EEL AND SALMON DOWNSTREAM MIGRATION BEHAVIORS ALONG THE MEUSE RIVER

MACHIELS O.[1] & THEUNISSEN P.[2]

[1] Arcadis, Liege, Belgium,
olivier.machiels@arcadis.com
[2] Luminus, Seraing, Belgium,
pierre.theunissen@edfluminus.be

ABSTRACT

This paper presents an integrative approach to define the migration status of Salmo Salar and Anguilla Anguilla in various scale (work scale, site scale, global scale) according to the results of on-site studies led on the low Belgian Meuse river. According to the stocks repartition fishes are introduced in the model along each reach. The losses along the reaches are than evaluated according the loss percentages observed during the on-site fish tracking. On each site, composed by several structures (dam, sluice, hydropower plant, and/or industrial water intake), the fishes repartition is realized according to the repartition observed in the tracking studies. A correction of these values is also proposed based on the literature to take into account variations of the river discharge. The fish survival related to the turbines is than applied to the part of the stock passing through the plant. This enable to define the part of the stock passing the site safely to the next reach. This approach provides results in terms of fish survival in each structure, on each site, and globally downstream the whole studied area. It also enables to analyze the sensitivity of the global system response function of the expected effectiveness of local solutions for downstream migration such as turbine replacement, predictive models, behavioral barriers and downstream fish passes.

Keywords: Fish passage, hydraulic modelling, hydropower plant, fish attraction

1 INTRODUCTION

Downstream migration of threatened species such as Salmo Salar and Anguilla Anguilla are key for hydropower plant (HPP) manager as well as for river manager. In Belgium, these species are of main importance and dedicated programs (Saumon 2000 and Eel Management Plan for Belgium) have been initiated respectively since 1987 and 2007. Parallel, an European program (Life4Fish) has been recently initiated enabling to develop several solutions to facilitate the downstream passage of salmon smolts and silver eels along 6 hydropower plants of the Meuse River in Belgium.

In order to define the initial status of downstream migration of these two species, on-site studies have been performed. An acoustic fish tracking enabled to define the fish passages along the varied structures (sluices, dams, hydropower plants, fish ways, industrial water intakes) and the indirect mortality along the reaches in between these structures (Sonny et al 2018, Roy et al 2017). An injection/recapture approach has also been planned on 3 sites to characterize the fish survival according to a direct passage through the varied turbine technology present along the studied area (Sonny et al 2018). According to the results of these on-site studies and the stocks repartitions defined in the protection plans of the two species, this paper presents an integrative approach to define the migration status of both species in various scale (work scale, site scale, global scale).

2 GLOBAL MODEL

According to the stocks repartition fishes are introduced in the model along each reach. The losses along the reaches are than evaluated according the loss percentages observed during the on-site fish tracking. On each site, composed by several structures (dam, sluice, hydropower plant, and/or industrial water intake), the fishes repartition is realized according to the repartition observed in the tracking studies. A correction of these values is also proposed based on the literature to take into account variations of the river discharge. The fish survival related to the turbines is than applied to the part of the stock passing through the plant. This enable to define the part of the stock passing the site safely to the next reach. This approach provides results in terms of fish survival in each structure, on each site, and globally downstream the whole studied area. It also enables to analyze the sensitivity of the global system response function of the expected effectiveness of local solutions for downstream migration such as turbine replacement, predictive models, behavioral barriers and downstream fish passes.

3 CONCLUSION (OMA + ULG)

Hydraulic modelling of the two pilots sites has been done using the complementary approaches of numerical and experimental modelling (composite modelling). Results of hydraulic modelling have been used to analyze the correlation between hydraulic parameters and fishes' behavior as well as to design the downstream passages. For both sites, considering constraints on diverted discharge and for the worst case of HPP operation, an optimized geometry of the fish passage intake able to create significant surface currents to the desired direction has been defined using large scale numerical modelling and local physical scale models.

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