

# **Growth hormone and somatolactin function during sexual maturation of female Atlantic salmon**

## **AKADEMISK AVHANDLING**

för filosofie doktorexamen i zoofysiologi som enligt naturvetenskapliga  
fakultetens beslut kommer att försvaras offentligt fredagen den 21 november  
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av

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## Dissertation Abstract

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**Background and aims:** The growth hormone-insulin-like growth factor I (GH-IGF-I) system is known to act during sexual maturation of female salmonids, but the specific roles are not known. Somatolactin (SL) is a pituitary hormone closely related to GH and is only found in fish. In some species, including salmonids, there are two forms, SL $\alpha$  and SL $\beta$ . The SL receptor (SLR) has recently been cloned and phylogenetic analysis shows that it is similar to previously cloned GH receptors (GHRs) of non-salmonids. The ligand-specificity of the GHR/SLR is unclear. Little is known about the role of the SLs in sexual maturation of fish. The aim of this thesis has been to increase our knowledge about the regulatory role(s) of both the GH-IGF-I system and of SLs during sexual maturation in female Atlantic salmon.

**Methods:** The cDNA sequences of Atlantic salmon GHRs (two isoforms), SLR, as well as SL $\alpha$  and SL $\beta$  were obtained with the goals of carrying out a phylogenetic analysis, and of developing molecular tools for analysis of mRNA levels using real time quantitative PCR (RTqPCR). The roles of GH, IGF-I and SL were examined in a 17-month long study on one sea winter Atlantic salmon females. mRNA expression levels of ovarian components of the GH-IGF-I system and SLR and pituitary GH, SL $\alpha$  and SL $\beta$  were studied by RTqPCR. Levels of GH and IGF-I in plasma, and of GH in the pituitary were measured by radioimmunoassay.

**Results and Conclusions:** The phylogenetic analysis (**Paper I and II**) of the cloned sequences reveals the placement of Atlantic salmon GHR in the GHR type II clade and SLR in the controversial GHR type I clade (putative SLRs). Concurrent analyses of pituitary GH mRNA levels, GH protein and plasma GH in the same individual fish demonstrates the complex dynamics of the GH system, which is inhibited by a continuous light. **Papers III and IV** confirm that there is an active GH-IGF-I-gonad axis in the female Atlantic salmon that appears to be functional at the start of exogenous vitellogenesis, final oocyte growth, spawning and possibly during postovulatory events. Evidence has been found for a photoperiod-driven GH-system activation which is initiated in January with stimulation of GH secretion from pituitary somatotropes. The role of this activation of the GH system in late winter/early spring appears to be the reversal of a prior plasma IGF-I and ovarian IGF-I mRNA downregulation driven by an unknown factor(s). This downregulation in IGF-I is thought to inhibit somatic cell proliferation. The activation of the GH-IGF-I-gonadal system also appears to limit energy allocation to gonadal growth. This series of events involving the GH-IGF-I system appears to take place during the so-called spring window of opportunity and it is the first time this has been described. The GH-IGF-I system also appears to have an important role during final oocyte growth, spawning and post-spawning events. SL $\alpha$  and SL $\beta$  are both actively regulated during sexual maturation and could have several roles, such as signaling the status of visceral fat reserves during the spring window of opportunity, signaling lipid metabolic status before the onset of anorexia, involvement in Ca mobilization during vitellogenesis and/or control of lipid metabolism in lieu of GH during the final stages of oocyte growth.

**Keywords:** Growth hormone, somatolactin, insulin-like growth factor I, GH, SL, IGF-I, GHR, SLR, IGFIR, ovary, maturation, reproduction, Atlantic salmon, spawning, pituitary.