Opposite trends in biomass distributions of two freshwater species under climate change

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Abstract

Changes in the thermal structure of lake ecosystems have been documented as a precursor of climate change, but the dynamics of biomass distribution, which fundamentally determines species conservation, have been less studied. An interdisciplinary approach was used to demonstrate the influence of climate-driven changes on the biomass distribution of two species (*Gymnogobius isaza* and *Palaemon paucidens*) in Lake Biwa. In field surveys in 2016–2017 (full water circulation) and 2019 (partial water circulation), environmental DNA concentrations of these species were used as proxies for biomass to measure 43 and 47 sites sampled at the lake bottom, respectively. A structural equation model was used to estimate the correlation between species biomass and environmental parameters. The species-environment relationship was applied to species biomass distributions under existing and future environments calculated by the model. Differences between the species were found in their responses to climate change. The biomass distribution of *G. isaza* will benefit in the future if full water circulation occurs, although it appears to be independent of water circulation at present. Partial water circulation enlarges the distribution area of *P. paucidens*, but its biomass will be low in the future, regardless of the extent of water circulation. These findings advance the knowledge of how species respond to climate change and suggest special attention should be given to species such as *P. paucidens*, which is currently abundant but sensitive to climate change. Furthermore, they emphasize the potential application of interdisciplinary methodologies for improved species conservation.

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