Q&A: Why ponds and kettle holes are also water sources worth protecting

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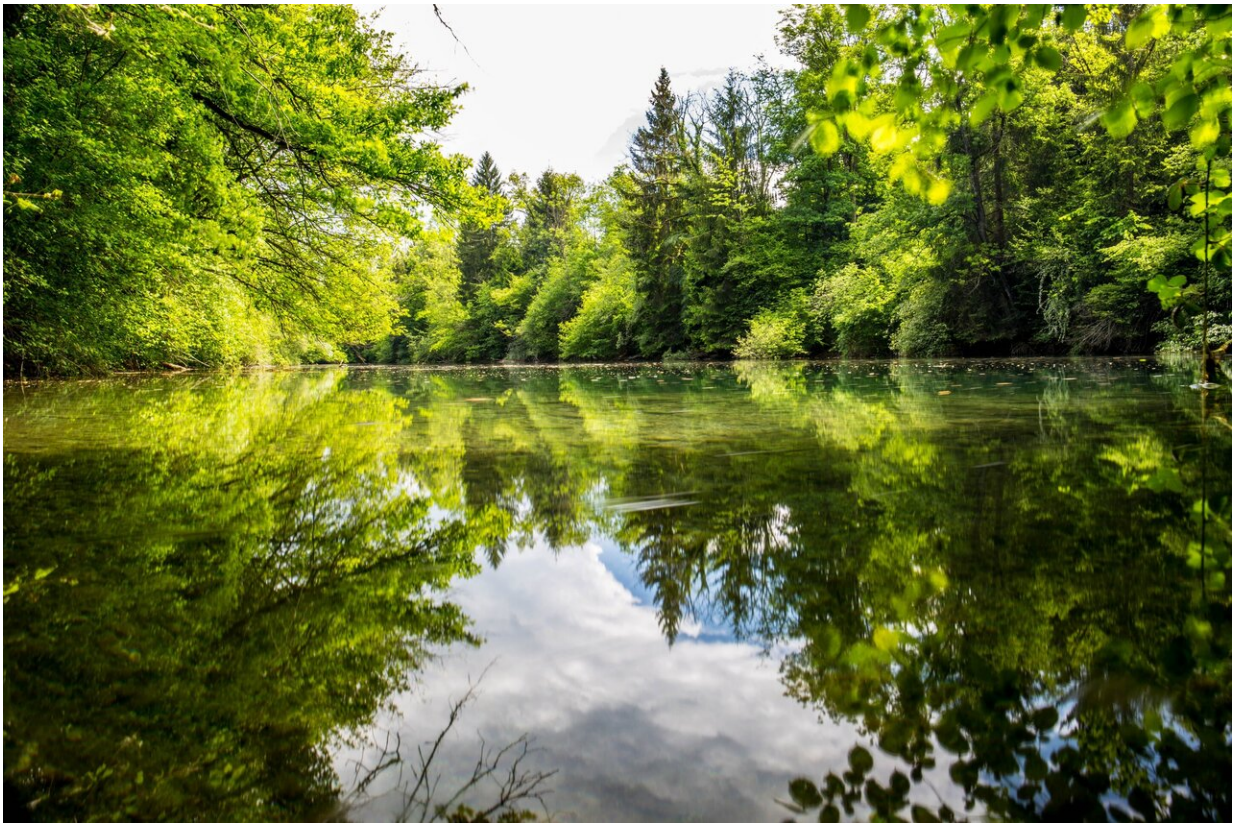

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Small bodies of water, i.e., natural ponds, kettle holes and pools, account for 30 to 50% of the world's standing water. Owing to their size, however, the importance of small water bodies was long underestimated.

As a result, they are scarcely mentioned in regulations and legal provisions. It is now known, however, that because of their abundance, heterogeneity, exceptional biodiversity and biogeochemical potency, small water bodies play an important role in catchments, landscapes, and possibly even on a continental scale that is completely out of proportion to their small size. On the occasion of World Water Day on 22 March, experts from the Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB) take a look with us at these rather under-appreciated ecosystems. Five answers to five questions:

Mr. Mehner, your newly launched EU project PONDERFUL is all about small freshwater ecosystems. This involves you taking a close look at an area in northeast Germany. How beneficial are kettle holes and pools not only there, but elsewhere, too?

In the lake-rich landscape of northeast Germany, small bodies of water such as kettle holes, pools, puddles and ponds are often overlooked or perceived as having little value. Yet this is not the case. After all, they are key to aquatic biodiversity, for example as stepping stone habitats for almost 70% of the regional freshwater species in Europe. They create island-like connections between dispersed habitats, enabling animals to recolonize or repopulate habitats. In addition, these small water bodies play an important role in mitigating climate impacts and in climate adaptation. They provide a wide range of ecosystem services, including regulation of the carbon cycle, water supply, flood protection, groundwater recharge and local recreation. In our region, however, we have lost 70 to 80% of kettle holes and puddles due to desiccation—partly as a result of recent summer droughts. It is not yet clear what impact this will have on biodiversity and ecosystem services.

Ms. Wollrab, you are involved in modeling the spatial distribution of species in the landscape. How important is it to have a network of small water bodies? Will we lose species and populations if there is a dramatic decrease in the number of small freshwaters?

Small water bodies such as kettle holes provide habitat for many species in northeast Germany, significantly increasing biodiversity in the landscape. The number of small water bodies and their distance from each other have a major impact on species diversity. The fewer water bodies exist and the greater the distance between them, the less probable it is that species will reach these water bodies. Water body density has a particularly large impact on species that are passively distributed, such as plankton organisms, or species with a short dispersal range. A loss of small water bodies due to desiccation or other factors therefore always results in a loss of important habitat. Since we must assume that small water bodies will dry out more frequently in the future or fall dry permanently in the wake of global warming, this will also have a negative impact on the number and abundance of species. In fact, our model analyses suggest that there are critical thresholds of habitat availability, which depend on the dispersal range of individual species. However, further research is needed to determine specific thresholds. Small water bodies are not only habitats for aquatic organisms, but also an important source of water for terrestrial animals. It is therefore very important to protect this habitat.

Ms. Bizic, you have also conducted research into small water bodies in a northeast German agricultural landscape recently, using environmental RNA to

investigate how the type of land use affects biotic communities in the water. What did you discover?

Our work, undertaken as part of the Bridging in Biodiversity Science (BIBS) project, involved using environmental DNA and RNA to obtain a holistic picture of biodiversity in the study area. Besides using deep sequencing of marker genes to follow the distribution of organisms—from bacteria to mammals—in small water bodies and their environments, we also extracted the identity and gene expression patterns of active communities from the RNA data. Contrasting the DNA results from pond water with that of the sediment taught us that, in the past, it mattered whether a small water body was surrounded by forest, grassland or arable land, whereas today, after decades of intensive land use, biodiversity is more or less homogeneous. The RNA work showed us that this homogeneous community continues to react to input from its environment, such as field fertilization, at least for a while. So, although intensive agriculture has already changed the previous state of biodiversity in recent decades, communities continue to respond to land management. In order to prevent further degradation of biodiversity, therefore, it is essential that we understand the immediate effects of local agricultural practices on small water bodies. Environmental RNA (eRNA) provides a valuable set of tools for this task.

Mr. Wolter, in contrast to your colleagues, you have mainly been working on small urban water bodies—to be precise, Berlin's 400+ ponds, small lakes and ditches. What role do these systems play for the urban climate, local recreation and stormwater management? And what does this mean for future urban development?

Small urban water bodies are very diverse, ranging from well-maintained park ponds to virtually forgotten, fenced-in ponds. As such, some have a greater recreational use than others. Basically, water bodies always act as a magnet for walkers and people seeking recreation. Moreover, for many city dwellers, small urban water bodies are their first or even only encounter with nature. Inner-city small water bodies may not necessarily be hotspots of biodiversity, but they are very important places where residents can experience nature. And they have a positive effect on the urban climate—in combination with riparian vegetation, which may or may not be lush, they produce evaporative cooling, which reduces the local temperature. Water retention in the landscape is another key function of small water bodies that could be improved in Berlin. In many places, rainwater is discharged via the sewage system, and is then no longer available for freshwater systems. This is why many small water bodies in Berlin dried up completely or almost completely in the dry years from 2018 to 2020. Urban planning must therefore increasingly promote the removal of sealed surfaces in the catchment area, not only of small water bodies, as well as allowing roof drainage etc. to seep into the ground locally.

Mr. Grossart, small water bodies are particularly affected by declining water levels due to sealing, drainage and drought. What happens when ponds intermittently run dry, and how resilient are they to weather extremes?

The United Nations predicts that 1.1 billion more people will be living in urbanized areas in ten years from now. This will be accompanied by a sealing of the landscape and severe anthropogenic interferences with the hydrology of water bodies. This is problematic because small bodies of water in urban areas are already drying out more frequently as a result of higher temperatures and longer periods of drought. As BUND's Small

Waterbody Report 2020/21 shows, 55.3% of Berlin's water bodies have major deficiencies, for example because they are dry or very overgrown. Nearly 10% of small water bodies were no longer recognizable as such. These dramatic figures show that many small water bodies are no longer just drying up temporarily, but are disappearing completely. This is devastating for the biodiversity of these ecosystems, because population densities in urban habitats are generally often very low. Populations especially tied to these water bodies, e.g. amphibians, are much more endangered by local extinction events than populations in larger and better-connected water bodies. Thus, it is to be feared that species diversity will decline further. As water bodies dry out and species disappear from the urban landscape, ecosystem functions, such as cleaning water bodies, providing oxygen or remineralizing carbon, also change. More frequent weather extremes put these important functions at even greater risk. Polluted, nutrient-rich waters produce significantly more of the harmful climate gases methane and carbon dioxide. These negative consequences must therefore be increasingly counteracted by taking sustainable measures, e.g., through better water retention in the landscape.

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