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Press Release

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Only 14% of the World Rivers host fish faunas little impacted by humans

Rivers provide a habitat for a rich biodiversity of fishes, with more than 17,000 species recorded to date, corresponding to a quarter of all vertebrates on the planet. Rivers are also profoundly impacted by human activities through fishing, pollution, water extraction and fragmentation by dams, which have already caused a decline of fish faunas in the most impacted rivers. However, the impacts of human activities on biodiversity have often been measured only in the number of species (taxonomic diversity), while they could also be measured in the relatedness of species (phylogenetic diversity) or in the role of different species on ecosystem functioning (functional diversity). In a report published in *Science* this week, a consortium of researchers led by Sébastien Brosse from the University of Toulouse (France) developed a new biodiversity indicator taking into account these different dimensions of biodiversity. They show that the fish faunas of more than 50% of the 2,456 world's rivers considered in this study have been heavily modified by human activities. Only 14% of the rivers remain little impacted but they provide a habitat only for 22% of the world's freshwater fish species. Thus, this study underlines the need of an urgent action to protect biodiversity of the rivers already impacted by human activities.

Biodiversity can be measured in different complementary facets. Regarding freshwater fish, it can be measured, in each river, through taxonomic diversity that accounts for species composition, through phylogenetic diversity that accounts for the relatedness of species and through functional diversity that accounts for the role of different species on ecosystem functioning. Biodiversity can also be measured as the differences in biodiversity (taxonomic, phylogenetic or functional) between rivers. Then, it provides insights into the particular biodiversity of some rivers, compared to surrounding ones. These six measures of biodiversity, were so far used independently making the process of measuring the multiple consequences of human activities on biodiversity difficult. To solve this problem, we suggested to combine the six biodiversity measures into a synthetic indicator called "Cumulative Change in Biodiversity Facets" (CCBF).

The CCBF index has been used to measure the changes in biodiversity that more than 2,400 rivers around the world have undergone, over the past two centuries. Those rivers gather more than 10,000 fish species and cover almost all the

continental areas of the globe except deserts and poles. The results of this study show that the fauna of more than 50% of the rivers has undergone profound changes in both taxonomic, functional and phylogenetic dimensions of biodiversity, while only 14% of the rivers did not suffer from changes in their fish faunas. The most frequently observed change was an increase of the number of species due to the introduction of exotic species. Most of the time, those exotic species are distinct from evolutionary lineages of the natives. Generally, they are also larger bodied than the natives and have a morphology adapted to stagnant environments. Most of them have laterally compressed bodies, such as the Common Carp, the Largemouth Bass or the Tilapia, three of the most widespread exotic fishes in the world rivers. This overrepresentation of exotic species adapted to still waters underlines a strong effect of river fragmentation by dams. Moreover, since most of the world's rivers are subject to similar human pressures, both taxonomic, functional and phylogenetic differences between rivers subjected to these same disturbances tend to decrease. This phenomenon leads the aquatic ecosystems towards greater faunistic homogeneity, thus reducing the ability of the ecosystems to respond to ongoing global changes.

The little-impacted rivers represent less than 14% of the surface of the world's rivers and provide a habitat for less than a quarter of freshwater fish species. In addition, they are mainly located in Africa and Australia, while South America, which provides a habitat for a large part of the global biodiversity of freshwater fish, has only 6% of its rivers little impacted by dams and exotic species. The few rivers with little human impacts are thus not sufficient to preserve the world aquatic biodiversity. Conserving biodiversity in already impacted rivers is particularly needed as many endangered fish species inhabit rivers heavily impacted by humans. If no conservation actions are led to stop the ongoing change of biodiversity, the forthcoming extinction would trigger the biodiversity changes we report. Such abrupt changes would jeopardize the essential services provided to humanity by aquatic ecosystems.



The Oyapock river, flowing between Brazil and French Guiana, is among the rare rivers from South America with a fish fauna still little impacted by humans. © Sébastien Brosse

Reference :

Human impacts on global freshwater fish biodiversity, Su G., Logez M., Xu J., Tao S. Villéger S. & Brosse S., ***Science***, 2021.

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