

River Assessment using Benthic Macroinvertebrates in the Hindu Kush-Himalaya Region -
Substrate and Current Preferences and Development of an Assessment Method

Abstract

This thesis investigates the ecology of benthic macroinvertebrates inhabiting rivers in the Hindu Kush-Himalaya region, and covered the countries Bangladesh, Bhutan, Nepal, India, and Pakistan. In these countries, river monitoring focuses mainly on physical and chemical parameters, pollutants, and other human toxic substances. Only in parts of India and Nepal biological monitoring is applied using the ASPT (Armitage et al. 1983) adapted to the indigenous rivers. In none of the countries exists a comprehensive assessment method to evaluate rivers as ecosystems, which are mainly ruled by various anthropogenic influences. In addition, the knowledge of benthic macroinvertebrates for biological monitoring purposes is still incomplete. On this perceived need, two objectives become central issues of this thesis.

1. The thesis introduces an approach to obtain information about substrate and current preferences of benthic invertebrates for river assessment in regions where knowledge is scarce. A substrate specific sampling of 271 reference sites was conducted located in the lower mountains and the lowland areas. Statistical data analysis revealed significant substrate and current preferences for 50 taxa of Ephemeroptera, Plecoptera, Trichoptera, Coleoptera, Diptera, Odonata, Mollusca, and Oligochaeta. On basis on the preferences four metrics were developed. The metric Lithal comprises 34 taxa with significant preferences for stony substrates (fine gravel size to bedrock size). Metric Lithophil contains 21 taxa with strong linkage to stones but also found at other substrates. Metric Lithobiont consists of 13 taxa exclusively found at stones. Metric Lotic consists of 11 taxa with significant preferences for moderate to faster current velocities. From these four metrics Lithal, Lithophil and Lotic are able to detect the impact of hydromorphological degradation. A 20 point system was developed to allocate scores for substrate and current preferences of taxa. Seven taxa of Ephemeroptera and Trichoptera reveal low ecological potential to habitat alteration.

2. An assessment system was developed based on benthic invertebrates. 198 sites, located in 5 different ecoregions and covering degradation gradients, were sampled twice (pre-monsoon and post-monsoon) applying a multi-habitat sampling procedure. Out of 38 environmental parameters we constructed complex PCA gradients, separately for the stressors organic pollution, eutrophication, floodplain land-use and hydromorphological degradation. Correlation analysis between invertebrate metrics and environmental parameters revealed candidate metrics, which are most responsive to river deterioration and from which redundant metrics were deleted and robust metrics were selected. The range of the index under reference conditions was defined and a 5-class river quality system was generated.