

**SPATIAL VARIATION IN THE OPPORTUNITY FOR GROWTH  
DURING A POTENTIAL CRITICAL PERIOD:  
IS THERE A LINK TO SURVIVAL FOR AGE-0 ATLANTIC SALMON?**

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**EXTENDED ABSTRACT ONLY - DO NOT CITE**

**Introduction**

Survival during the first 2-9 weeks after stocking or emergence has been proposed to strongly influence year class strength in stream-dwelling salmonids. Differences in survival (usually estimated via loss rates) within a particular stream have been suggested to result from differences in the ability of streams to provide suitable feeding locations during this critical period (Elliott 1989, Armstrong 1997). Previously, we examined survival and growth for age-0 Atlantic salmon in six Vermont, USA streams. We found that the amount of habitat providing positive growth opportunity for Atlantic salmon fry was significantly more limited in the first six weeks after stocking than later in the summer. In addition, differences in overall spring to summer loss rates among these rearing streams could be predicted by the amount of good early season habitat at each site (Nislow et al., 1999, Nislow et al., 2000). These findings were consistent with predictions for the importance of a critical period for survival.

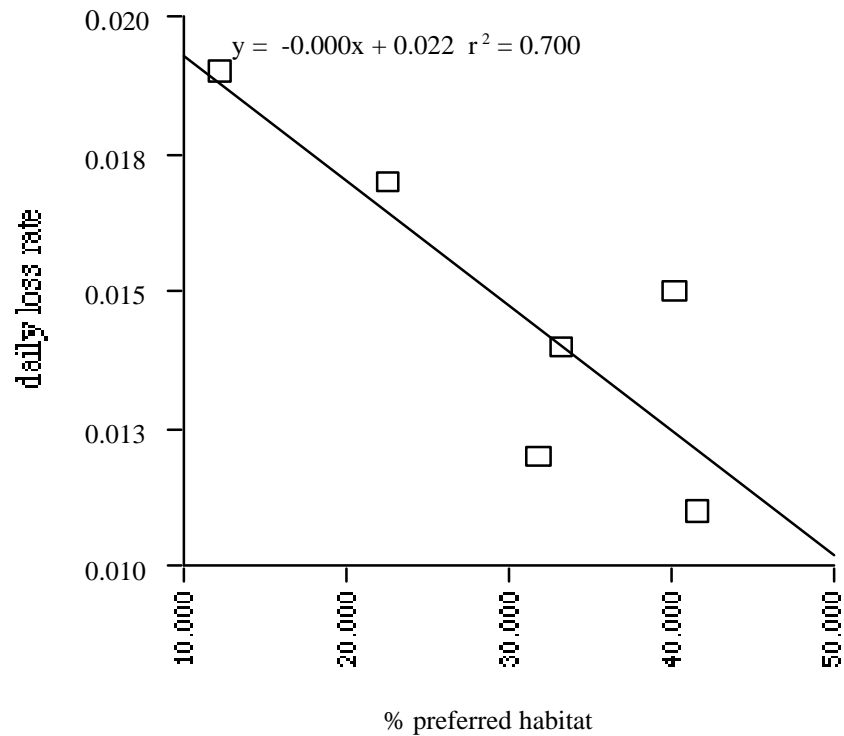
If this hypothesis is true, we would expect to see that sites that have high overall loss rates, and low amounts of high quality early season habitat, would also have high early season loss rates. However, few studies have actually measured loss-rates during this proposed critical period (Elliott, 1985; Bley and Moring, 1988). Furthermore, none have tested the relationship between growth opportunity and loss-rates during a potential critical period. Our objectives were to test these hypotheses by measuring early season habitat and loss rates, in rearing tributaries with known differences in total spring-summer survival. Our goal was to strengthen the link between habitat and performance in juvenile Atlantic salmon.

We collected field data on microhabitat use and availability from six 3rd- 4th-order streams in the White and West River drainages, two major tributaries of the Connecticut River in central and southern Vermont. We hand stocked unfed age-0 Atlantic salmon fry, obtained from the White River National Fish Hatchery in Bethel, VT, into 100m-long sections of the six study sites at various dates between May 3 and June 3 1997. These sections were stocked on the same dates and at the same densities (30 - 50)/ 100m<sup>2</sup>) that the rest of the stream was stocked by management personnel. We then conducted censuses, using 3-pass electrofishing removals, in 40m sections located within the 100m study sections in all six streams, during the early season, which we categorize as 7-8 weeks after stocking. Fish population size for all species, and, for salmonids, separately for each age class, was estimated using a modified Zippin removal method (McMenemy, 1995). We used correlation analysis to test whether 1) streams with a greater proportion of microhabitats preferred by age-0 salmon had higher early season retention rates, 2) early season loss rates were correlated with total spring-summer loss-rates.

## **Results and Discussion**

Habitat conditions in all six tributaries exhibited the normal seasonal pattern of change characteristic of salmon rearing streams in central and southern Vermont - decreased current speed, depth and stream width over the course of the season, as discharge declines to summer low flows. White River basin sites tended to have higher discharges, particularly in the early season. Estimates of the proportion of habitats suitable for early season fish in the six index sites ranged from <13% in the Tweed River site to >40% in the Marlboro Branch site. Index sites with the highest proportion of suitable early season habitat had the lowest daily loss rates of age-0 salmon (n=6  $r^2 = 0.7$ ,  $p < 0.05$  (Fig. 1).

Fig. 1 Daily loss rates of age-0 Atlantic salmon vs. % preferred habitat (predicted by a habitat suitability model). The relationship is significant ( $p < 0.05$ )



Index sites in streams with consistently high total spring-summer survival had low early season loss rates in our study sections. In conclusion, supporting our original hypothesis, age-0 salmon loss rates within the first 8 weeks after stocking were negatively correlated with the availability of favorable foraging locations, and these early loss rates accurately predicted overall, long-term differences in age-0 performance between sites. To our knowledge this is the first study to explicitly link early life history conditions and salmon early season

site-specific survival or site-specific retention, reinforcing a potentially important mechanism underlying growth and survival.

### **References**

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