

## EVALUATING FISH COMMUNITY COMPOSITION IN A SEMIARID AQUATIC SYSTEM, A MODEL-BASED APPROACH



*Mojgan ZARE SHAHRAKI\** and *Thomas MEHNER \**

\* Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Germany, [mojgan.zare.shahraki@igb-berlin.de](mailto:mojgan.zare.shahraki@igb-berlin.de) and [Thomas.mehner@igb-berlin.de](mailto:Thomas.mehner@igb-berlin.de)

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### **Abstract**

Understanding the factors that influence biodiversity and species distributions is a central question in ecology, particularly within community ecology, which focuses on the interactions between species and the processes shaping community composition. Ecological communities serve as indicators of broader impacts, such as habitat fragmentation and climate change. Knowledge of current community composition and its abiotic correlates is crucial for predicting future ecological scenarios. Among aquatic organisms, fish communities, recognized as sensitive keystone indicators of environmental degradation, provide critical insights into overall ecosystem health.

This study investigates how fish species in the Karun River Basin respond to environmental predictors along a gradient from upstream to downstream sites using Generalized Linear Latent Variable Models (GLLVMs). The Karun River Basin, a heavily regulated river system located in a semiarid region in the Middle East characterized by its diverse climates, provides a unique opportunity to understand the composition of fish communities in response to the longitudinal climate-related zonation. By modeling fish abundance and environmental data collected from 108 sites during the summers of 2019 and 2023, the study evaluates how different species respond to varying environmental predictors and illustrates the patterns of co-occurrences and interactions among species.

The model identified temperature as the most significant environmental predictor, with alien species responding positively to higher temperatures, suggesting potential shifts in their distribution due to climate change. In contrast, endemic species responded negatively to temperature increases, reflecting their vulnerability. Additionally, the species-specific model coefficients for total nitrogen concentration and average precipitation were often negative, indicating potential threats from nutrient enrichment and changing precipitation patterns. The model explained 62% of the variability in the data and also effectively captured bivariate correlations among fish species, revealing responses to environmental predictors and potentially significant positive and negative interactions that shape community structures.

This research established a baseline of current fish community structures in the Karun River Basin, providing valuable insights for predicting future ecological shifts under different climatic scenarios. The study contributes to broader concepts of diversity and distribution patterns in semiarid river ecosystems, enhancing our understanding of how environmental factors shape biodiversity in complex and rarely studied landscapes.