identifying suitable restoration locations and ensuring efficiency in restoration actions. They set up a restoration system for the macroalga *Gongolaria barbata*, a *Cystoseira* s.l. species, in the marine protected area of Miramare (Trieste, Italy) and in Piran (Slovenia) to deepen knowledge of the reproductive potential and success of donor populations and evaluate the out-planting success in relation to the different donor and receiving sites. Additionally, they test the effectiveness of *ex-situ* and hybrid methods combined with mesocosm cultivation and suspended culture in the field.

We thank all contributing authors and hope that you will enjoy reading their papers. We hope that these papers will support progressive advancement in monitoring practices as the base of effective conservation and restoration of aquatic ecosystems.

Author contributions

EM: Conceptualization, Writing–review and editing. CB: Conceptualization, Writing–original draft, Writing–review and editing. RP: Writing–review and editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Acknowledgments

We wish to express our gratitude to all colleagues who submitted manuscripts to this Research Topic and to all the reviewers for their time, attentive criticisms, and constructive comments and suggestions.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

European Commission (2000). Directive 2000/60/EC of the European parliament and of the council of 23 October 2000 establishing a framework for community action in the field of water policy (Water framework directive). *Off. J. Eur. Union* 73.

European Commission (2008). Directive 2008/56/EC of the European parliament of the council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine strategy framework directive). *Off. J. Eur. Union* 27.

Miloslavich, P., Bax, N. J., Simmons, S. E., Klein, E., Appeltans, W., Aburto-Oropeza, O., et al. (2018). Essential ocean variables for global sustained observations of biodiversity and ecosystem changes. *Glob. Change Biol.* 24 (6), 2416–2433. doi:10.1111/gcb.14108

Pereira, H. M., Ferrier, S., Walters, M., Geller, G. N., Jongman, R. H. G., Scholes, R. J., et al. (2013). Essential biodiversity variables. *Science* 339 (6117), 277–278. doi:10.1126/science.1229931