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Global habitat loss of freshwater fish species in a 1.5-degree warmer world

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Freshwater habitats host over 10,000 fish species, corresponding to approximately 40% of the global fish diversity. Amid the future threats that freshwater fish species will face, climate change plays a key role. Increasing air temperature and changing precipitation patterns modify water temperature and flow regimes, which directly affect the habitat of freshwater species. In this study, we assessed the influence of climate change on the habitat of 7,000 fish species worldwide, highlighting vulnerable species and areas at different warming levels, including 1.5°C and 2.0°C above pre-industrial levels. To that end, we modelled potential changes in the extent of suitable habitat of each species as function of altered flow and temperature regimes. First, we derived and validated species-specific tolerance thresholds for maximum weekly water temperature, minimum weekly flow and number of zero flow days. Then, we predicted changes in the extent of suitable habitat of each species by confronting the tolerance thresholds with the expected patterns of future water temperature and flow. We employed an ensemble of five global climate models, each run for four different Representative Concentration Pathway scenarios, in combination with the global hydrological model PCR-GLOBWB to model current and future water temperature and flow at high spatial resolution (∼10x10 km2). We project the largest reductions in the extent of suitable habitat for fish species in areas with a tropical, sub-tropical or Mediterranean climate. We further observe that, on average, projected changes in water temperature will have a larger impact on the habitat of freshwater fish species than changes in streamflow. Nonetheless, we find water temperature and flow to be complementary stressors due to their limited spatial overlap. Finally, our findings suggest that a warming target of 1.5°C on average will halve the potential habitat losses of freshwater fish species compared to a higher target of 2.0°C.