WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: KY2341

Title: Where have all the yellow perch (Perca flavescens) gone: Are endocrine disruptors (Xenoestrogens) involved?

Focus Categories: Conservation, Models

Keywords: reproduction, endocrinology, physiology, teleost

Start Date: 03/01/2001

End Date: 02/28/2002

Federal Funds: $12,000

Non-Federal Matching Funds: $25,191

Congressional District: Sixth

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Abstract

Growth, development and reproduction, in all vertebrates, are regulated through the orderly, but complex, release of the pituitary hormones, growth hormone (GH), prolactin (PRL) and their intermediaries, the insulin-like growth factors (IGF-I and IGF-II). The idea that a single pituitary hormone can simultaneously regulate multiple physiological sectors (e.g., growth, osmoregulation and reproduction), suggests that perturbations in the physiology of a single hormone may negatively impact organismal physiology in several ways. Adding to this complexity are pollutants, present in the aquatic environment, which mimic or alter the actions of endogenous hormones. In many cases, these hormonal mimetics, called "endocrine disrupting chemicals" (EDCs), possess estrogenic activities that can affect endogenous hormones in inappropriate ways. To date, studies have mainly focused on the effects of EDCs on physiological end-points, with little emphasis on the impacted endocrine pathways themselves. An approach, focused on determining the mechanism(s) of endocrine disruption, is required to understand/predict the sub-lethal impacts of EDC exposure in aquatic vertebrates. The study of an ecologically-important organism, that responds uniquely to estrogen, would facilitate our understanding in many ways. In this regard, our aim is to develop the yellow perch (P. flavescens) as model to study the effects of estrogen/EDCs on teleost endocrine physiology. In addition to having a unique estrogen-dependent physiology, the yellow perch has a wide distribution in North America and is an ecologically and economically important teleost. An understanding of the endocrine physiology of this teleost will aid in future studies to improve the environmental monitoring and management practices of this important species, and others, particularly within areas of the Commonwealth of Kentucky and the Great Lakes Region, where endocrine disruption is suspected. We hypothesize that estrogenic EDCs will alter the pituitary hormones (GH & PRL) that control perch growth, development and behavior, thus impacting the physiology, and ultimately population ecology, of this important animal.

Molecular tools will be developed to characterize the hormonal pathways responsible for growth and development in yellow perch. We shall clone the genes for PRL, GH and the estrogen receptors. RT-PCR procedures (5'-RACE) and DNA sequencing will be employed to clone and verify cDNA sequences. These clones will be further characterized using Northern Blotting procedures. Once validated, the sex-specific

and developmental expression of these genes will be examined using quantitative hybridization procedures. This work will provide basic data that are necessary for comparisons with experimental populations exposed to specific EDCs. We shall also initiate efforts to purify native perch GH and PRL. This will permit the development of assays to measure blood hormone (GH/PRL) levels and receptor abundance, distribution and affinity in perch throughout the life-cycle and in those exposed to EDCs. At present, we are most concerned with characterizing the endocrine pathways that are involved during the early development in yellow perch. Since it will be very difficult to collect sufficient blood plasma from such small animals, our efforts will focus on developing the molecular endocrine tools that will enable us to obtain measurements in smaller animals.

Our immediate objective is to develop the molecular endocrine tools needed to investigate the endocrine mechanisms of development/growth in this teleost. These tools will enable us to examine the sub-lethal effects of EDCs on the physiology of this important teleost. In the long-term, the availability of these tools will allow us 1) to determine how xenoestrogens (like estrogen) alter yellow perch physiology, 2) to characterize the impacted endocrine pathways that contribute to these alterations, and 3) to examine alternative pathways (alterations in GnRH levels) by which EDCs may alter yellow perch development and reproduction.