CALCIUM SENSING RECEPTOR ACTIVATION INFLUENCES PARR-SMOLT TRANSFORMATION IN HATCHERY ATLANTIC SALMON

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Efforts to rebuild populations of Atlantic salmon (*Salmo salar*) in the northeastern United States depend in part on stocking of hatchery smolt to mitigate habitat losses from logging, agriculture and hydroelectric development. Hatchery-origin smolt, however, often fail to grow and survive in the ocean at rates comparable to those of wild fish, reducing the potential benefits from stock supplementation. Recent evidence suggests that lower ocean growth and survival of hatchery salmon may involve antagonistic modulation of calcium sensing receptor proteins (CaRs), first identified in mammals as the principal regulators of extracellular Ca2+ homeostasis. CaRs have been shown to function as salinity sensors in fish that coordinate sensing and regulation of specific cations and L-amino acids in various osmoregulatory, sensory and nutrient absorbing tissues to physiologically remodel salmon for ocean life. We hypothesized that in contrast to the natural conditions experienced by wild salmon, the altered water chemistry and nutrition typically encountered in hatchery environments may limit the completion of parr-smolt transformation in the appropriate time frame, and thereby increase osmotic stress that delays ocean entry, reduces early ocean growth and subsequent ocean survival. This view is supported by research showing that seawater acclimation of hatchery salmon before release increases the number and size of returning adults compared to fish released directly from freshwater.

We tested the effects of various CaR reactive compounds added to the feed and rearing water on hypo-osmoregulation and subsequent marine growth and survival of hatchery Atlantic salmon stocked in the Penobscot River (Maine) from 2003 to 2005. Treated fish exhibited a significant ($P \leq 0.05$) increase in gill Na^+K^+ATPase activity compared to control fish before or at the time of stocking in each year of the study. A higher number of treated fish were also captured earlier during post-release trawls in the Penobscot River estuary and near-shore marine environment in two of the three years. However, there were no significant differences ($P \geq 0.09$) in the number of one sea winter adults that returned from smolt stocked in 2003 and 2004, nor in the number of two sea winter adults that returned from smolt stocked in 2003, although the length of two sea winter adults from treated fish was significantly ($P = 0.03$) greater than that of control fish. Our results suggest that use of CaR reactive compounds to acclimate smolt to seawater before stocking may increase the size of returning hatchery fish, possibly through more rapid growth during early ocean residence. Additional studies in 2006 and adult return data from smolt releases in 2004 and 2005 will help validate this hypothesis.