RIVEAL PROJECT

RIPARIAN FOREST VALUES AND ECOSYSTEM SERVICES – RIVER REGULATION EFFECTS ON THE FLUVIAL HABITAT

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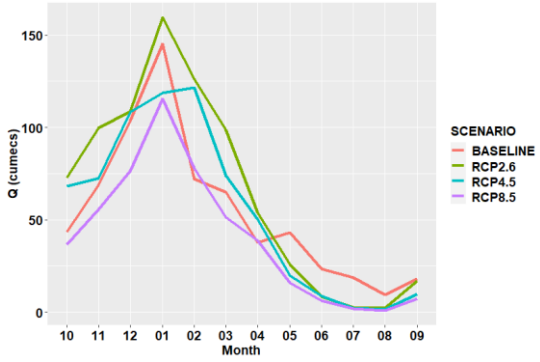
HABITAT DEGRADATION

One of the major threats to freshwater ecosystems. River flow modifications from the natural river flow pattern change the interactions between river flow and channel morphology. This defines different hydraulic conditions resulting in amendments of the biological assemblages, which are proportional to the flow regime detour from natural conditions.

CLIMATE CHANGE AMPLIFICATION

- Climate change will disturb river flows, modifying the hydrologic cycle of river basins, and posing important concerns as an additional interference on ecosystem functions and human well-being.



Mean monthly discharges (Q) of the flow regimes considered for the study site, according to the baseline and climate change RCPs 2.6, 4.5 and 8.5 scenarios (from Rivaes et al., 2022; doi:10.1016/j.scitotenv.2021.151857).

- In regulated rivers, climate change will impose further changes by interfering with hydropower production.

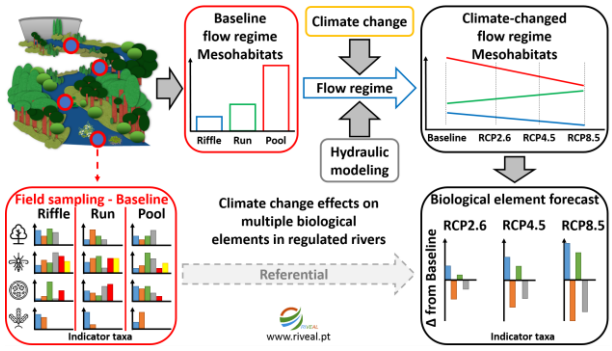
- Dams should experience discharge modifications and performance loss.

Description of the IPCC climate change scenarios considered in the study (from Rivaes et al., 2022; doi:10.1016/j.scitotenv.2021.151857).

Scenario	Radiative forcing	Atmospheric CO_2 (ppm)	Mean temperature increase (°C)	Changes in hydropower production
RCP2.6	2.6 W/m²	480	1.0	NA
RCP4.5	4.5 W/m²	650	1.8	-19%
RCP8.5	8.5 W/m²	1370	3.7	-41%

METHODOLOGY

This work assesses the combined effects of flow regime changes by dam reoperation as a result of climate change and expected hydropower demand alteration in the future.



Workflow of the study to determine the effects of climate change on the aquatic habitat of regulated rivers (from Rivaes et al., 2022; doi:10.1016/j.scitotenv.2021.151857).

MESOHABITAT APPROACH

- Instream habitats can be classified hierarchically according to the area and grouping details, such as macro-, meso- and microhabitats.

- Mesohabitats are:
  - Visually distinctive habitat units;
  - Physically uniform biotopes;
  - Individual habitat units in the river;
  - Area scale between few to tens of square meters.

- One of the most commonly used approaches to study ecohydraulic characteristics of stream reaches. Allows the use of a wide range of habitat variables in biological models to evaluate instream biota composition.

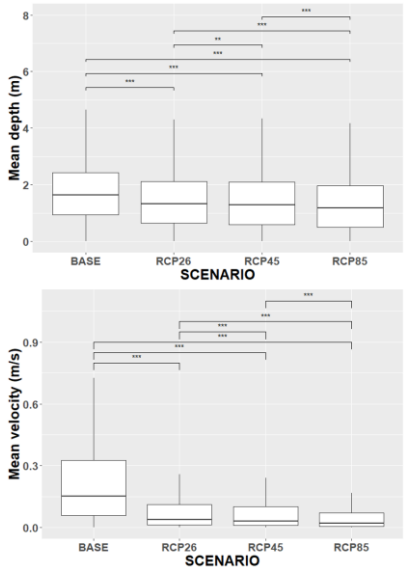
- The physical habitat structure drives the aquatic biota. Thus, assemblages are mesohabitat-specific whereas mesohabitat patches may vary temporally and spatially.

Example of different mesohabitats found in a river stretch.

RIVER HYDRAULICS

- Flow velocity, water depth and river width are the major factors of mesohabitat differentiation.

- The river system hydraulics change for every scenario, with significantly different water depths and mean flow velocities decreasing proportionally with the scenario worsening.



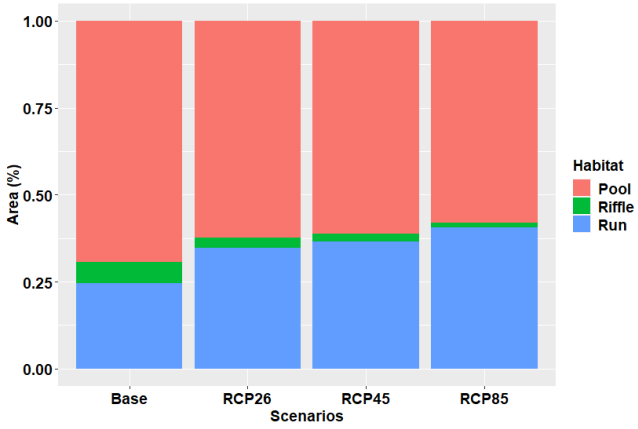
Boxplots of the mean water depths (top) and mean flow velocities (down) expected for the considered flow regime scenarios (adapted from Rivaes et al., 2022; doi:10.1016/j.scitotenv.2021.151857).

MESOHABITAT MODIFICATIONS

- The summer season will always be harsher in terms of water runoff.

- The availability of run habitats is expected to increase while it is expected to decrease for riffle and pool habitats.

- Habitat changes are more evident with increasing severity of the climate change scenarios.



Mesohabitat areas in the modeling stretch according to the flow regime scenarios during the summer months (from Rivaes et al., 2022; doi:10.1016/j.scitotenv.2021.151857).

INSTREAM BIOTA CHANGES

- The indicator taxa used in this study were macroalgae, diatoms, macroinvertebrates and macrophytes.

- Changes in the abundance/cover of indicator taxa can go from mild to drastic according to the severity of the considered climate change scenario.

- Severe modifications are more common regarding decreasing abundance/cover trends of indicator taxa.

- In the worse scenarios, decreases can reach less 80% of the present abundance/cover.

- Vascular macrophytes seem to be the least affected biological group, with cover losses that never reach 20%.

- Diatoms may be the most affected biological group with abundance increases expected to go beyond 40%.

- This study reveals a substantial threat to biodiversity, with the potential loss of species in every biological group.

https://www.riveal.pt

Factsheet elaborated by Rui Rivaes · Francisca Aguiar
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