# Environmental Concentrations of Pharmaceutical Estrogens and Xenoestrogens in Municipal Wastewater: Implications for Health of Wildlife and Humans

Maxine Wright-Walters, MSc., and Conrad Volz, Dr.PH, MPH, University of Pittsburgh, Graduate School of Public Health, Department of Environmental and Occupational Health; Center for Healthy Environments and Communities, Pittsburgh PA

---

A major route of introduction of both pharmaceutical and xenoestrogens into the environment is through municipal waste water treatment plant (WWTP) effluent sources. These effluents contain natural and synthetic estrogens; surfactants, plasticizers, glues, metals and halogenated hydrocarbons that can mimic estrogens; and are discharged directly into rivers and lakes. Many USA cities have dense concentrations of combined sewer overflows releasing untreated sewage directly into surface waters thus increasing the amounts of xenoestrogens finding their way into drinking water supplies and commercial and subsistence fishing habitat. Xenoestrogens can have adverse reproductive effects in aquatic and terrestrial wildlife through sex reversals, production of intersexes, alterations in mating or parental behavior, and prevention of gonadal maturation. Additionally, xenoestrogens have been implicated in various human health outcomes, such as testicular dysgenesis syndrome including testicular cancer and breast cancer in women.

In the United States, humans are exposed daily to xenoestrogens from various sources. As rivers and lakes are used for food supply and recreational purposes, and wastewater effluent usage increases due to diminishing clean water resources, the presence and concentration of xenoestrogens in surface water becomes a critical human health risk component.

The natural estrogens, 17β-estradiol (E2) and estrone (E1), and the synthetic E2 derivate 17a-ethinylestradiol (EE2) are most responsible for in vitro estrogenic activity in domestic WWTP effluents. Less than 1 ng/L EE2 can induce vitellogenin (associated with adult females) production in male rainbow trout, 4 ng/L caused male fathead minnows failure to develop normal secondary sexual characteristics. E2 has been detected in domestic wastewater at concentrations from 1 ng/L up to 80 ng/L. Total estrogenicity (E2 equivalents) of up to 147 ng/L has been measured in WWTP effluents.

Understanding the species and concentrations of xenoestrogens in surface water is imperative for environmental public health tracking of associated disease states. Such research will determine the necessity for utilizing limited and competing public financial resources to invest in technology to remove xenoestrogens from surface waters and, in regulation of fish or wildlife consumption from our rivers and lakes.