

Monitoring Endocrine Disruption Using Caged Bivalves

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Collectively, the results from the caged mussel studies using *Elliptio complanata* on the St. Lawrence River in Montreal and the Kennebec River in Maine, show that the vitellin (Vn) biomarker is a sensitive effects endpoint, suggesting endocrine disruption (ED) and effects on reproduction. Furthermore, specific estrogenic effects (increased vitellin and feminization) appear to be related to unidentified chemicals in both municipal and pulp and paper mill effluents. Similar studies with *Mya arenaria* (a marine clam) show androgenic effects (decreased vitellin and masculinization) may be related to TBT exposure. Although relatively little is known about the endocrine system in invertebrates, synthesis of vitellin, the major protein found in oocytes of invertebrates synthesized from vitellogenin, has been shown to be regulated by estrogens in freshwater and marine bivalves. This process appears to be susceptible to endocrine disruption in a manner similar to that of fish. Increased levels of these vitellin proteins have been reported in the marine clams, mussels, and oysters. Feminization and masculinization have been shown in several of these species, depending on the chemicals of exposure. Results from a 1-year benthic cage study suggest that prolonged exposure to these chemicals can result in sex reversal. Due to their high filtration rate, an ability to accumulate and bioconcentrate chemicals, and their sedentary life style, bivalves may be at particular risk to ED chemicals. This increases their utility as sentinels for monitoring purposes. The caged bivalve methodology provides the advantage of knowing the bivalves' chemical, biochemical, and biological properties at the beginning of the test as well as conducting field experiments at locations of interest, even though they may not normally be found at those locations. Results also suggest that ED chemicals can be added to the list of potential stressors on native unionid populations by affecting reproduction and the sex ratios of existing populations.

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