

**BIOLOGICAL DIVERSITY OF FRESHWATER FISHES  
IN SMALL STREAMS IN PENINSULAR MALAYSIA**

**Ph.D. thesis**

**Amirrudin Bin Ahmad**

**UNIVERSITY OF ST ANDREWS**

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## Abstract

Peninsular Malaysia has a diverse flora and fauna, much of which is yet to be documented. The freshwater fishes are one important group that have received little attention. Accordingly, the overarching goal of my study is to investigate the pattern of species richness and analyse the community composition and assemblage structure of fishes in the small streams in Peninsular Malaysia. Small stream habitats appeared to be particularly important repositories of fish biodiversity in this region thus obtaining a reliable census of species occurring in such habitats is critical for conservation and management of biodiversity. Although samplings were far from completed, these habitats support a great variety of species with more than 100 species were recorded from fifty streams sampled in this study. A few are extremely rare with restricted distribution and can thus be considered important in biodiversity conservation of the Peninsular Malaysian ichthyofauna. Human-influenced modification of lowland, headwater stream habitats in Peninsular Malaysia is common and often exemplified by the creation of pools in stretches of rapids and riffles. However, it was not possible to separate pristine and disturbed sites which contained almost identical for species diversity. These findings suggest that local habitat modification does not necessarily cause a decrease in freshwater fish diversity, with only minor negative consequences for other community variables recorded in this study, and therefore raise interesting issues regarding conservation. That said it remains premature to conclude that small stream fishes are insensitive to disturbance and thus their potential utility as bioindicators of disturbance-influenced community changes remain to be confirmed. The maintenance practises being applied to small streams modified for recreational usage were not imposing detectable negative consequences, at least across the sites sampled in this study. The rich diversity of tropical stream environments is the result of both within-habitat (alpha) diversity and between-habitat (beta) diversity. The results showed that there was substantial beta diversity particularly amongst sites that are geographically separated from one another. On the contrary, the lowest beta diversity values were portrayed by contiguous sites. Many fishes exhibited discontinuous patterns of distribution and were considered to be rare while only a handful were widely distributed and abundant. Ordination based on the relative resemblance of fish communities to one another support the existence of two distinct ichthyogeographic divisions in Peninsular Malaysia. It was possible to assign the species recorded to all seven of Rabinowitz's categories of rarity, with at least 10 restricted to a single stream and locally scarce, although not all of these could be described as hyper-endemic. It is recommended that a sizeable augmentation of the existing protected areas is needed to safeguard Malaysia's exceptionally diverse stream-dwelling fauna of which fishes are simply the most well-known inhabitants. Conservation managers should therefore place particular emphasis on small streams since localities in close proximity to one another can exhibit surprisingly high beta diversity, meaning that partial or small-scale habitat protection may prove insufficient.