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Exploring nature based strategies in upland landscapes for managing low flows and stream temperatures

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In most cases, extreme weather events are predicted to occur more frequently under future climate projections. Linked to this and warming trends, there is a risk of elevated stream temperatures, particularly during low flows. Such prolonged low flows and increased water temperatures pose water availability threats to the natural functioning of ecosystems and downstream water use. In humid northern environments, Nature Based Solutions (NBS) such as ponds or wetlands for infiltration, or tree planting inducing shading for temperature mitigation are increasingly explored for environmental risk protection (mainly against flooding and diffuse pollution). However relatively little research has been conducted on the potential for NBS in the context of low flows and water temperature.

This project aims to address these knowledge gaps and explore how NBS can affect hydrological processes relating to water availability and temperature. For an upland catchment (0.9km2) in Scotland which supplies the distilling industry with process and cooling water, we (i) assess catchment flow paths and associated water temperatures within a regional context, and (ii) explore where and when NBS might be most appropriate. We combine historical temperature and flow data with a dense monitoring network, which also includes stable water isotopes and water quality parameters as tracers to understand surface and sub-surface hydrological functioning.

Preliminary results show spatial variation in water source areas and temperatures. This indicates differences in the origins and ages of the water which relate to the influence of catchment geology, soil types and land use. This suggests that the efficacy of NBS will be spatially variable and highlights the importance of obtaining an in-depth understanding of the relevant flow paths and catchment functioning as an evidence base to guide site selection for NBS. Future work will assess the temporal variability of water transport and include scenarios of future pressures on the catchment. Eventually, this project will contribute to increase efficacy of NBS, improving the potential to reduce water temperatures and increase supply in times of drought thereby potentially providing future resilience to ecosystems and dependent industries.