

**SPATIAL AND TEMPORAL VARIABILITY
OF JUVENILE ATLANTIC SALMON SIZE AND
OF SIZE-SELECTIVE MORTALITY RATE:
INFLUENCE ON THE INCIDENCE
OF PRECOCIOUS SEXUAL MATURITY IN MALE PARR.**

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Introduction

Focus on the freshwater part of juvenile Atlantic salmon (*Salmo salar*) life reveals important differences in growth and reproductive patterns. Variability in juvenile size can be detected between rivers but also between sites within a river and between years for a particular site. One important alternative reproductive tactic that has been recognised is the occurrence of precociously mature male parr, which are capable of reproducing with mature anadromous females while being 1/10th of their size (Hutchings and Myers 1988). It has been suggested that the expression of this alternative reproductive pattern is related in part to size attained by juvenile males at a particular moment in life (Myers et al. 1986, Rowe and Thorpe 1990, Gross 1996). The occurrence of this tactic could therefore be as variable as size reached by individuals. Experiments suggest that

size-selective mortality in age 0+ salmon is important and that the direction, i.e. the size class affected, is variable among years (Good 1997). It is not known if this differential mortality rate among individuals related to size occurs in subsequent years of freshwater life for this species. If this is the case, it could have a major influence on size attained by parr of a given age. Thus, the incidence of precocious parr could not only reflect that a certain number of individuals attained the threshold size for maturity but also that their size class survived. Our objectives were to 1) evaluate the spatio-temporal variability of size-at-age and of the incidence of precocious maturity in age 1+ and 2+ Atlantic salmon parr, 2) estimate if size attained at different moments of life vary significantly between precocious males and immature parr in the wild, 3) evaluate the importance and direction of size selective-mortality and its influence on precocious maturity.

Methods

During the summers of 1996 to 1999, seven sites on the Ste-Marguerite river in Québec, Canada (48°20'N, 70°00'W) were sampled. The sampling schedule involved a visit to each site in June and August. 40 to 50 juvenile salmon of a length expected to correspond to age 1+ or 2+ fish were collected. Length, weight and sexual maturity were recorded. Age was assigned using scales and otoliths. Individual backcalculated size at different moments of life (first-feeding, end of first summer of life, beginning of the second growth season) were obtained for precocious and immature male parr sampled in August by using the microstructure of sagittal otoliths. This analysis was also performed on otoliths of male parr collected in June. We used the relationship between otolith and somatic length validated in another study for age 1+ salmon parr (Aubin-Horth and Dodson, unpublished) and the backcalculating method described in Sirois et al. (1999). It was then possible to compare the mean size and size frequency distribution at different moments of life of male parr depending on their sexual maturity. These data also permitted us to compare the backcalculated size frequency distribution of the population at the beginning of the growth season for individuals taken either at the beginning or the end of summer. This allowed us to evaluate which size-classes that were present at the beginning of the growing season survived until August. If these two distributions differed, it suggests that individuals of a particular size disappeared from the population during the time interval between the two sampling periods. It is therefore possible to estimate the importance and direction of size selective mortality for a definite time period. This method also permits us to distinguish between the effect of individual growth and survival on size attained by an individual.

Results and conclusion

Our data suggest that size attained at a given age is variable at different spatio-temporal scales and that an important proportion of precocious males are present in the Ste-Marguerite river system for each age-class studied. The mean occurrence of precocity for the whole system is relatively stable among years. This mean percentage of males that are precocious is calculated by pooling the data from all the sites sampled for each age class. Nearly half the age 1+ males and more than two-third of the age 2+ parr are precocious for the years studied. The proportion of male parr that are precocious is much more variable among years when it is computed on a site-by-site basis. Furthermore, the spatial variability within the river for a given year is more important than the temporal variability for a given site. The results concerning the relationship between size at different moments of life and the incidence of this conditional strategy as well as the importance of size-selective mortality for the size structure of juvenile cohorts will be discussed during the oral presentation.

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