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The role of groundwater-surface water relations in disturbing lake ecosystems: the case of the Rémoray Lake Natural Reserve (Jura, France)

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Abstract

The Lac de Remoray National Natural Reserve was created in 1980. Its purpose is to conserve biodiversity and maintain the state of the natural environment. A wealth of biological diversity is found in the wetlands around Lac de Remoray. The trophic and acidity gradients result in a high mesological diversity and, consequently, a large number of remarkable or protected species. Conservation management is now implemented using three tools: no intervention, extensive grazing, and late mowing. Despite this management approach, the lake's water quality has deteriorated in recent years. One of the findings is that the proliferation of decomposers is suffocating Lake Remoray. This is linked to the excess of organic matter and nitrogen from the agricultural land in the catchment area. Studies have been carried out to identify the origin of these transfers. These have focused on the main tributaries of the lake, without taking into account the geological context of the area and the contribution of groundwater to the contamination. From a more general point of view, there is currently no definition of the hydro-geological basin of Lake Remoray. However, the lake is in a karstic context, which implies that there are numerous underground circulation systems, which allow the communication of sometimes distant hydrographic networks. Knowledge of the hydrogeological boundaries should allow other, more distant sources of pollution to be taken into account. This study aims to assess the potential for groundwater transfer from a small catchment located to the west of the catchment and separated from it by a regional fault (the Mouthe Fault). The Mouthe Fault is considered to be a barrier to water transfer. To propose a new delimitation of the hydrogeological basin of Lake Remoray, this work proposes a multidisciplinary approach to the characterization of flows. For this purpose, all water bodies (surface water and groundwater) have been mapped and then characterized through hydrological balances at two scales: topographic basin and hydrogeological basin. These balances indicate the presence of inputs from outside the topographic basin as well as exchanges between the different systems. This is consistent with the karst context of the study area. The hydrological behavior of the lake's two main tributaries (the Drésine and the Lhaut) also varies according to the hydrological regime, as shown by the flowmeter study carried out at high and low water levels. Similarly, the study of geological structures is an indication of the fact that certain connections are only possible during periods of high

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water. Finally, the characterization of the physicochemical signatures of the groundwater has revealed three characteristic signatures of the Cretaceous and Jurassic aquifers. The Jurassic signature influences the Cretaceous signature. Finally, a joint study of the flow rates, the structural arrangements (geology), and the physico-chemical characteristics of these waters has identified a contribution coming from the closed basin to the west of the Mouthe fault. This link will be subject to verification using artificial tracing.

Keywords: quality of water surface, contaminant, groundwater, surface water links, multidisciplinary approach