Relating Environmental Factors to Fish Diversity Index by Using Soft Computing Techniques and Sensitivity Analysis

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Due to the limitation of geographical environment and the extreme climatic conditions in Taiwan, rivers flow into oceans very fast and water resources management is a challenging task. Moreover, the high intensity and short duration of typhoons and the uneven temporal and spatial distribution of rainfall would cause significant impacts on river ecosystems. Because rationality and integrity is essential for making sustainable water resources planning, the Taiwan Ecohydrology Indicator System (TEIS) is regarded as an important guiding reference for sustainable water resources management, which confines water resources development subject to environmental load. In river systems, water quality and flow regimes closely relate to each other and affect river ecosystems simultaneously. Therefore, this study explores the complex impacts of water quality and flow regime on fish communities in order to comprehend the situations of the eco-hydrological system in a river basin. Then, we build up an estimation model for extracting the relationship among each other for finding out a way to improve the river ecosystem and promote the capacity of water resources management. The Tamsui River is chosen as the study area, which has long-term observational data through field investigation. The relationships among the water quality, the flow regime and the fish diversity index of the river are first constructed by using both statistical methods and the clustering analysis method (i.e. Self-Organizing Map). Then the fish diversity index is estimated by using the Adaptive Network-Based Fuzzy Inference System (ANFIS) based on key factors determined by the Gamma Test (GT), which is a powerful tool for reducing model complexity. Moreover, several scenarios are set with sensitivity analyses to explore the strength of the links among all the factors. Expecting to keep abreast of variation of the river ecosystem, this study can provide valuable results as a guiding reference for planning sustainable water resources management and maintaining the development of ecosystem.