

**ENVIRONMENTAL CONTAMINANTS IN WHITE STURGEON: IS
ENDOCRINE DISRUPTION OCCURRING
IN THE COLUMBIA RIVER?**

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EXTENDED ABSTRACT ONLY - DO NOT CITE

The lower Columbia River supports one of the most productive white sturgeon, *Acipenser transmontanus*, fisheries in North America. Fish trapped behind the dams of the hydroelectric system however, have reduced reproductive success when compared to animals in the free-flowing portion of the river. Reduced reproductive fitness of fish in these impounded sections of the river has been attributed to habitat, flow and temperature but environmental toxicants could also be playing a role. The long-lived, late-maturing and benthic lifestyle of sturgeon make them particularly susceptible to the actions of persistent bioaccumulating pollutants. We are presenting the preliminary findings of an

ongoing study examining possible effects of environmental toxicants on sturgeon reproductive physiology.

Fish were collected from the free-flowing portion of the Columbia River in the estuary and pools above Bonneville, The Dalles and John Day dams. Condition factor (CF) and gonadosomatic index (GSI) were determined for each fish and blood samples were collected for analysis of plasma estradiol, testosterone (T), 11-ketotestosterone (KT) and vitellogenin (Vg). Livers and gonads were examined histologically and analyzed for 19 chlorinated pesticides and 26 PCB congeners. Livers were also analyzed for mercury content.

Some males and immature females showed elevated vitellogenin levels in The Dalles and John Day pools indicating an exposure to some type of xenoestrogen. Mercury was present in all livers examined at relatively high concentrations. Most of the pesticides and PCBs analyzed were detected in at least some of the samples. Metabolites of DDT (DDE and DDD) were consistently found in fish at relatively high levels. A negative correlation was found between CF and levels of DDE, DDD, total PCBs and mercury. Some gonadal abnormalities were observed, including inter-sex fish. In males, a negative correlation was found between plasma androgens and DDE content of livers (Figure 1). Male

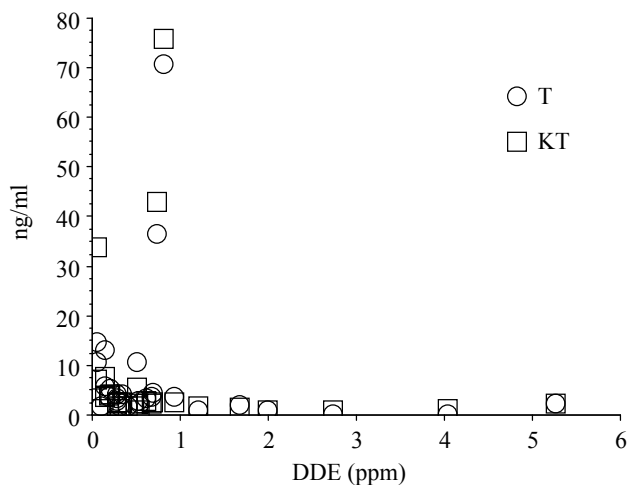


Figure 1. Plasma testosterone (T) or 11-ketotestosterone (KT) versus liver p-p'-DDE (DDE) in parts per million (ppm) for Columbia River male white sturgeon. Reciprocal-Y regression: $p=0.0005$ for T and 0.0452 for KT

fish also showed a negative correlation between GSI and DDE content of livers. Fish residing in the reservoir behind the oldest of the dams examined (Bonneville) had the highest contaminant loads (Figure 2).

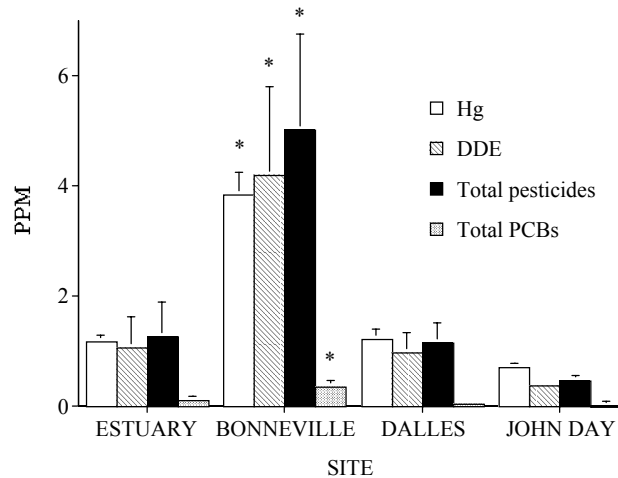


Figure 2. Concentrations in parts per million (ppm) of mercury (Hg), p-p'-DDE (DDE), total pesticides and total PCBs in livers of Columbia River white sturgeon from 4 locations. Histograms represent mean + S.E.M. "*" denotes statistically different from other locations (ANOVA; Bonferroni post-hoc test, $p < 0.05$).

Elevated levels of VG seen in some fish were not correlated with any of the chlorinated pesticides or PCB congeners that were analyzed. This suggests that some other xenoestrogen(s) not being monitored by this study may be causing these feminizing effects. Tissue concentrations of DDE and PCBs found in this study were similar to those seen previously by our laboratory in Columbia River white sturgeon. (Foster *et al.*, 2001a). The negative correlation between plasma androgens and DDE content of livers in males has also been documented by our laboratory in a previous sampling year (Foster *et al.*, 2001b). We have preliminary evidence that the mechanism by which DDE reduces plasma androgens involves one of the liver cytochrome P450 isozymes. Liver content of p,p-DDE is positively correlated with the putative cytochrome P450 3A. This enzyme is responsible for metabolizing androgens. Thus, DDE may be

decreasing plasma androgens in males by enhancing steroid metabolization and excretion.

Fish with the highest tissue toxicant loads were residing in the reservoir of the oldest dam suggesting that these compounds are accumulating behind dams over time. These fish also had the lowest CF and highest incidence of gonadal abnormalities. Our results indicate that exposure to environmental contaminants may be affecting both growth and reproductive physiology of sturgeon in some areas of the Columbia River.

References

- Foster, E.P., Fitzpatrick, M.S., Feist, G.W., Schreck, C.B. and Yates, J. (2001a). Gonad organochlorine concentrations and plasma sex steroid levels in white sturgeon (*Acipenser transmontanus*) from the Columbia River, USA. *Bull. Environ. Contam. Toxicol.* 67:239-245.
- Foster, E.P., Fitzpatrick, M.S., Feist, G.W., Schreck, C.B., Yates, J., Spitsbergen, J.M. and Heidel, J. (2001b). Altered reproductive physiology, EROD induction, reduced condition factor, and the occurrence of organochlorine pollutants in white sturgeon (*Acipenser transmontanus*) from the Columbia River. *Arch. Environ. Contam. Toxicol.* 41(2):182-191.