



OPEN ACCESS

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

*CORRESPONDENCE
Alberto Doretto,
✉ alberto.doretto@uniupo.it

SPECIALTY SECTION
This article was submitted to Freshwater
Science,
a section of the journal
Frontiers in Environmental Science

RECEIVED 07 December 2022

ACCEPTED 12 December 2022

PUBLISHED 04 January 2023

CITATION
Quadroni S, Doretto A, Fornaroli R and
White JC (2023), Editorial: Hydropower:
From ecology to policy.
Front. Environ. Sci. 10:1118157.
doi: 10.3389/fenvs.2022.1118157

COPYRIGHT
© 2023 Quadroni, Doretto, Fornaroli
and White. This is an open-access article
distributed under the terms of the
[Creative Commons Attribution License
\(CC BY\)](#). The use, distribution or
reproduction in other forums is
permitted, provided the original
author(s) and the copyright owner(s) are
credited and that the original
publication in this journal is cited, in
accordance with accepted academic
practice. No use, distribution or
reproduction is permitted which does
not comply with these terms.

Editorial: Hydropower: From ecology to policy

Silvia Quadroni¹, Alberto Doretto^{2*}, Riccardo Fornaroli³ and James Christopher White⁴

¹Department of Theoretical and Applied Sciences, University of Insubria, Varese, Italy, ²Department for the Sustainable Development and Ecological Transition, University of Eastern Piedmont, Vercelli, Italy, ³Department of Earth and Environmental Sciences, University of Milano-Bicocca, Milan, Italy, ⁴Cranfield University, Cranfield, United Kingdom

KEYWORDS

regulated rivers, diversity, ecosystem processes, impact, mitigation, management, modelling

Editorial on the Research Topic Hydropower: From Ecology to Policy

Hydropower generation through river exploitation is widely considered to be a renewable and clean energy source because of the absence, or negligible level, of greenhouse gas emissions into the atmosphere. However, previous studies have demonstrated that hydropower plants and related structures often affect river ecosystems and their biota in several ways (Kondolf et al., 2014; Grill et al., 2019). These ecological effects can occur during all the phases associated with hydropower facilities, from construction to operation, and are primarily driven by changes in the physical habitat (e.g., water temperature, sediment grain size, water depth and velocity, discharge fluctuations, and dewatering). Quantifying the magnitude of the impact of such shifts on biodiversity and river processes is usually difficult, and outcomes may vary depending on the operational strategy of the hydropower plant and site-specific conditions.

In this Research Topic, Pérez-Calpe et al. evaluated the synergic effects of water diversion for hydropower generation and pollution on coarse particulate organic matter (CPOM) processing and CO₂ fluxes in four rivers in the Northern Iberian Peninsula, controlling for season and type of channel (i.e., wet or dry). Focusing on other ecosystem components and adopting a different spatio-temporal scale, Scotti and collaborators conducted a multi-year study on a glacier-fed stream (Saldur Stream, Northern Italy), assessing the impact of a small hydropower plant on both the taxonomic (Scotti et al.) and the functional (Scotti et al.) diversity and composition of benthic macroinvertebrate communities. Overall, these studies stress the importance of considering concomitant pressures and the specific environmental setting when examining the direct and indirect outcomes associated with hydropower production.

Increased environmental awareness has prompted widespread research into new management strategies aimed at mitigating the impact of hydropower on riverine ecosystems. This consideration has assumed pivotal importance, especially under the

current circumstances with respect to global climate change, which imposes an urgent need for energy from renewable sources, as declared in the 2030 Agenda for Sustainable Development published by the United Nations (Goal 7; Colglazier, 2015). This has fuelled the proliferation of small to medium hydropower plants in the mountainous areas of Europe during recent decades, and their number is expected to increase worldwide in the near future (Zarfl et al., 2015). In the light of this, quantification of the impact of hydropower can serve as a basis for the adoption of science-based criteria and management solutions to improve the sustainability of hydropower plants and their operations. Several of the articles published in this Research Topic support this goal.

Pander et al. investigated the effects on fish mortality and fish communities of dewatering of a side channel and associated riverbank habitats occurring as a result of the periodic maintenance operations of a weir in the Inn River (Germany). Based on the results obtained, the authors propose suggestions and guidelines for the reduction of the impact of these routine operations on the fish fauna of this habitat. In a mesocosm experiment, Führer et al. tested the individual and combined effects of down-ramping rate, slope of the riverbank, and timing of down-ramping (daytime or nighttime) on the stranding of various larval stages of common nase (*Chondrostoma nasus*). This is one of the first studies evaluating the response of a Cyprinid species to habitat changes induced by water level fluctuations due to hydropeaking. Thus, it provides useful information on potential ways to make such operations less ecologically harmful by limiting the effects on target fish species. Similarly, Alfredsen et al. developed a 2D hydraulic model to evaluate the areas most affected by hydropeaking operations, in terms of ramping rate and water level fluctuations, in the River Nidelva (Norway), and the related impact on juvenile Atlantic salmon (*Salmon salar*). On the basis of their results, the authors propose a potential mitigation strategy that involves increasing the duration of the stop of the hydropower plant to ensure low dewatering rates and releasing a higher volume of water at each shutdown.

Finally, to enable the implementation of effective management strategies and solutions to mitigate the impact of hydropower on river ecosystems, a comprehensive evaluation should consider not only the environmental impact but also the social and economic consequences. To this end, Opperman et al. examined possible trade-offs between the need for hydropower plants and their social, economic, and environmental benefits by considering the best solutions at different scales, ranging from individual projects to basin and regional levels. By comparing case studies from different countries, the authors provide useful insights into ways of maximizing the benefits of such projects from a sustainability perspective.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Colglazier, W. (2015). Sustainable development agenda: 2030. *Science* 349 (6252), 1048–1050. doi:10.1126/science.aad2333
- Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., et al. (2019). Mapping the world's free-flowing rivers. *Nature* 569 (7755), 215–221. doi:10.1038/s41586-019-1111-9
- Kondolf, G. M., Gao, Y., Annandale, G. W., Morris, G. L., Jiang, E., Zhang, J., et al. (2014). Sustainable sediment management in reservoirs and regulated rivers: Experiences from five continents. *Earth's Future* 2 (5), 256–280. doi:10.1002/2013EF000184
- Zarfl, C., Lumsdon, A. E., Berlekamp, J., Tydecks, L., and Tockner, K. (2015). A global boom in hydropower dam construction. *Aquat. Sci.* 77 (1), 161–170. doi:10.1007/s00027-014-0377-0