Floodplains improve the water quality of rivers

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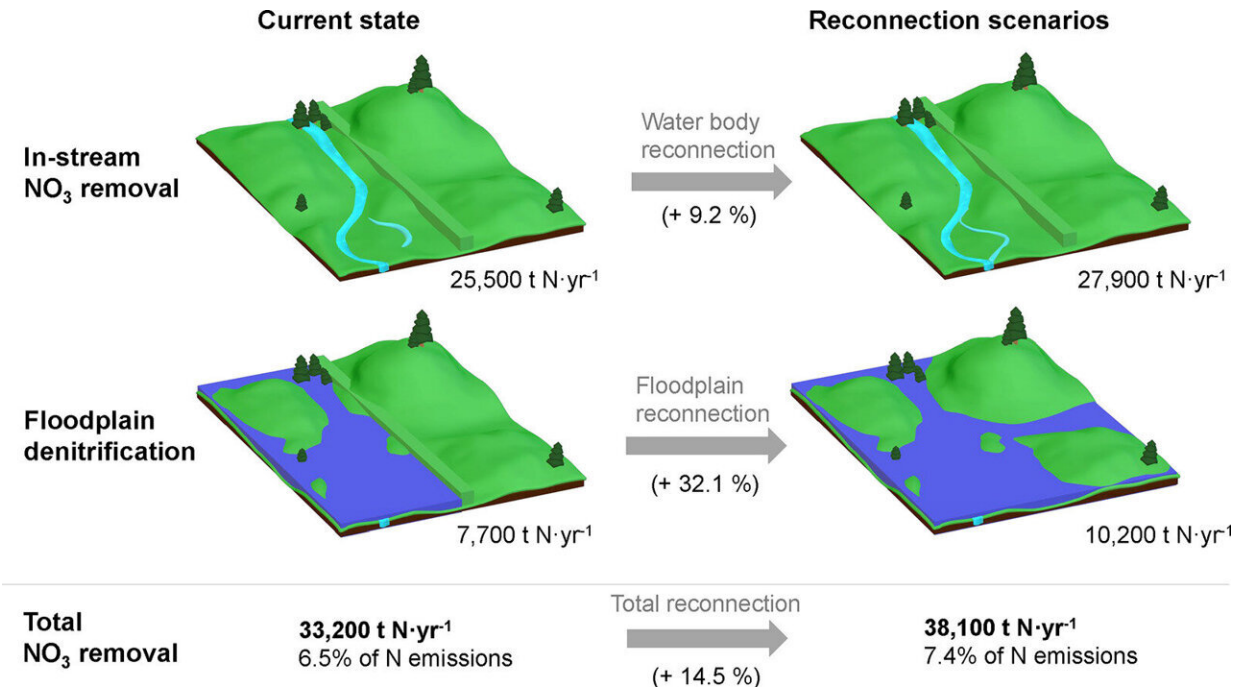

Graphical abstract. Credit: *Science of The Total Environment* (2022). DOI: 10.1016/j.scitotenv.2022.156879

Riverine floodplains are among the most species-rich ecosystems on earth. Because they form the interface between land and water, they are hotspots of nutrient turnover and biodiversity. Along many rivers, however, numerous floodplains have been cut off from waterways or converted to other uses. At the same time, too many nutrients enter the

water, especially nitrogen. Both degrade water quality and threaten biodiversity—both in the rivers themselves and in the seas into which they flow.

To a certain extent, rivers have the ability to break down nutrients in the river water itself and in the floodplains. Researchers working on the international IDES collaborative project have determined just how large the contribution of floodplains is to reduce nitrogen for the Danube River basin. "The special feature of our study is that we looked at such a large area for the first time, because the Danube has the second largest catchment area in Europe," said IGB scientist and co-author Dr. Andreas Gericke.

The Danube catchment covers an area of more than 800,000 km^2 and stretches across 19 countries. Some 70 to 80% of its floodplains have been cut off from the river or converted into agricultural land in recent decades, depriving it of its ecosystem functions and services.

The researchers now wanted to know how much of the nutrient retention is provided by the remaining active floodplains. To do this, the team used the MONERIS model developed at the IGB, which determines nutrient inputs from various sources—including the atmosphere, fertilizer use in agriculture and sewage treatment plants—and calculates their fate and transport in the river system.

According to the study, 500,000 metric tons of nitrogen enter the waters of the Danube River Basin each year, predominantly as nitrate. Most of the inputs come from agriculture (44%) and urban sources (30%). Two-thirds of these inputs reach the Black Sea, and one-third, or 160,000 metric tons, are degraded in water bodies.

To find out how large the share of floodplains in nitrate retention is, the team supplemented the MONERIS calculations with further modeling

for the Danube and its tributaries Sava, Tisza and Jantra. There, 3,842 km^2 of floodplains are found, accounting for nearly half of all active floodplains in the Danube basin.

"Most nitrate is degraded in the water network, for example by nitrogen being taken up by plankton or converted by bacteria (denitrification). But floodplains can also contribute to a not inconsiderable extent to nutrient retention," Andreas Gericke reports. The results show that active floodplains degrade 33,200 tons of nitrate annually, which corresponds to 6.5% of the input. Based on the model results, the researchers estimate that nitrate removal could be increased by 14.5% if the approximately 1,300 km^2 of potentially restorable floodplains and oxbow lakes were reconnected to the main streams.

"Our results impressively show that it makes sense to preserve floodplains and restore their functions—not only because of their ability to break down nutrients, but also to preserve biodiversity among many other ecosystem services," said Martin Tschikof from the Institute of Hydrobiology and Water Management at BOKU. He is the lead author of the study. The simplified assumptions and data allow only limited statements. However, they are a good basis for better consideration of floodplains and their reconnection for good water quality in Europe's major river basins.

The research was published in *Science of The Total Environment*.

More information: Martin Tschikof et al, The potential of large floodplains to remove nitrate in river basins—The Danube case, *Science of The Total Environment* (2022). DOI: 10.1016/j.scitotenv.2022.156879

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