Executive Summary

D1.3 Fish Population Hazard Index

Aim

Assessing the impact of hydropower plants (HPP's) on different fish species and communities is a key-component supporting decisions during the commission process and operation of hydropower plants. Therefore, work package 1 "Fish population development in hydropower affected environments" aimed to develop a Fish Population Hazard Index as a decision and management tool for environmental impact assessment of hydropower plants. The index should allow for risk assessment while considering site-specific effects of single hydropower plants, fish species sensitivity against mortality as well as overarching environmental and societal development targets for the respective water body.

Methods

These different tasks have been conceptualized as three distinct components: the biological resilience of species, the operation-related impacts and the site- or group-specific impacts of hydropower. Here we address the site-specific impact of a HPP and combine species' sensi-tivity against mortality (D1.1, van Treeck et al. 2017) and species at risk (D1.2, Wolter et al. 2018) with site-specific water body, habitat and project parameters as well as mitigation measures to the Fish Population Hazard Index as an assessment tool.

This tool serves as the first step – environmental risk assessment – in the Decision Support System (DSS) of FIThydro (D5.4). We identified and assessed eight aspects that affect fish health and that can be used as surrogates for relevant hazards in the context of hydropower installations:

1. Type of the plant
2. Height of the barrier/dam
3. Installed to average discharge ratio
4. Type of the installed turbines
5. Blade strike rates of Kaplan and Francis turbines
6. Mode of operation
7. Availability of an upstream migration facility
8. Installed fish protection facilities for downstream migration

Because of the extremely high variability of construction details, spatial arrangements, modes of operation and their various interaction effects on risks for fishes paired with rather limited availability of empirical data, it was impossible to derive accurate quantitative models for reliable risk assessments. Therefore, the assessment approach suggested here uses ordinal, categorical scores of high, moderate and low risks according to typical impact thresholds obtained from the available data. We individually scored and offset the hazards with the species-specific sensitivity (D1.1, van Treeck et al. 2017), conservation concern and guild-specific considerations and averaged them across a representative sample of fishes that are native to the respective river. For that, we made use of the knowledge produced for D1.2 (Wolter et al. 2018). The resulting

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 727830.

hazard score determines an unmitigated hazard of low, moderate and high risk, associated with decimal values of 0-0.2, >0.2-0.6 and >0.6-1, respectively.

Further, a set of both technical and operational mitigation measures were identified that we integrated into the index. These measures include design and configuration of a fine screen, a downstream bypass and adjusting the operational regime in a more fish-friendly manner. By implementing mitigation measures the score can be incrementally lowered by 0.1 to a maximum of 0.3 points, which permits shifts to an overall lower hazard class.

However, the effectiveness of mitigation measures is particularly dependent on the quality of implementation. This can cause mitigation measures to either work as advertised, work only to some extent or not work at all. During the compilation and scoring process of the relevant parameters we therefore always assumed the implemented measures to be fully operational and a non-fully operational measure is to score like a non-existent one.

Results

The Fish Population Hazard Index is operational and delivers sensible results within real-world application thresholds. The Excel-based tool “Fish Population Hazard Index” (Appendix 1) and a technical user guide (Appendix 2) are available for download at the page https://www.fithydro.eu/fphi/.

Conclusions

The Fish Population Hazard Index allows environmental impact assessment of existing and planned HPPs. It also serves the cumulative impact assessment (D1.4) by providing the potential risk for fish for consecutive HPPs. The Index is further considered as the first step in a Decision Support System to assess the potential mitigation needs.

Full deliverable download

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