**Brook trout passage performance in culverts**

**Elsa Goerig, Theodore Castro-Santos and Normand Bergeron**

1. **Introduction**
   Access to habitat is a fundamental metric of habitat quality. Culverts may act as partial or complete barriers to fish upstream movements, due to specific hydraulic or environmental conditions. Predicting the probability of passage success for a given fish is challenging.

2. **Methodology**
   1093 wild brook trout were tested during field passage trials in 17 culverts located in 3 watersheds of Quebec. Attempts and passage success were monitored with five Passive Integrated Transponders systems (PIT-tags), installed in each culvert (Fig. 1). Hydraulic conditions were measured before the trials, with a current meter.

3. **Model of passage success**
   The probability of successful passage is higher in corrugated culverts than in smooth ones, particularly among smaller fish (Fig. 3, panels A-C). Fish < 175 mm may take advantage of the hydraulic complexity of corrugated culverts to increase their ascent distances (Fig. 4). Passage success increases with water temperature, but this effect diminishes above 15°C (Fig. 2, panel C). Success is lower in culverts with high flow velocities, steep slopes and deep downstream pools (Fig.2, panels A; B).

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**Analysis of brook trout spatial behaviour in a corrugated culvert using near-infrared video recordings**

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1. **OBJECTIVES**
   1. Document spatial behaviour of brook trout individuals while ascending a corrugated (rough) culvert using video recordings and document low flow velocity zones to see if it can promote fish passage success, as seen in a previous study.
   2. Document trout personality, i.e. consistent individual behavioural differences over time and across situations, and test if it can be related to their spatial behaviour while ascending culvert and passage success.

2. **METHODOLOGY**
   Spatial behaviour of brook trout individuals (n=23) while ascending a rough culvert (34 m x 2.2 m) was documented using 12 near-infrared (λ > 850 nm) illuminated video cameras (Fig. 1). Passive integrated transponder (PIT) antennas equally distributed along the culvert allowed individual identification of fish on video images (Fig. 2).

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**CONCLUSIONS AND FUTURE WORK**
To the best of our knowledge, this is the first work that document spatial behaviour of fish along an entire culvert. Those results show that if we give the fish the opportunity, by adding baffles or even smaller rough element, their passage success would probably be higher, reducing culvert impacts on fish daily movements and migration. However, more investigations need to be done to confirm this hypothesis.

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**REFERENCES**

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**Habitat fragmentation of Atlantic salmon (Salmo salar) by road and forest curvurs**

**Rosemarie Gabriel-Pontier** and **Normand Bergeron**

1. **OBJECTIVES OF THE STUDY**
   1. Assess the fragmentation of juvenile Atlantic salmon habitat by culverts in the watersheds of salmon rivers in Quebec (Grande Casapédia in Gaspésie and Sainte-Marguerite in Saguenay) using the Passive Integrated Transponder technology.
   2. Validate and refine the predictive model for upstream passage though culverts developed by Coffman et al. (2009) specifically for juvenile Atlantic salmon using fish movement data and physical characteristics of culverts.
   3. Calculate habitat loss associated with culverts classified as impassable and prioritize construction according to the expected benefits.

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**REFERENCES**

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**FUTURE WORK**
Field work will focus on two variables of interest: the slope and length of culverts. Culverts in the Sainte-Marguerite watershed will be instrumented with fixed antennas and PIT tagged juvenile salmon will be released into a cage attached to the downstream end of the culvert. The antenna system can detect passage attempts of each individual.

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**REFERENCES**