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Editorial: Effects of non-random sources of alteration on biodiversity and ecosystem functioning

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Editorial on the Research Topic
Effects of non-random sources of alteration on biodiversity and ecosystem functioning

Exploring the relationship between biological diversity and ecosystem functioning has long been recognized as one of the main concerns in modern ecology (Loreau et al., 2001; Loreau, 2010). This is especially true in the recent context of global changes induced by human activities such as water abstraction, flow regulation, shifts in agricultural practices, contamination, climate change, and biological invasions (Gaston et al., 2010; Bellard et al., 2012). Although many previous studies have demonstrated that these changes can affect biodiversity, ecosystem functioning, and the biodiversity-ecosystem functioning (BEF) relationship (Strayer, 2012; Zhao et al., 2019; Stewart et al., 2022), our understanding of how genetics, individuals, populations, communities, and ecosystems respond to such changes is limited. Moreover, trophic structure is considered the link between biodiversity and ecosystem functioning (Cardinale et al., 2006), connecting species, populations, communities, and ecosystems. Therefore, understanding the response of food webs to perturbations can help ecologists better understand the relationship between biodiversity and ecosystem functioning. In the present Research Topic, we collected 16 research papers and two review papers related to this topic. These studies focused on a wide range of biological groups, such as microbes, algae, invertebrates, fish, and marine mammals, covering a variety of ecosystems, including soil, karst bedrock, freshwater, and marine waters. Several different data collection and analysis protocols were used in these studies, including stable isotopes, environmental DNA, genetic sources, and ecological models. Importantly, these studies involved in several non-natural sources of alteration induced by global changes such as contamination, habitat fragmentation and degradation, climate change, and biological invasions.

Contamination has received considerable attention because it affects not only biological diversity but also human health. Using six fish and two crustacean species as models, Ji et al. demonstrated the pollution characteristics of 16 polycyclic aromatic hydrocarbons (PAHs) in marine organisms in the East China Sea. They found that the main source of PAHs in the study animals was coal combustion and that gasoline combustion, oil combustion, crude oil spills, and vehicle emissions were important contributors. Therefore, the potential risk of lifetime cancer from the consumption of seafood should be considered and monitored over a long period. Eutrophication is another form of pollution that occurs in freshwater ecosystems. Zhu et al. revealed that the eutrophication level differs in Taihu Lake, China, with the level being higher in summer and in the southern region. Interestingly, microbial diversity was negatively correlated with the degree of water eutrophication, whereas its abundance was positively correlated with nutrient levels. Because the function of microorganisms indicates their participation in the migration and transformation of nutrients, more attention should be paid to these organisms when purifying lakes. Eutrophication may also be associated with cyanobacterial blooms. Wang et al. analyzed the effects of light on the diversity of cyanobacteria and coexisting microorganisms. Moreover, changes in related genes, functional structures, and internal metabolism involved in nitrogen cycling were revealed using 16S rRNA and non-targeted metabolomics sequencing technologies. Their results indicated that natural light conditions could regulate the diversity, abundance, and metabolites of cyanobacteria and coexisting microorganisms. Eutrophication is correlated with the composition of specific fish communities. Guo et al. found that fish communities differed significantly among zones with different nutrients in lakes. Accordingly, they suggested that reasonable stocking of piscivorous fish could be a potential approach for regulating lake ecosystem functioning.

Habitat change is another key factor that affects biological diversity. In lakes, this could be due to watershed land-use changes, which have been investigated by Du et al., affecting the traits and functional diversity of phytoplankton in lakes in Northeast China. Specifically, five of the 18 functional trait categories (i.e., flagella, filamentous, unicellular, mixotrophic, and chlorophyll *c*) can be considered potential indicators of the intensity of watershed land-use change. Functional richness decreases with intensive agricultural and urban land use, which is associated with an increase in functional homogenization. Moreover, soil fauna biodiversity can be regulated by urbanization. Yu et al. observed that soil physicochemical characteristics changed dramatically along an urbanization gradient. Subsequently, they detected variance using Shannon's diversity and Pielou's evenness indices. Although soil fauna abundance, taxon number, and community structure also exhibited different patterns along an urbanization gradient, their variance contributed slightly to the change in soil physicochemical characteristics. In terms of stream ecosystems, Li et al. found that native fish alpha diversity in the streams of four basins in the Wannan Mountains could decline because of the effects of low-head dams, which may in turn favor the colonization of native-invasive fish. Therefore, the fish community structure and beta diversity can also be modified. Similar results were reported by Gu et al., who found that small hydropower stations in the upper reaches of the Yangtze River have an impact on freshwater biodiversity such as fish, benthic invertebrates, plankton, and microorganisms. Liao et al. demonstrated that dams can also affect fish diversity in reservoir cascades connected to rivers. However, the response patterns of fish taxonomic, functional, and phylogenetic diversity were distinct in different reservoirs and were associated with their impounding age and longitudinal location. All the above studies provide essential references and implications for freshwater biodiversity conservation under habitat change conditions.

Climate change is a hot topic when discussing human-induced perturbations that cause environmental changes in ecosystems, such as lakes and streams. In our Research Topic, B-Béres et al. focused on flow intermittence in streams located in Hungary. They found that the drying of streams has a complex influence on benthic diatoms, with taxonomic diversity, functional diversity, and diatom-based quality indices exhibiting different responses. Taxonomical and functional redundancies can compensate for the negative effects of short-term flow intermittency on diatom assemblages. Lentic and lotic environments also induce a shift in the microeukaryotic communities of rivers. For instance, Wang et al. found that the network and stability of lotic areas are strongly determined by a microeukaryotic network. In contrast, the microeukaryotic network is highly fragmented in lentic areas, causing the loss of key functions in the microeukaryotic community, thus decreasing the stability and resilience of ecosystems. Organisms located at high-elevational sites are more easily affected by climate change. This was implied by the observations of Wang et al., who found that temperature and salinity were the key factors driving benthic macroinvertebrate elevational diversity patterns in lakes through three potential mechanisms: climate/productivity, environmental heterogeneity, and dispersal/history. Climate change may also affect vertebrates such as fish. Liu et al. indicated that the trade-off between maximum metabolic ability and energy efficiency is important before fish migration. Moreover, Wang et al. suggested that the trophic traits of fish, such as food and habitat, are correlated with resource utilization. As these performances can be affected by climate change, subsequent responses in the physiological and ecological traits of fish can be expected.

Biological invasion is a threat to global biodiversity, causing the decline and even local extinction of native populations. Based on genetic sources and diversity, Zhong et al. indicated that the genetic origins of some paddy field carp populations in South China are complex. More importantly, *Cyprinus carpio carpio* genetic resources have invaded paddy field carp populations in South China and should be given more attention in the future to preserve native germplasm resources. Biological invasions can even occur in the karst bedrock. In the review prepared by Li et al., they summarized the habitat characteristics and invasion status of karst bedrock to biological invasions. They found that the number of invasive species increased over time through competition, mutualism, allelopathy, and phenotypic plasticity. Interestingly, invasive species in karst bedrock usually have specific biological traits, such as strong fecundity, rapid growth rate, strong environmental adaptability, strong phenotypic plasticity, and high genetic diversity. These traits may help them to colonize the karst bedrock more easily. Finally, they indicated that some areas in China might face a higher risk of invasion, providing useful information for the management of invasive species. To survey invasive species, traditional approaches include field sampling using gillnets and traps. In Lin et al., environmental DNA (eDNA) metabarcoding was found to be a better approach than multi-mesh gillnets sampling approach in assessing fish diversity because it is sensitive, effective, and noninvasive. More importantly, eDNA technology can detect species that cannot be collected using traditional approaches; thus, it is particularly useful for rare, enigmatic, invasive, and endangered species.

In addition to focusing on the indirect effects of human activity, Li et al. reviewed the direct effects of human whale hunting on deep-sea biodiversity. Indeed, whale fall is beneficial for the diffusion and succession of deep-sea organisms, supporting the survival and evolution of specific fauna. However, the microbial processes, reproductive strategies, population genetics, and biogeography contributing to whale falls remain unclear. As the largest vertebrates in the deep sea, whales should be protected to preserve the deep-sea environment.

Overall, this Research Topic made a significant contribution to our understanding of how global changes in environmental characteristics can affect biodiversity, ecosystem functioning, and the BEF relationship. Studies on this topic have also provided suggestions to manage and compensate for these effects. However, further studies are required to better understand the mechanisms underlying these effects. Additionally, effective measures should be developed for policy managers.

Author contributions

TZ: Writing – original draft, Writing – review & editing. CW: Writing – review & editing. PM: Writing – review & editing. CL: Writing – review & editing. CL: Writing – review & editing.

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Conflict of interest

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References

Bellard, C., Bertelsmeier, C., Leadley, P., Thuiller, W., and Courchamp, F. (2012). Impacts of climate change on the future of biodiversity: biodiversity and climate change. *Ecol. Lett.* 15, 365–377. doi: 10.1111/j.1461-0248.2011.01736.x

Cardinale, B. J., Srivastava, D. S., Emmett Duffy, J., Wright, J. P., Downing, A. L., Sankaran, M., et al. (2006). Effects of biodiversity on the functioning of trophic groups and ecosystems. *Nature* 443, 989–992. doi: 10.1038/nature05202

Gaston, K. J., Davies, Z. G., and Edmondson, J. L. (2010). "Urban environments and ecosystem functions," in *Urban Ecology*. Ed. K. J. Gaston (Cambridge, UK: Cambridge University Press), 35–52. doi: 10.1017/CBO9780511778483.004

Loreau, M. (2010). Linking biodiversity and ecosystems: towards a unifying ecological theory. *Phil. Trans. R. Soc B.* 365, 49–60. doi: 10.1098/rstb.2009.0155

Loreau, M., Naeem, S., Inchausti, P., Bengtsson, J., Grime, J. P., Hector, A., et al. (2001). Biodiversity and ecosystem functioning: current knowledge and future challenges. *Science* 294, 804–808. doi: 10.1126/science.1064088

Stewart, P. S., Voskamp, A., Santini, L., Biber, M. F., Devenish, A. J. M., Hof, C., et al. (2022). Global impacts of climate change on avian functional diversity. *Ecol. Lett.* 25, 673–685. doi: 10.1111/ele.13830

Strayer, D. L. (2012). Eight questions about invasions and ecosystem functioning. *Ecol. Lett.* 15, 1199–1210. doi: 10.1111/j.1461-0248.2012.01817.x

Zhao, T., Villéger, S., and Cucherousset, J. (2019). Accounting for intraspecific diversity when examining relationships between non-native species and functional diversity. *Oecologia* 189, 171–183. doi: 10.1007/s00442-018-4311-3