Global climate change drives fish fitness zones in typical marine habitats, finds study

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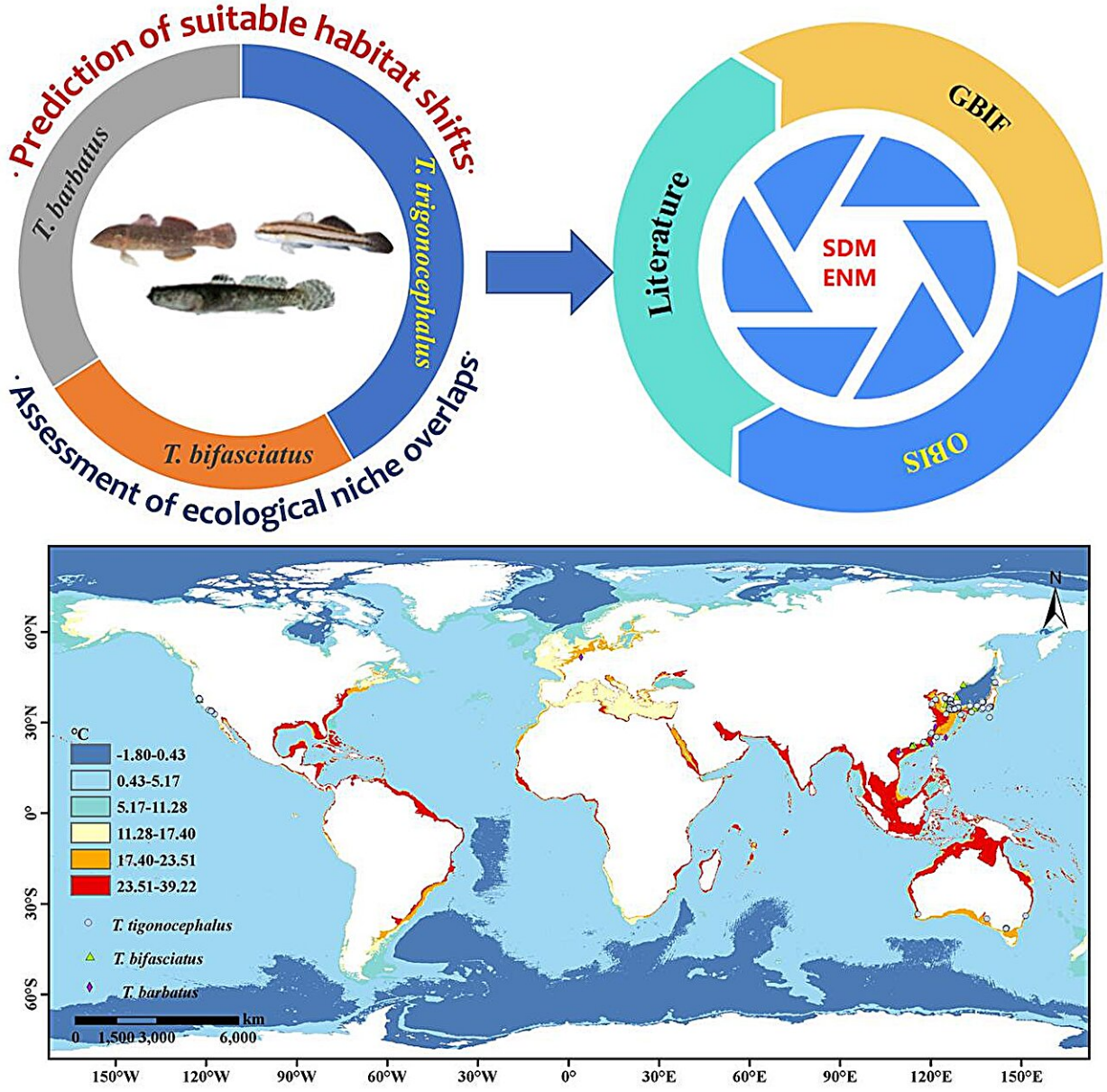

Habitat-driven and ecological niche overlay study design for the Tridentiger. Credit: IOCAS

The tridentiger typically inhabits semi-saline and freshwater environments located in the tropical, subtropical, and temperate regions of the western Pacific Ocean. It occupies a crucial position in the food chain, making it ecologically important. As an indicator species, the tridentiger is highly vulnerable to environmental changes, and it is likely that global climate change will result in significant changes or even loss of its habitat. Therefore, it is vital to systematically analyze the response strategies of the tridentiger to global climate change in various habitats.

A research team led by Prof. Li Jun from the Institute of Oceanology of the Chinese Academy of Sciences (IOCAS) conducted a systematic analysis of the dynamic shift of suitable habitats for three species of tridentiger (Tridentiger trigonocephalus, Tridentiger bifasciatus, Tridentiger barbatus).

The study was published in *Marine Pollution Bulletin*.

"We used the species distribution model (SDM) and ecological niche assessment model (ENM) to quantify the first-ever overlap of ecological niches between intertidal and subtidal tridentigers," said Chen Shaohua, first author of the study.

According to the researchers, environmental factors such as distance from the shore, primary productivity, and temperature were found to be the primary factors influencing the distribution of intertidal and subtidal habitats suitable for Tridentiger. These factors contributed to 94% of the distribution of all three species studied.

The SDM Maximum Entropy Model (Maxent) identified four hotspots for T. trigonocephalus and T. barbatus globally, in addition to those in the western Pacific Ocean. T. bifascitus and T. barbatus inhabit waters off the coasts of Seattle and California in the eastern Pacific Ocean, off the coasts of New York and New Jersey in the western Atlantic Ocean, off the coasts of Amsterdam and Brussels in the eastern Atlantic Ocean, and off the coasts of Uruguay and Mar del Plata in South America. T. bifascitus has three main habitats located in the western Pacific Ocean, off the coasts of New Jersey and Delaware in the western Atlantic Ocean, and off the coasts of Flensburg and Amsterdam in the eastern Atlantic Ocean.

Additionally, another habitat can be found offshore of Uruguay in the southern Atlantic Ocean. It also has a habitat off the northern coast of Uruguay in South America.

"Previous studies were insufficient in providing a clear explanation of the tridentiger, a sedentary burrower, under future climate change," said Dr. Xiao Yongshuang, corresponding author of the study. "Based on the results of the current study, it can be concluded that tridentiger did experience a significant local expansion and contraction of its viable habitat, but did not exhibit any poleward migration."

Analysis of ecological niche overlap showed that T. trigonocephalus and T. barbatus exhibit considerable ecological overlap. Their habitats overlap by 44.7×105 km^2, accounting for 25.2% and 40% of suitable habitats for the two species, respectively. The researchers revealed that T. trigonocephalus is able to adapt to both intertidal and subtidal habitats, and has a stronger ability to adapt to future global climate change compared to T. barbatus. It is evident that the T. trigonocephalus has a high level of resilience to changing environmental conditions.

In addition, the study confirms that the T. trigonocephalus can adapt to

both intertidal and subtidal habitats, has wider distribution range within its habitat, and has a greater capacity to adapt to future global climate change.

"This study offers new insights into how typical intertidal and subtidal fish species respond to global climate change, and also demonstrates varying degrees of ecological overlap among intertidal/subtidal species with specific life history traits," said Prof. Li.

More information: Shaohua Chen et al, Prediction of suitable habitat shifts and assessment of ecological niche overlaps for three Tridentiger species with intertidal and subtidal characteristics under future climate changes, *Marine Pollution Bulletin* (2023). DOI: 10.1016/j.marpolbul.2023.115827

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