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New tool developed to highlight and help prevent declines in freshwater biodiversity

Biodiversity is declining in freshwater ecosystems across the globe, a new study has shown. The researchers created a mathematical model, called GLOBIO-aquatic, which builds a picture of the threats to the biodiversity of rivers, lakes and wetlands that are posed by a variety of human activities. The most crucial of these are land-use changes, nutrient and chemical pollution, and disturbances to the water cycle — which could be from infrastructure such as dams, or from climate change. The authors hope that the model will help policymakers identify regions which are most at risk from these pressures.

Lakes, rivers, marshes and other freshwater and wetland areas make up around 9% of the Earth's land surface. These inland water bodies host a diverse array of species as well as providing a range of ecosystem services, including water purification, climate regulation, food, and recreation. However, it is estimated that, worldwide, wetland areas have been depleted by 60% since the beginning of the 20th century. There is therefore an urgent need to examine future impacts on the biodiversity of freshwater ecosystems, which is what this research aims to achieve.

To build the GLOBIO-aquatic model the researchers gathered data from international, peer-reviewed studies on freshwater biodiversity[1], and incorporated a range of projection models that focus on drivers such as land use, climate change, economics and human population. This information was combined with maps of the global distribution of water bodies to define catchments and to present the results graphically.

The model showed that, by the year 2000, the biodiversity of freshwater ecosystems had already declined dramatically in comparison to their undisturbed state. This state was derived from historical data on the same water body or from data on a comparable water body with minimal human interference. The western, central and southern areas of Europe are among the worst affected in the world, and natural water systems surrounding heavily populated areas may have lost up to 80% of their original biodiversity. In contrast, areas of northern Europe have seen a much less severe impact. Data from the Organisation for Economic Co-operation and Development shows that the most extensive land use changes over the next 50 years will take place in central Africa, South America and South-East Asia. Incorporating this information, the model predicted that these areas will experience the greatest losses of freshwater biodiversity, while some areas of Europe have the potential to see a slight improvement on their current degraded state.

The model so far is restricted because data from many studies were presented in a way that meant they could not be used, and the researcher's access was limited to papers that had been formally peer-reviewed and published, which favoured papers from more developed parts of the world. This means that the results cannot be treated as precise figures; however, they do give an important indication of the state of the world's freshwaters. In the future, the model has the potential to become more robust with a greater wealth of biodiversity data and a wider scope of research sources.

Alongside biodiversity indicators like the Living Planet Index and the Red List Index, the GLOBIO-aquatic model could prove to be a useful tool in fulfilling ecological criteria set out in the Water Framework Directive, providing policymakers with important information about the kinds of activities which are most damaging to freshwater biodiversity, and identifying the regions which are most vulnerable.

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1. The biodiversity of the water systems was expressed in terms of the mean relative abundance of original species (MSA), which can be linked to the Ecological Quality Ratio (EQR), as used in the European Water Framework Directive.