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Maintaining functional connectivity is essential for reducing negative effects of climate change on endangered species

qing deng and xinhua zhang
water resource&hydropower,Sichuan university,Chengdu, China (912186918@qq.com)

Maintaining riverine habitat connectivity for important ecological processes like fish reproduction is essential for conserving endangered migratory species in regulated river. The unique reproductive behavior of migratory fish, which has a potential effect on habitat connectivity assessment, is the key for the success of population restoration in a changing climate conditions. However, existing analytic connectivity models mostly focus on broad-scale terrestrial studies tested with landscape features and large-scale riverine hydrological cases, they are not able to describe aquatic micro-habitat connectivity and cannot incorporate effects of multiple pathways linking spawning function areas with altered hydrological conditions. Here, we developed an ecological functional connectivity model that overcame these obstacles by borrowing from electrical circuit theory and highlighting functional attributes of habitat patches. It was the first time for circuit theory to apply in water ecosystem environment for habitat protection and population rebuilding. In this model, a function path tree restricted to patch connectivity constraints was first proposed for micro-habitat connectivity index. The model greatly improves aquatic habitat suitability predictions because it incorporates patch function attributes to account for habitat status and simultaneously integrates all possible pathways connecting spawning function areas for a more reliable connectivity assessment. When applied to data from Chinese sturgeon (a well-known endangered anadromous fish) in the Yangtze River, our model outperformed conventional aquatic habitat models, revealing that the low functional connectivity in spawning function areas, especially between dispersal area and incubation area, was a limiting factor for Chinese sturgeon reproduction. Results also demonstrated that contributions of global warming on increasing stream temperature intensified spawning habitat fragmentation, which would further hampered fish breeding activities. The proposed model is transferrable to fish species with different life histories, and holds much promise in habitat restoration, river management and conservation planning to reduce future ecological impacts of climate change.