

ENVIRONMENTAL FLOWS FOR BALANCING RIVER HEALTH AND AQUATIC BIODIVERSITY IN THE HIMALAYA

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CHALLENGE

Rivers are crucial components of a landscape, providing habitats for wildlife and a means of socio-economic development for the region. In Nepal, rivers are relatively free from large infrastructural development, but small-scale water resource development projects are abundant in many of the headwaters of the Mahakali and Karnali River Basins. Headwaters have been modified for local activities like irrigation, water mill operation and micro-hydropower development, leading to changes in freshwater community structure in downstream sections of the rivers (see photos). The ecological consequences are huge, but the lack of detailed studies on river biota does makes it difficult to quantify the effects. For this study, we employed benthic macroinvertebrates as biological indicators for quantifying the amount of water required for balanced river ecosystems and water use.



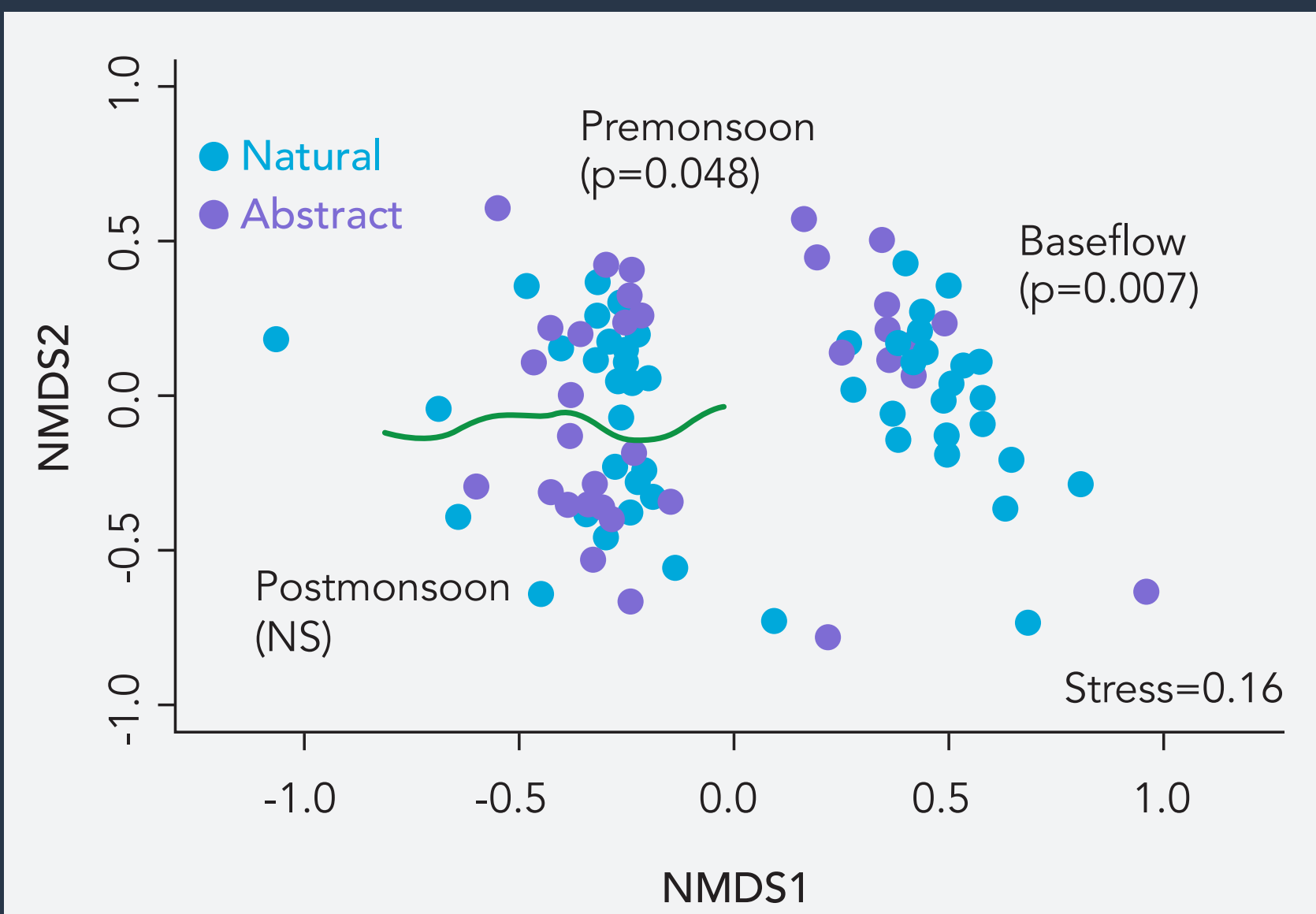
Water abstraction to operate micro-hydropower in Bauli Gaad, Bajura District.



Downstream of water abstraction in Bauli Gaad, Bajura District.

INSIGHTS AND INNOVATIONS

We observed seasonal variation in water abstraction. In the driest season, over 90% of river water was abstracted for operating water mills and irrigation. The impact of water abstraction was significant for the driest season of the year. This study also determined that abundance was a more sensitive biotic metric compared to richness and that among other rheophiles, such as Trichoptera, abundance declined significantly with increased water abstraction. Similarly, we found that over 80% of the water abstraction during the driest season has negative impacts on benthic macroinvertebrates in the headwaters of the western river systems (see figure). At least 20% of the natural river discharge downstream from a water diversion project (termed “environmental flows”) is required to maintain river health and aquatic biodiversity.



Clustering of sites across seasons and between natural and water-abstracted sites for baseflow and pre-monsoon seasons.

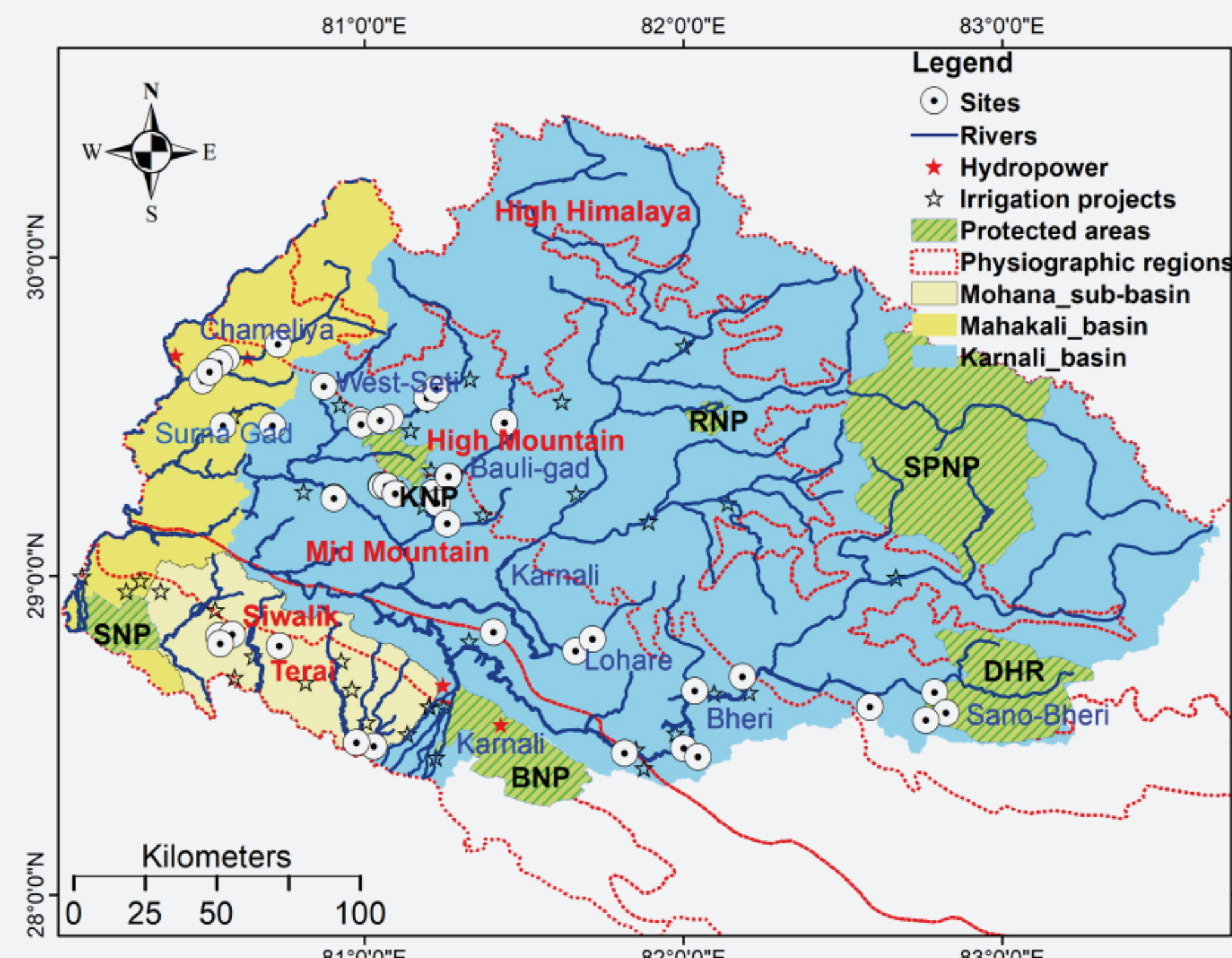
NEXT STEPS

It is important to extend this research in main stems of the major river systems across the country to determine the impacts of large-scale water resource development on river health and aquatic biodiversity.

RESEARCH APPROACH

A total of 1,270 benthic macroinvertebrate samples pertaining to habitat, water depth and water velocity were collected from natural and disturbed sites along a 50- to 100-meter stretch of river in the headwaters of the Mahakali, Karnali and Mohana River Basins for the years 2016 and 2017 (see map and photo). Benthic

macroinvertebrates were sorted, identified and counted to the genus and family level. The data were then subjected to multivariate analysis to determine the impact of water abstractions seasonally. Various biological metrics were used to identify sensitive indicators for different water abstraction categories.



Distribution of sampling sites in the headwaters of the Mahakali, Karnali and Mohana Basins in western Nepal.



Sampling of benthic macroinvertebrates in a 50- to 100-meter stretch of river.