Growth Pattern and Seawater Tolerance of Precocious Male Sockeye Salmon

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Sockeye salmon (*Oncorhynchus nerka*) exhibit one of the most complex life-history patterns among all salmonid species; maturing at ages ranging from 2–5 years post fertilization. Each year, the sockeye salmon enhancement program of the National Salmon Resources Center in Japan produces a significant number of male fish that precociously mature (PM) at age-2. PM's can be further classified in two phenotypes; the predominant one remains in freshwater until reproduction while the other migrates to the ocean and resides for several months before returning to the spawning grounds to reproduce. Previous studies of salmonids have demonstrated that the rate of PM is significantly influenced by growth rate at specific times of the year (Lundqvist 1980; Berrill et al. 2003). This study investigated the effects of alteration in growth rate in the winter and spring on the prevalence of PM and compared seawater adaptation between immature (I) and PM hatchery sockeye salmon.

Juvenile sockeye salmon were divided (50 fish per treatment) into one of three feeding treatments (A–C) and fed rations (% body wt/day) as follows: Treatment A (1% November–March and 3% March–May), Treatment B (3% November–January and 1% January–May), and Treatment C (3% November–May). Fish were monitored monthly for growth in fork length (FL) and at the end of the experiment in May the rate of PM in each treatment was determined by designating all males with a gonadosomatic index (gonad wt/body wt X 100) greater than 0.15% as PM. Seawater adaptation was examined in May in a subset of 30 fish (I and PM) by measuring plasma sodium concentration after a 24-hour seawater challenge test at 33 ppt. Furthermore, gill Na^+/K^+-ATPase activity was measured in May in a second subset of 20 fish (I and PM) maintained in freshwater. Growth rates corresponded with feeding rates in all treatments with FL increasing in all groups from approximately 11 cm in November to 17.1, 16.1, and 18.4 cm, in treatments A, B, and C, respectively. PM rates were 50% in treatment A, 80.3% in treatment B, and 79.2% in treatment C. The plasma sodium concentration was 167.5 mM for PM (n = 9) and 155.0 mM for I or smolts (n = 21). The mean gill Na^+, K^+-ATPase activity was 8.6 µmols Pi/mg pro/h for PM (n = 6) and 13.6 µmols Pi/mg pro/h for I or smolts (n = 14).

These results suggest that rapid growth in winter has a stronger influence on PM rate than rapid growth in spring and PM's are less seawater tolerant than I (smolts) in the spring.

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