

**ENDOCRINE PATHWAYS FOR THE DISRUPTION OF THE
PARR-SMOLT TRANSFORMATION BY ESTRADIOL AND
NONYLPHENOL IN ATLANTIC SALMON.**

Stephen D. McCormick, Michael F. O'Dea and Amy Moeckel
Conte Anadromous Fish Research Center
U.S. Geological Survey, Biological Resources Division
One Migratory Way—PO Box 796
Turners Falls, MA. 01376 U.S.A.
413-863-3804/413-863-9810/stephen_mccormick@usgs.gov

Björn Thrandur Björnsson
Department of Zoophysiology
University of Göteborg
Göteborg, Sweden

EXTENDED ABSTRACT ONLY- DO NOT CITE

The parr-smolt transformation is a hormone-driven developmental process that is adaptive for downstream migration and seawater entry. Recently, environmental estrogens such as nonylphenol have been implicated in reduced returns of Atlantic salmon in the wild (Fairchild *et al.* 1999). Previous research has shown that sex steroids interfere downstream migratory behavior and the development of salinity tolerance that normally occurs during smolting (Madsen *et al.*, 1997; Munakata *et al.* 2000). The present study was designed to determine the endocrine pathways through which sex steroids and their agonists may act to affect the parr-smolt transformation.

Junvenile Atlantic salmon were injected with 0.5, 2, 10, 40 and 150 ug/g branched 4-nonylphenol and 2 ug/g estradiol-17 β during the parr-smolt transformation in late March and sampled 1 and 2 weeks after first exposure. Treatment with estradiol and 150 ug/g nonylphenol resulted in lower salinity tolerance after two weeks of exposure. Plasma insulin-like growth factor I (IGF-I) was 30-60% lower in estradiol and 150 ug/g nonylphenol treated fish after 1 and 2 weeks of treatment. Plasma growth hormone was elevated at intermediate doses of nonylphenol, but there was no effect of higher doses of

nonylphenol or estradiol. Plasma cortisol was not affected by nonylphenol or estradiol. Plasma thyroxine showed a strong dose dependent decrease in response to nonylphenol and estradiol after one week, but no effect after two weeks. Plasma triiodothyronine was 25-60% lower in estradiol and 150 ug/g nonylphenol treated fish after 1 and 2 weeks of treatment

The results indicate that plasma IGF-I is the likely endocrine pathway for the effects of estrogenic compounds on osmoregulation during smolting. The thyroid axis is also sensitive to estrogenic compounds, and plasma thyroxine is negatively affected by nonylphenol at relatively low doses. Thus, thyroid-dependent processes during smolting, such as imprinting and migration, may also be impacted by estrogenic compounds.

References

- Fairchild, W. L., E. O. Swansburg, J. T. Arsenault, and S. B. Brown. 1999. Does an association between pesticide use and subsequent declines in catch of Atlantic salmon (*Salmo salar*) represent a case of endocrine disruption? *Environmental Health Perspectives* 107 (5):349-357.
- Madsen S. S., A. B. Mathiesen, and B. Korsgaard. 1997. Effects of 17-beta-estradiol and 4-nonylphenol on smoltification and vitellogenesis in Atlantic salmon (*Salmo salar*). *Fish Physiology & Biochemistry* 17 (1-6):303-312.
- A. Munakata, M. Amano, K. Ikuta, S. Kitamura, and K. Aida. Inhibitory effects of testosterone on downstream migratory behavior in masu salmon, *Oncorhynchus masou*. *Zool.Sci.* 17 (7):863-870, 2000.