

**REGULATION OF IONIC AND OSMOTIC BALANCE  
DURING SMOLTING AND DESMOLTING OF HATCHERY-REARED  
SAIMAA LANDLOCKED SALMON (*Salmo salar* m. *sebago* Girard)**

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**EXTENDED ABSTRACT ONLY - DO NOT CITE**

Saimaa landlocked salmon (*Salmo salar* m. *sebago* Girard) has been isolated in fresh water at least for several thousands of years as a consequence of the isostatic uplift of the landmass following the last ice age. Under natural conditions this salmon displays a life pattern similar to those of their anadromous conspecifics. However, the construction of hydroelectric dams in the middle of the 1950's and early 1970's destroyed all natural breeding areas. Hence, the present stock of endangered Saimaa landlocked salmon is maintained by stocking hatchery-reared smolts near to their previous reproduction areas. This necessitates detailed studies of parr-smolt transformation under fish farm conditions.

Physiological changes associated with smolting and desmolting were examined in one- and two-year-old hatchery-reared Saimaa landlocked salmon. The early development of the fish was accelerated by increasing the water temperature

from 4 to 8°C from about four weeks after the eyed stage of the embryos until startfeeding when the ambient temperature reached 8°C. Studies were done in one-year-old upper modal and two-year-old lower modal fish as well as in fish which were not graded into upper and lower modal groups within year classes. For determination of the smolting stage, the development of external smolt indices, size and condition factor, muscle lipid content, gill Na<sup>+</sup>,K<sup>+</sup> -ATPase activity and plasma ion concentrations (Na<sup>+</sup>, Cl<sup>-</sup> and Mg<sup>2+</sup>) were measured from ten randomly selected fish from each group at intervals of about one month in January-July or April-December. In addition, ten to twenty fish from each group were exposed to a seawater challenge test (SW test) for 48 h at c. 30 ‰. Tests were done at constant 10°C temperature. The mortality, muscle water content and concentrations of plasma ions (Na<sup>+</sup>, Cl<sup>-</sup> and Mg<sup>2+</sup>) were determined from these test fish.

Our results from studies with hatchery reared Saimaa landlocked salmon showed that transformation processes associated with smolting are similar to those of anadromous Atlantic salmon (*Salmo salar*) including typical smolt colouration, reduced condition factor, decreased muscle lipid content and elevated gill Na<sup>+</sup>,K<sup>+</sup> -ATPase activity and hypoosmoregulatory ability. Based on these parameters smolt status was reached during April-May and May-June in two- and one-year-old fish, respectively. Interestingly, a transitory reduction in freshwater osmoregulatory capacity was observed coincident with smolting as judged by decreased plasma ion concentrations (Na<sup>+</sup>, Cl<sup>-</sup> and Mg<sup>2+</sup>) and high muscle water content in fresh water. Desmolting was observed after June-July as indicated by darkening of the scales, increases in condition factor and muscle lipid content and decrease in gill Na<sup>+</sup>,K<sup>+</sup> -ATPase activity. However, no clear reduction in hypoosmoregulatory ability was observed, but the capacity to regulate the osmotic and ionic balance in seawater was maintained until late autumn.

The current research is concentrated on clarifying seasonal changes in structure of gill chloride cells as well as gill Na<sup>+</sup>,K<sup>+</sup> -ATPase activity and plasma ion (Na<sup>+</sup>, Cl<sup>-</sup> and Mg<sup>2+</sup>) concentrations in fish exposed to seawater challenge test for 48-96 h at ambient and 10°C temperatures. Regulation of osmotic and ionic balance during smolting and desmolting as well as idea of smolting as evidence of maladaptation of the fish to fresh water will be discussed.

