

Oder disaster 2022: How the toxic algae harmed fish

October 2 2025



In the summer of 2022, toxins produced by the brackish-water alga *Prymnesium parvum* killed about 1,000 metric tons of fish in the River Oder. Credit: Luc De Meester

In the summer of 2022, toxins produced by the brackish-water algae *Prymnesium parvum* killed about 1,000 metric tons of fish, snails, and mussels in the River Oder. In a study [published](#) in the journal *Ecotoxicology and Environmental Safety*, researchers of the Leibniz

Institute of Freshwater Ecology and Inland Fisheries (IGB) analyzed the toxic effect of the brackish water algae *Prymnesium parvum* on the blood cells of various fish species in the Oder. The results revealed species-specific differences in sensitivity to the toxins.

The toxins responsible, prymneseins, exert their effects in various ways. One possible mode of action of *P. parvum* involves [direct interaction](#) with the [cell wall](#), making it more permeable and disrupting ion exchange. This ultimately leads to cell dissolution. In the worst case, this can lead to the cessation of gas exchange, causing the animals to suffocate. Until this study, little research had been conducted into which species are sensitive to these toxins and how.

Perch and carp particularly sensitive, trout more resistant to the toxin

The researchers investigated the Oder1 *Prymnesium* strain, which was isolated during the 2022 algal bloom. They examined its effect on the [blood cells](#) of five fish species found in the Oder: [rainbow trout](#), sturgeon, perch, bream and carp. Blood cells were taken from the fish after they had been killed, isolated and incubated with different concentrations of the algae for 24 hours. Hemolytic activity, i.e., the breakdown of blood cells, was determined by measuring the relative contents of intact red blood cells compared to the control group at 15, 18, 21 and 24 hours.

"Perch and carp were the most sensitive to the toxin, while rainbow trout were the least sensitive. Such species-specific differences may reflect variations in red blood cell membrane structure and composition, demonstrating the diverse ways in which animals can respond to toxic algal blooms," said Margie Glenn, IGB researcher and first author of the study.

The findings of this study are ecologically relevant and important for assessing toxic algal blooms. As there is currently no other method available, a hemolysis test on human blood cells is commonly used to assess the toxicity of *P. parvum*. This study shows that test results can vary considerably depending on the origin of the red blood cells. "Perch and carp blood cells are more sensitive indicators of toxicity than human erythrocytes," states Dr. Jörn Geßner, the IGB researcher who led the study.

Toxicity also depends on environmental conditions

The brackish water algae *Prymnesium* can produce various toxins depending on the strain, but it is not always toxic. Toxicity is strongly influenced by environmental conditions and nutrient availability. During the 2022 bloom, the algal concentration in the Oder River reached 100,000 cells per milliliter, leading to massive fish mortality. In contrast, during a subsequent bloom of the same strain in 2024 with more than 200,000 cells per milliliter, only a few fish were affected.

Given the complex interactions between algae or toxin type and [environmental conditions](#), the time it takes for the [toxin](#) to take effect can vary. While another study reported toxicity effects of a different algae strain of *Prymnesium parvum* after just one hour, the *Prymnesium* strain Oder1 in this study showed toxicity effects after more than 15 hours. These effects became apparent at a concentration of 80,000 *Prymnesium* cells per milliliter of water.

After 18 hours, hemolytic effects and initial differences between [fish species](#) were already apparent at concentrations of only 20,000 algae cells per milliliter of water. After 24 hours, the erythrocytes of most species were greatly reduced at all concentrations.

"The timing of toxicity tests must therefore be carefully considered to

ensure that toxic effects are neither overestimated nor underestimated," said IGB-researcher Dr. Sven Würtz, co-leader of the study.

"Our study once again highlights the problem that the ecology and [toxicity](#) of the brackish water algae responsible for the Oder disaster cannot be predicted using simple indicators. The most important preventive measure therefore remains to reduce the salinity of the Oder and strengthen the resilience of the river," said the researcher.

More information: Margie Glenn et al, Hemolytic toxicity of *Prymnesium parvum* (B-type) reveals species-specific differences in freshwater fishes, *Ecotoxicology and Environmental Safety* (2025). [DOI: 10.1016/j.ecoenv.2025.118928](https://doi.org/10.1016/j.ecoenv.2025.118928)

Provided by Forschungsverbund Berlin e.V.

Citation: Oder disaster 2022: How the toxic algae harmed fish (2025, October 2) retrieved 3 October 2025 from <https://phys.org/news/2025-10-oder-disaster-toxic-algae-fish.html>

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