AOGS 2005


**SESSION:** Ecohydrological perspectives for ecosystem conservation and restoration (HS07)
**Presentation:** Poster

# Evaluation of Habitat Conditions and Optimum Flow for the Freshwater Fish in the Dalcheon River, Korea

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Water supply, hydroelectric generation, and other activities leads to a conflict between instream and offstream water use and the suitable flow required for the preservation and maintenance of stream aquatic habitat. To protect and preserve aquatic fish habitat, assurance of adequate flow regimes is important.

This study estimates the hydraulic and water-quality conditions using a physical habitat simulation method and establishes an estimation method for optimum flow to protect and preserve fish habitat. A habitat-based approach known as the Instream Flow Incremental Methodology (IFIM) and a specific model known as the Physical HABitat SIMulation system (PHABSIM) are applied to simulate the fish habitat.

Steady and gradually varied flow is simulated at both microhabitat hydraulic conditions (i.e., water depth, velocity, and substrate) and macrohabitat water-quality conditions (i.e., water temperature and dissolved oxygen). Riffle habitat in rivers, in general, becomes more sensitive to flow variation during low flow conditions. Habitat suitability criteria (or index) for each life stage is made by applying existing fish-habitat surveys and professional opinions about fish habitat conditions. The optimum flow for each life stage of each target species is estimated using simulated weighted usable area (WUA)-flow relations. To investigate the relationship between optimum flow and low flow, the monthly optimum flow during critical period indicated by the habitat time series is graphically compared to the yearly and monthly low flow.

The physical habitat simulation system was applied to the three riffles in the mainstream of Dalcheon River, Han River, Korea. Two target species were selected: the Pirami (*Zacco platypus*), a riffle-dependent and dominant species in population, and the Mungnapcharu (*Acheilognathus signifer*), a swimming species designated as endangered in the Dalcheon by the Ministry of Environment. By using detailed surveys of channel geometric and hydraulic parameters, the generation of a relatively explicit model of the microhabitat is possible using one-dimensional gradually

varied flow in the HEC-RAS program. Also, the calibrated and verified QUAL2E-UNCAS model can predict accurate macrohabitat conditions based on flow direction. By using the hydraulic and water-quality habitat requirements of the selected fish species, habitat suitability criteria can be made indirectly using the trapezoidal binary format.

By applying the physical habitat simulation processes of the IFIM, the optimum flow of the three riffles for each life stage can be estimated by maintaining the hydrological river continuum concept. Considering the currently existing suitable water quality conditions for fish survival, the optimum flow was dependent on microhabitat hydraulic conditions rather than macrohabitat water-quality conditions. The monthly optimum flow for maintaining Pirami and Mungnapcharu's habitat closely approximates the 7-day 2.3-year low flow for each month in the Dalcheon mainstream. It was shown that the monthly optimum flow for Pirami ranges from 60% to 130% and for Mungnapcharu ranges from 80% to 180% of the 7-day 2.3-year low flow at the three riffles.

Keywords: Instream flow; Fish habitat; IFIM; PHABSIM; Habitat suitability criteria; Habitat time series; Optimum flow; Low flow

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