

# MODULATION OF ESTRONE EXPOSURE EFFECTS MEDIATED THROUGH ENVIRONMENTAL FACTORS IN MALE FATHEAD MINNOWS, *PIMEPHALES PROMELAS*

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Laboratory exposures indicate that estrogens and estrogen mimics can cause endocrine disruption in male fathead minnows (*Pimephales promelas*). In the wild, conditions are not static as is often the case in the laboratory. Changes in environmental parameters can trigger physiological and anatomical changes in fish that have the potential to alter the uptake and observed effects of estrogenic chemicals. To explore the role of environmental variables on the expression of biomarkers of estrogenic exposure, adult male *P. promelas* were exposed to estrone under various environmental conditions (differing temperatures, diets, salinities and dissolved oxygen concentrations) in the laboratory for 21 days in a flow-through system. Plasma vitellogenin, morphological characteristics, hematological parameters, and histopathology were assessed to determine the severity of estrogenic effect. Plasma vitellogenin was most drastically elevated in fish exposed to estrone at a low temperature (18°C) and fed a restricted diet, and was not significantly elevated over the control when fish were exposed to the same estrone concentration (78 ng/L at a high temperature (26°C) and fed a restricted diet. This may have implications in field studies taken during seasons in which these conditions are present, and vitellogenin is used as an indicator of the health of an aquatic system. Salinity at 10 ppm and 50 ppm added NaCl had no significant effect on biomarkers of estrogenic exposure, however estrone concentrations in excess of 85 ng/L corresponded with significantly reduced body condition factor compared to control. Fish exposed to estrone (13 and 51 ng/L) at low dissolved oxygen (hypoxic) conditions showed significantly greater increase in plasma vitellogenin concentrations in comparison to those exposed at near-saturated dissolved oxygen. This effect was not observed in fish exposed to much higher estrone concentrations (292 and 390 ng/L). Significant reductions in hematocrit and gonadosomatic index compared to control were also noted at high (282 ng/L) estrone concentrations. These data indicate that environmental conditions modulate the effects of estrogenic exposure in male *P. promelas*. We anticipate that accounting for a spectrum of environmental conditions may be necessary for laboratory exposures designed to assess the impact of exogenous estrogenic chemicals.