Safeguarding Migratory Fish via Optimal Planning of Future Small Hydropower in Brazil

Abstract: Large-scale electricity policies that embrace renewable resources have led to continued investments in hydropower. Despite evolving viewpoints regarding the sustainability of large hydropower installations, there has been a major increase in support for the widespread development of small hydropower plants (SHPs) – smaller dams designed to operate in small to mid-size rivers that generate less energy. Currently, 82,891 SHPs are operating or are under construction worldwide (11 SHPs for every one large hydropower plant - LHP), and this number is estimated to triple if all potential generation capacity were to be developed. This global proliferation of SHPs represents an important cumulative threat to blocking migratory fish and the important fisheries they sustain, which has been underappreciated in environmental policies and regulations when compared to LHPs. Using Brazil as a case study, my collaborators and I quantified the trade-offs between hydroelectric generation capacity and impacts on river connectivity in light of thousands of current and projected-future dams across the country. We found that SHPs are the main source of river fragmentation, resulting in average connectivity losses fourfold greater than LHPs. Fragmentation by SHPs is projected to increase by 21% in the future, and two-thirds of the 191 migratory species assessed occupy basins that will experience greater losses of connectivity by SHPs than LHPs. Multi-objective optimization identified optimal future dam portfolios that halve the number of hydropower plants required to deliver the same generation capacity compared to least-favorable solutions, while simultaneously resulting in lower river fragmentation and protecting numerous undammed basins. Our results highlight the need for strategic planning that consider the unprecedented growth and cumulative effects of SHPs globally.

Featuring

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