Ecological Processes

EDITORIAL Open Access

Biodiversity and aquatic ecosystems conservation in global large river basins: a synthesis of the 5th Mississippi-Yangtze International Symposium

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The aquatic fauna of large river systems have been the cornerstones of multiple civilizations throughout human history. Today, they remain critically important as primary resources for humans as well as indicators of general ecosystem structure and function. Unfortunately, nearly all large-river systems globally are at risk from over-exploitation, pollution, large-scale development, navigation, dredging, climate change, and other threats. For instance, human stressors (such as dams, navigation, agriculture, fishing) and flooding and droughts have affected aquatic biological resources in both the Mississippi and Yangzte River basins (Chen et al. 2016). The Mississippi-Yangtze River Basin Symposium (MYRIBS) is a series of international symposia supported by American Fisheries Society (AFS) and China Society of Fisheries (CSF) dedicated to the promotion of international collaborations and communications in fisheries and aquatic sciences. Although communications and exchanges have centered primarily around the USA and China, other large-river basins have been represented and welcomed into the various symposia. From previous symposia, we have published an AFS book (Chen et al. 2016), and two journal special issues (AHS 2018; Chen and Phelps 2021). The current Mississippi-Yangtze special issue in the journal *Ecological Processes* includes a total of 13 articles in three focus areas: (1) non-native fish monitoring and assessment, (2) habitat and biodiversity under human stressors, and (3) restoration and management.

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Non-native fish monitoring and assessment

Non-native fish is a hot topic in aquatic biodiversity conservation of global large river basins. Under the global trade and other factors, non-native freshwater fishes have successfully established their populations in many of the biogeographical regions (Gozlan 2008; Bernery et al. 2022). In this issue, Bernery et al. (2024) conducted a global scale analysis on the introduction pathways of non-native fish species, and found that those with broad diets, high parental care, and multiple introduction pathways are the mostly widely introduced and established species. In the lower Mississippi River basin, Eggleton et al. (2024) compared fish assemblages in oxbow lakes before and after bigheaded carps [i.e., largely silver carp (*Hypophthalmichthys molitrix*) but also bighead carp (*H. nobilis*)] establishment and found fish indices such as richness, diversity, evenness, and dominance were greater during the post-carp period. In the Pearl River, a large subtropical river in southern China, Shuai et al. (2023) investigated the invasion impacts of Nile tilapia (*Oreochromis niloticus*) and found that the trophic

position of the widely distributed and locally important economically harvested piscivorous culter fish (*Culter recurviceps*), mandarinfish (*Siniperca kneri*), and catfish (*Pelteobagrus fulvidraco*) in the invaded Dongjiang River was significantly lowered compared with the uninvaded reference.

Habitat and biodiversity under human stressors

Human related stressors have greatly affected aquatic ecosystems and increased habitat and biodiversity loss in large river basins (Chen et al. 2020; Su et al. 2021). In the Mississippi Alluvial Plain, Skoog et al. (2024) compared water quality, habitat, and fish assemblages in both agriculture and forest streams, and found that forest streams had significantly better instream and riparian habitats than agriculture streams, and that fish assemblages showed a clear gradient in response to instream habitat conditions, water quality, and benthic chlorophyll a production. In the Yangtze River, Gao et al. (2024) examined phytoplankton taxonomic and functional group patterns and found that water quality (nitrate, total suspended solids, turbidity) and habitat (water flow, river bank and river channel conditions) were critical in driving phytoplankton patterns, followed by climate and land use. Jia et al. (2023) studied freshwater mussel populations in Poyang Lake and found that freshwater mussel density had significant relationships with habitat conditions such as Froude number, water temperature, and chlorophyll a. Zhang et al. (2023) applied a species distribution model to estimate the extent and quality of breeding habitat changes of Chinese mitten crab *Eriocheir sinensis* in the Yangzte River Estuary and found that habitat degradation significantly affected female distribution and their reproductive processes, particularly gonad development during the pre-reproductive period and fecundity during the reproductive period. In French Guiana, Cantera et al. (2023) applied the environmental DNA metabarcoding technique to study fish communities and found that deforestation is modifying the functional diversity of freshwater fish communities in both streams and rivers. In the Ganga River of India, De et al. (2023) studied effects of habitat disturbance on riparian spider community and found a significant difference in the indices of functional diversity among the lowly, moderately, and highly disturbed sites.

Restoration and management

To bend the freshwater biodiversity loss curve, many conservation, restoration, and management strategies and approaches are needed (Tickner et al. 2020). In the Yangtze River, Gao et al. (2023) developed a phytoplankton-based index of biotic integrity for ecological health assessment and found that the phytoplankton-based ecological health of the Yangtze River was rated as "good" during both dry and wet seasons, with an overall better condition in the dry season. Zhu et al. (2024) studied strontium (Sr) markers in juvenile blunt-snout bream *Megalobrama amblycephala* and found that fin ray Sr marking is a successful method for juvenile *M. amblycephala*, with the advantages of non-lethality and negligible sampling injuries, which facilitates the rapid and effective evaluation of Sr marking in restocking of this fish for ecological restorations. Liu et al. (2023) assessed fish resources changes 5 years after the fishing ban in the Chishui River, a tributary of the Yangtze River, and found that a total of 11 native fish species that had disappeared for many years appeared again after the fishing ban. In the Upper Mississippi River, Ward et al. (2023) applied the Resist-Accept-Direct (RAD) framework in large-river management, and found that the RAD framework helps identify plausible long-term trajectories in different reaches (or subbasins) of the river and how the associated social-ecological transformations could be managed by altering site-scale conditions.

Experience and lessons can be learned from international communications and collaborations such as the MYRIBS series. Under multiple human stressors and climate change, fishery ecologists and biologists should continue working together to promote biodiversity and aquatic ecosystems conservation in global large-river basins.

Acknowledgements

We thank many colleagues from both the Mississippi and Yangtze River Basins and globally for their continued support for MYRIBS and related science communication activities. We would also like to thank the Mississippi Interstate Cooperative Resource Association (MICRA), the Lower Mississippi River Conservation Committee (LMRCC), the Arkansas Game and Fish Foundation, the American Fisheries Society (AFS), China Society of Fisheries, Institute of Hydrobiolgy, Chinese Academy of Sciences, and symposium co-organizers Hae Kim, Steve Waste, Craig Paukert, and Alf Haukenes for their support of the 5th MYRIBS in 2022. This work was supported by National Key R&D Program of China (2023YFC3209002, 2019YFD0901203), and Chinese Academy of Sciences (QYZDB-SSW-SMC041, ZDRW-ZS-2017-3-2).

Author contributions

Yushun Chen developed the first draft, Yushun Chen, Michael Eggleton, Michael Moore, and Quinton Phelps revised and approved the final manuscript.

Funding

The current study was mainly supported by National Key Research and Development Program of China (2023YFC3209002; 2019YFD0901203) and Chinese Academy of Sciences (QYZDB-SSW-SMC041, ZDRW-ZS-2017-3-2).

Availability of data and materials

Not applicable.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interest.

Received: 4 March 2024 Accepted: 24 June 2024
Published online: 02 July 2024

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