ECOLOGICAL INTERACTIONS BETWEEN JUVENILE TRIPLOID AND DIPLOID ATLANTIC SALMON

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Introduction

A contributing factor to the current decline in wild salmon stocks in the Bay of Fundy may be the growing numbers of aquaculture escapees interacting with wild stocks. The possible mandate for obligatory use of sterile salmon in the aquaculture industry relies on their reduced negative effects, both genetically and behaviorally, on dwindling wild populations in the event of accidental escapement. Juvenile aquaculture salmon are found in rivers via escapement from freshwater hatcheries or as a result of successful spawning from mature aquaculture escapees. The stocking of sterile salmon, such as triploids, would eliminate the possibility of genetic interactions but the potential for behavioral interactions have yet to be investigated. In addition to possibly addressing environmental concerns, sterile salmon have considerable potential in aquaculture. Their growth is entirely somatic therefore energy is not diverted from muscle growth to gonadal development and as a result flesh quality does not deteriorate. Sterile salmon can consequently be marketed at a later time and larger size whereas their diploid counterpart must be harvested prior to sexual maturation.

Induction of triploidy is the most effective method of sterilization. In diploid fish, cells contains two sets of chromosomes whereas triploids retain one extra set of chromosomes found in the polar body of the egg which inherently renders the fish sterile (Cotter et al., 2000). Triploid fish differ from their diploids in three ways; they are more heterozygous, they have larger and fewer cells, and the gonad development is altered (Benfey, 1996). It has been reported that triploids are less aggressive than diploids, which would be a key factor in establishing dominance in feeding territories in competition situations (Cotter et al., 2000). This reduced competitiveness can result in their inability to acquire a feeding territory and subsequently result in forced emigration downstream to less-optimal feeding grounds and possible starvation (Cutts et al., 1999).

Project Description

In this study, behavioral interactions between juvenile diploid and triploid salmon will be examined in semi-natural tanks. An extensive and unique experimental set-up has been established at the Mactaquac Biodiversity Facility (Dept. of Fisheries and Oceans) as part of this project. The four tanks (6.1m long x 1m high x 1m) are subdivided lengthwise with a solid divider and each channel has gravel substrate and a downstream emigration trap (refer to Appendix A). The viewing windows are covered as to not disturb the fish. The tanks receive approximately 946 L/min with temperatures varying between 9° C and 16°C depending on which water source is used (ie. river or well water). Water velocities in the channels can be adjusted to vary between 10-30 cm/sec. Belt feeders are set-up at the head of the channel and will dispense food at dawn and dusk to mimic peak feeding times in the wild. The experimental set-up is very versatile as to accommodate different behavioral studies and increase partnership opportunities with DFO and the university.

The first part of the project is a growth study, which will determine if Saint John River diploids out compete same size triploids for food. This study will be restricted to similar sized individuals to evaluate interploidy differences since larger size has been demonstrated to supersede interspecific competition as a determinant for competitive advantage. The juveniles will inherently compete for the territory with optimal feeding. Feeding success will be monitored using individual specific growth rates (growth rate over time) (Underwood, 1997). In conjunction with the growth study, differences in emigration rate between triploids and diploids from the main channel to the trap will be examined (see figure 1). The trap will remain closed for 5 days to allow for the fish to acclimate to the tanks and begin establishing territories (Sosiak, 1978). Once the trap is open, the fish that cannot establish territories can pass over the spill-gate into the emigration trap.

The two groups, diploids and triploids, will be exposed to four treatments each with duplicates; (1) all diploid control (2N), (2) all triploid control (3N), (3) 50% diploid and 50% triploid, and (4) 25% diploid and 75% triploid. The trap will be emptied daily and the fish will be measured, weighed and sexed. Each trial will last two weeks and naïve fish will be used for each subsequent trial. All fish will be individually marked with non-toxic Visible Implant Elastomers (VEI), minuscule latex paint injections inserted under a thin layer of skin at varying locations on the fish (see figure 1).

(a)

(b)

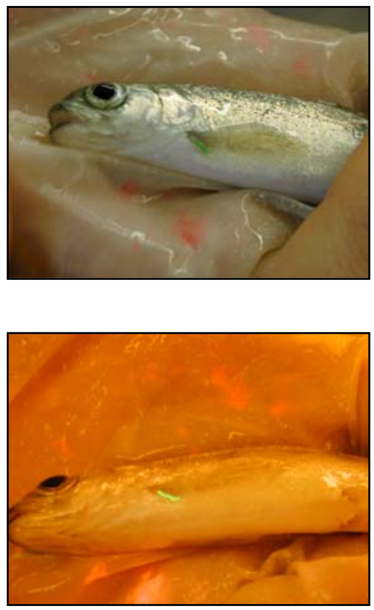

Figure 1- (a) picture of green VIE tag on left pectoral and (b) tag under fluorescent light

Results will be presented from the completed trials and further description of the experimental set-up will be provided. This study will provide new information on triploid salmon behavior in semi-natural tanks, which will provide aid to managers to make decisions on alternatives to diploid aquaculture stocking.

Appendix A

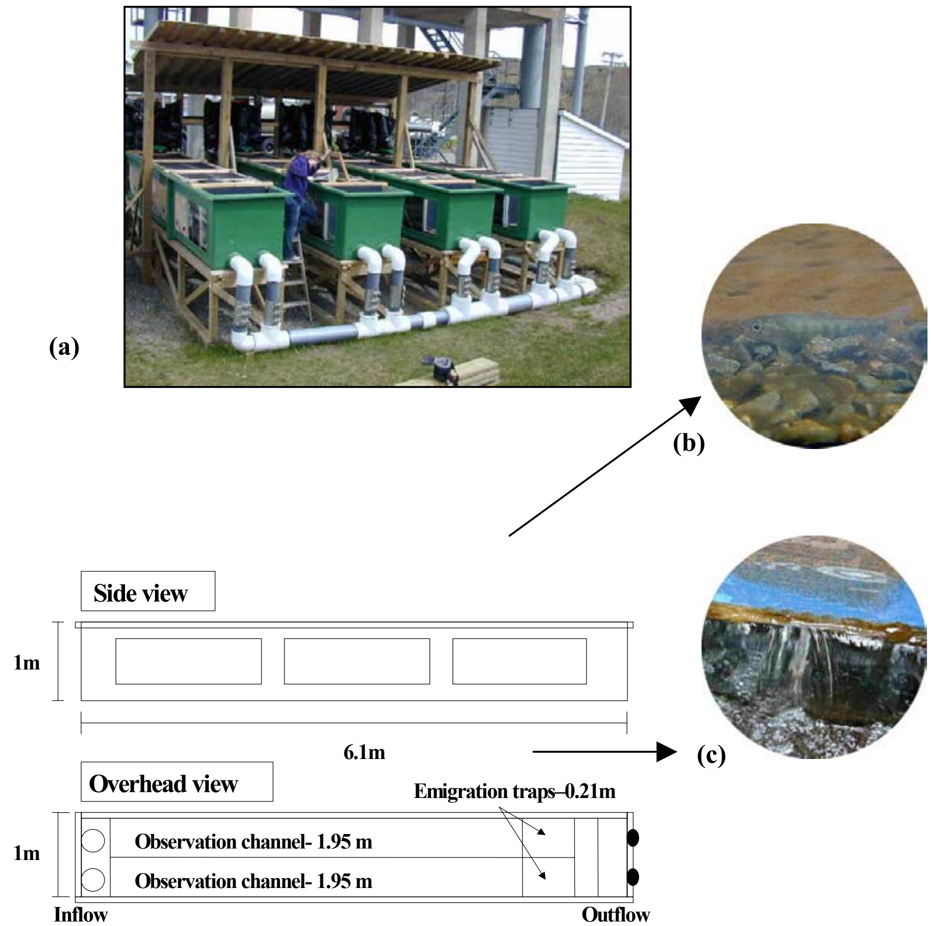

Figure 1: Experimental set-up at the Mactaquac Biodiversity Facility (DFO): (a) Overview of tanks (b) juvenile salmon in channel and (c) salmon going over spill-gate into emigration trap.

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