Biotic alteration of benthic macroinvertebrate communities based on multispatial-scale environmental variables in a regulated river system of Kashmir Himalaya

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ABSTRACT: The Run-of-River (RoR) hydropower projects change the natural flow regime and impact the ecology of the river ecosystem. Assumptions of eco-friendliness surrounding RoR hydropower plants have been rarely tested. Keeping this knowledge gap in view, the present study was undertaken to understand the impact of ROR power plants on the macroinvertebrate assemblages in the Sindh River Basin of Kashmir Himalaya. Multivariate statistical techniques were employed to understand the relationship between dynamic patterns and variability in diversity (Alpha and Beta), abundance and pattern of macroinvertebrate assemblages and environmental factors. Non-metric multidimensional ordination plot (Bray Curtis index) revealed that taxa composition differed among sites, and to a lesser extent among seasons. β-diversity evaluation at spatial scale revealed a significant difference between sites based on abundance data, but the difference was pronounced using presence-absence data. Betadisper and Adonis's test indicated that the sites are homogeneously dispersed (distance to centroid) about taxa studied while having significantly different compositions. Alpha-diversity metrics (Shannon) along the gradient of Sindh River, is largely explained by the variations in substrate types and Total Solids (TS) while the variance in macroinvertebrate assemblage (beta diversity) to a large extent is explained by altitude (alt), discharge, and medium-large cobbles (MLC) throughout the study area. Based on relative abundance (%), the upper turbulent and unregulated sites (S1 to S6) characterized by cobble and gravel were found dominated by Deuterophlebiidae, Tipulidae**,** and Blephariceridae while Simulidae, Gammaridae, and Chironomidae had a greater preference for lower sites. The hydrological modifications resulting from RoR hydropower plants showed clear impact on beta-diversity and other macroinvertebrate assemblage patterns at regulated stretch (S7 and S8) and downstream reaches. Furthermore, Bray-Curtis and Jaccard's metrics results demonstrated that sites in the regulated stretch (S7 and S8) have higher similarity in terms of macroinvertebrate diversity and abundance. Regulated (S7 and S8) and downstream site had higher percentage of collector functional feeding group compared to the other sites. The present study provides valuable information on the effects of environmental factors and river regulation on macroinvertebrates assemblage patterns critical for effective management and restoration of river ecosystems.

Keywords: Rivers; Macroinvertebrates; River regulation; Run of river hydropower plants; Indian Himalayan Region