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To cite this article: Rafael Miranda, Virgilio Hermoso & Christopher Hassall (2019) Ecological quality and conservation status of inland waters, *Inland Waters*, 9:3, 275-277, DOI: [10.1080/20442041.2019.1645548](https://doi.org/10.1080/20442041.2019.1645548)

To link to this article: <https://doi.org/10.1080/20442041.2019.1645548>



Published online: 04 Oct 2019.



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## Ecological quality and conservation status of inland waters

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### ABSTRACT

Assessment of freshwater ecosystems is crucial for measuring their ecological status and providing primary information for their conservation. This editorial introduces a special section of Inland Waters regarding the study of ecological monitoring and biodiversity conservation of inland waters. Papers in this special section of Inland Waters are briefly described and a synthesis of the topic is provided to offer a summary of contents and an overview of the subject matter.

### ARTICLE HISTORY

Received 30 June 2019  
Accepted 12 July 2019

### KEYWORDS

biodiversity threats;  
biological monitoring;  
ecological indicators;  
freshwater ecosystems; river  
connectivity

Freshwater ecosystems are among the most valuable resources on earth and harbour a rich biological diversity (Collen et al. 2014). The relevance of the biodiversity they hold and the services they provide contrasts with the small spatial extent of these ecosystems, which cover <1% of the world's surface (Gleick 1998). Freshwater ecosystems are estimated to provide suitable habitat for at least 126 000 species, after taking into account that this biodiversity is only partly surveyed (Balian et al. 2008, Schmidt-Kloiber et al. 2019).

At the same time, freshwater ecosystems may well be the most endangered of any in the world (Veríssimo et al. 2018, Reid et al. 2019). The decline experienced by freshwater biodiversity is much greater in inland waters than in most terrestrial ecosystems. This distinction is related to the complexity and fragility of freshwater ecosystems and the huge pressures they face, including habitat alteration, invasive species, pollution, overfishing, and climate change (Barrett et al. 2018).

The need to assess conservation status and ecological health of these systems is the first step to improving management. The distribution of freshwater biodiversity depends on environmental features and general ecological status. Environmental variables and biotic interactions (e.g., competition, predation) show temporal and spatial variation and define the structure and composition of the communities present in an aquatic ecosystem. The ecological status of inland waters reflects the structural quality and function.

Currently, many indicators allow us to evaluate the ecological status of freshwater ecosystems. Conservation of freshwater ecosystems poses a major challenge to our

society. Monitoring and improving the ecological health of freshwater ecosystems is crucial for the integration of sustainable development and nature conservation.

To address this challenge, the Biodiversity Data Analytics and Environmental Quality group (BEQ) of the Department of Environmental Biology of the University of Navarra organized and held a Conference on Ecological Quality and Conservation Status of Inland Waters on 28–29 September 2017 at the School of Sciences, University of Navarra, in Pamplona, Spain. The purpose of the meeting was to gather a group of specialists interested in the study and conservation of inland waters. Encouraging debate and knowledge exchange is essential to identifying solutions to the current problems concerning freshwater ecosystems.

The conference was organized by a local organization and comprised scientific program speakers, including, in alphabetical order, Lluís Benejam, Elías D Dana, Ana Filipa Filipe, David Galicia, Christopher Hassall, Virgilio Hermoso, Stephanie Januchowski-Hartley, Luis Lassalletta, César Pérez Martín, Alfredo Ollero, Javier Oscoz, Ibon Tobes, Pedro Tomás, and Iván Vedia, whose efforts contributed greatly toward the outcome of this special section of Inland Waters. A major sponsor for this conference was the Research Plan of the University of Navarra (2014–15, PIUNA). Further support was kindly provided by the Administrative Office of the School of Sciences.

This editorial introduces a special section of Inland Waters of chosen communications from the conference. The scientific committee selected 8 papers related to the study of ecological monitoring and biodiversity

conservation of inland waters to produce this special section. In this context, 2 groups of articles were considered. The first group relates to the development of ecological indicators, including a new ecological indicator (García-Chicote et al. 2019), 2 new specific indices (Rodeles et al. 2019, Soria et al. 2019), and a methodological analysis of known indicators (Sòria-Perpinyà et al. 2019).

García-Chicote et al. (2019) propose the use of zooplankton as a new indicator taxon to estimate ecological quality of reservoirs around Mediterranean rivers. According to their study, selected zooplankton species are good indicators of mesotrophic, eutrophic, and hypertrophic states of reservoirs. In the same way, Soria et al. (2019) propose a new index based on phytoplankton, comparing it to other indexes based on the concentration of chlorophyll *a* and physicochemical parameters. The new index permits the evaluation of the ecological status of reservoirs according to the European Water Framework Directive (Directive 2000/60/EC; EU 2000). Related to these 2 papers, a third study compares the chlorophyll *a* in several reservoirs, to test whether differences in concentrations obtained from different methods influence the results of several ecological indices. Results show that the 2 methods do not affect the indices (Sòria-Perpinyà et al. 2019).

A different index was developed by Rodeles et al. (2019), related to connectivity of rivers. These authors create a new index to estimate river connectivity and fragmentation by dams, considering habitat accessibility and suitability for breeding of a particular fish species.

A second group of articles brings together 4 papers in which ecological monitoring and analysis permit the authors to propose local and international management and conservation measures. Two articles explore local ecological studies: one focused on ecology of phytoplankton blooms in United Kingdom canals, with the aim of helping to control harmful algal blooms (Kelly and Hassall 2018); and the other analyses the effects of agricultural activity and land use on streams of Andean Choco in Ecuador (Morabowen et al. 2019). Both studies highlight severe human impacts and suggest management practices to avoid unwanted effects on biodiversity.

Two final papers in this Special Section, by Filipe et al. (2019) and Gozlan et al. (2019), review the ecological assessment and status of freshwater ecosystems at the geographic continental level. Filipe et al. (2019) review the European Water Framework Directive (Directive 2000/60/EC; EU 2000) and the current status of European freshwaters, considering major challenges and threats for biodiversity. The authors propose recommendations in the context of European Water Directives to improve monitoring and assessment of inland waters. The final paper by Gozlan et al. (2019) provides a critical

assessment of issues facing decision-makers regarding freshwater biodiversity and ecosystems, as part of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report on Europe and Central Asia. The results of the review suggest that little progress has been made regarding the achievement of targets proposed in Europe and Central Asia. The aim of the targets is to attain the principal goals of the Strategic Plan for Biodiversity 2011–2020 (Convention on Biological Diversity 2010).

Collectively, the papers in this Special Section include research topics regarding indicators of ecological quality; connectivity of rivers and threats to biodiversity; research, conservation, and management of freshwater species; and related issues about planning, regulation, and legislation of inland waters. These studies highlight threats and challenges facing freshwater ecosystems and their biological diversity and demonstrate the urgent need to increase research into freshwater diversity to develop new indicators, improve ecological status of rivers, and assess this complex biodiversity (Collen et al. 2014).

The Guest Editors thank the authors for submitting high quality manuscripts to this Special Section. We acknowledge the contribution of the reviewers who participated in the review process and provided helpful comments and suggestions to the authors on improving their manuscripts. We specially thank Professor John R. Jones, currently Editor Emeritus and previous Editor-in-Chief of *Inland Waters*, and Professor David Hamilton, current Editor-in-Chief, for their advice and strong support during the process of putting together this Special Section. We also hope that the readers will enjoy reading the papers included in this Special Section.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Funding

This work was supported by Fundación Universitaria de Navarra.

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