

BI-O-RHÔNE: KNOWLEDGE OF SEASONAL AND INTER-ANNUAL FISH DENSITY VARIATIONS IN THE LIGHT OF SEDIMENT MANAGEMENT OPERATIONS ON THE SWISS AND FRENCH UPPER-RHÔNE RIVER

Bi-O-Rhône : Connaissance de la densité piscicole et de ses variations intra- et interannuelles dans le cadre des opérations de gestion sédimentaire du Haut-Rhône en Suisse et en France

Why the INTERREG 'Bi-O-Rhône' project?

- On the Upper-Rhône, dams are periodically operated to clear out the excessive load of fine sediment which deposits in the Swiss Verbois reservoir (Fig. 1).
 - Management operations include drawdown flushings, dredgings, and dam gates opening during floods.
- Ecological impacts of such operations are to be evaluated
 - Reservoirs are artificial waterbodies sheltering a typical biodiversity (e.g. birds, fish, beaver...)
- Fish assemblage composition and structure in reservoirs are poorly known, mostly because of sampling limitations
 - Sampling methods so far used are partial, selective, and invasive (e.g. electric fishing along banks, gillnets)

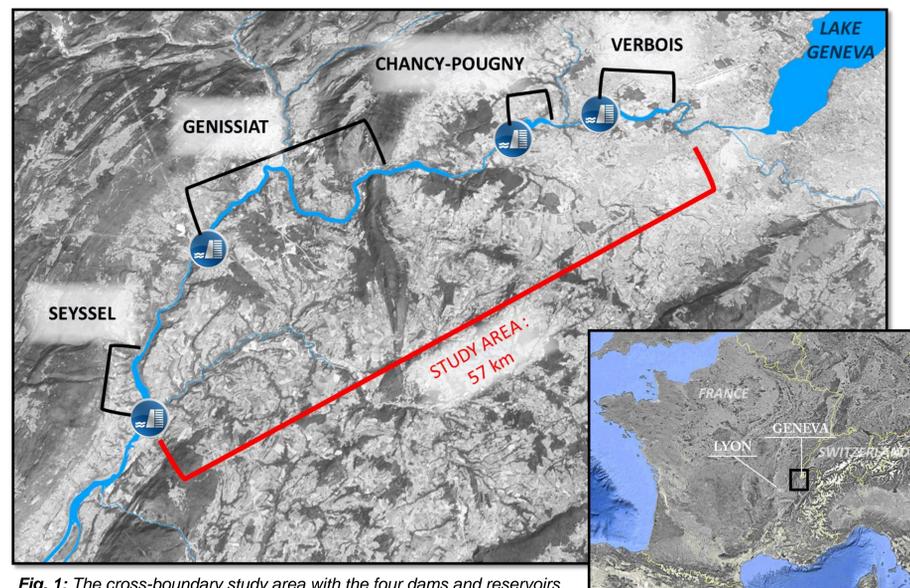


Fig. 1: The cross-boundary study area with the four dams and reservoirs.

Main objective

- To set up a global and non-invasive fish sampling methodology for reservoirs, based on hydroacoustics and eDNA:
 - Allowing both a quantitative and qualitative picture of the fish assemblage;
 - Sensitive enough to reflect potential impacts of sediment management operations, irrespective of other sources of variation.

Methodological developments

- Hydroacoustics
 - Suitable to monitor impacts of drawdown flushings (Grimardias *et al.* 2017)^a, but may be further optimized...
 - Accounting for the surface layer by use of a horizontal transducer in addition to the vertical one
 - Test in reservoirs of an autonomous aquatic drone (HARLE ©) equipped with a 120 KHz echosounder, and comparison with sampling by boat
- Both hydroacoustics and eDNA
 - Comparison / calibration with other sampling methods, e.g. gillnets, electric fishing, videocounting in fishways
 - Determination of adequate sampling frequency and timing to best capture the natural variability of fish assemblages
 - Combination of the strenghts of both methods to qualitatively and quantitatively characterize fish assemblages
- eDNA
 - Reliable to describe longitudinal fish assemblage patterns in a large river such as the Rhône river (Pont *et al.*, in press)^b but must be tested at a more precise scale in large reservoirs
 - Test of the influence on the results of DNA from tributaries and from upstream the reservoirs



Fig. 2: eDNA sampling and analysis

^a Grimardias, D., Guillard, J., Cattaneo, F. (2017). Drawdown flushing of a hydroelectric reservoir on the Rhône River: impacts on the fish community and implications for the sediment management. *Journal of Environmental Management*, 197: 239-249.

^b Pont D., Rocle M., Valentini A., Civade R., Jean P., Maire A., Roset N., Schabuss M., Zornig H., Dejean T. (in press). Environmental DNA reveals quantitative patterns of fish biodiversity in large rivers despite its downstream transportation. *Scientific Reports*.



In sum... what is Bi-O-Rhône?

- A cross-boundary project for an improved ecological monitoring of the Upper-Rhône River
 - The Rhône is a shared French-Swiss water resource, its management should be collaborative between both countries
- A piece of the puzzle toward a more sustainable strategy to manage fine sediment, with preservation of fish assemblages
 - Impacts assessment compulsory to help improve sediment management strategy, and to mitigate future ecological impacts
- A multiple stakeholder project, where hydroelectric operators, scientists, and water managers work in close partnership

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