

- Bryan, G. W. et al.: *J. Mar. Biol. Ass. U.K.*, 67, 525–544 (1987). [3]
Bryan, G. W. et al.: *J. Mar. Biol. Ass. U.K.*, 68, 733–744 (1988). [4]
Gibbs, P. E. et al.: *J. Mar. Biol. Ass. U.K.*, 67, 507–523 (1987). [5]
Horiguchi, T. et al.: *Mar. Pollut. Bull.*, 31, 402–405 (1995). [6]
Horiguchi, T. et al.: *Environ Pollut.*, 95, 85–91 (1997). [7] Gibbs, P. E. & Bryan, G. W.: *J. Mar. Biol. Ass. U.K.*, 66, 767–777 (1986). [8]
Gibbs, P. E. et al.: *J. Mar. Biol. Ass. U.K.*, 68, 715–731 (1988). [9]
Blaber, S. J. M.: *Proc. Malacol. Soc. Lond.*, 39, 231–233 (1970). [10]
Fioroni, P. et al.: *Zool. Anz.*, 226, 1–26 (1991). [11] Horiguchi, T. et al.: *Appl. Organomet. Chem.*, 11, 451–455 (1997). [12] Horiguchi, T.: In “Problems of Endocrine Disruptors in Fisheries Environment” (ed. by S. Kawai and J. Koyama), *Koseisha-Koseikaku*, Tokyo, pp. 54–72 (2000) [in Japanese]. [13] Horiguchi, T. et al.: *Mar. Environ. Res.* in press (2000).

Endocrine disrupting chemicals in the Canadian aquatic environment

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The presence of endocrine disrupting chemicals (EDCs) in the environment has recently become a high profile international issue. Field studies have shown that the growth, reproduction and development of many species including invertebrates, fish, birds and mammals, may have been altered by chemicals that interact with the endocrine system. Many of these chemicals have shown the ability to cause adverse biological effects at very low levels commonly found in the environment that may have been previously considered safe. Although reproduction and development have been, and continue to be, a major endpoint for assessment of chemicals by Environment Canada, the EDC issue has heightened our concerns for detecting effects mediated through the endocrine system. This presentation will review the scientific evidence for endocrine related alterations in wildlife in the Canadian aquatic environment. A few of the conclusive studies will be examined in detail demonstrating their direct links between chemical exposure and alterations in endocrine function. Our studies of the impacts of exposure of fish to pulp and paper mill effluents will be examined, as over the last ten years we have developed a number of endocrine techniques in order to evaluate the mechanisms responsible for the reproductive effects demonstrated in wild fish. A description of studies examining the correlation between declines in Lake Trout populations in Lake Ontario and sediment levels of 2,3,7,8 tetrachlorodibenzo-p-dioxin will also be made. Other Canadian studies of contaminant effects where direct links to endocrine dysfunction have yet to be demonstrated will also be discussed including studies examining the effects of municipal sewage wastes, heavy metals, pesticides, insecticides and other forms of agricultural runoff, refinery discharges, steel mill effluents and tributyltin.

Following this presentation of examples of endocrine disruption in the Canadian aquatic environment, Environment Canada's national EDC strategy will be discussed. It focuses the activities and research initiatives of the Department on determining the extent to which the Canadian environment is impacted by endocrine disrupting chemicals. Environment Canada is giving priority to assessing those sites and sectors, which have been identified as having the highest potential for adverse effects on growth, reproduction or development. These include both those sites previously identified, such as pulp and paper mill effluents, and those emerging issues such as intensive agriculture (pesticides and animal wastes), urban effluents (especially sewage) and priority substances which have been shown or are suspected of having effects on the endocrine system. A new Federal Government initiative has earmarked research funds for studying the effects of endocrine disruptors. A summary of the research being conducted through the Toxic Substances Research Initiative will also be made.

A description of Canada's new Environmental Effects Monitoring Program (EEM) will also be discussed. The EEM program was first initiated in 1992 for the pulp and paper industry in Canada, which requires industry to monitor the effects of their effluents on the receiving environment including those on fish and benthic invertebrates. This program is cyclical in nature (every three years) and is designed to evaluate whether the existing effluent regulations are protecting the Canadian receiving environment. The EEM program has been expanded into the metal mining industry, which will conduct its first cycle in the year of 2002. A brief description of my studies at Environment Canada relating to both endocrine disruptors and the EEM program will also be presented.