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Estrogen Addition to ELA Lake 260 (Hormone Mimics)

Hormones are naturally-occurring, chemical compounds that control many critical life processes, including reproduction, in plants and animals. Many chemicals synthesized through human technologies are chemically similar to natural hormones and can, through mimicry, sometimes interfere with normal hormonal functions. Sometimes this mimicry is intended; often it is not.

One such hormone mimic (or endocrine disrupting chemical (EDC)) is a synthetic estrogen used in birth control pills. This synthetic hormone is a potent mimic of natural estrogen. Women taking "the pill" release this chemical from their bodies via the urine. It then passes through most sewage treatment systems without being broken down and is released in low concentrations to downstream waterbodies. In Europe, with its densely populated areas, there is evidence that this synthetic estrogen is causing the feminization of male fish in these downstream waters. Some male fish are actually producing eggs. This presents serious concerns for the sustainability of fish populations in these waters.

Following two years of background studies, ELA researchers, under the leadership of Dr. Karen Kidd, began adding small quantities of this synthetic estrogen to ELA Lake 260 in May, 2001. Additions were continued in 2002, and again in 2003. The estrogen was added to maintain a concentration of a few nanograms of estrogen per litre of lake water (a few parts estrogen per trillion parts water). This concentration is similar to that found downstream of many municipal wastewater treatment plants. At the same time, the researchers were closely monitoring invertebrates, frogs, and fish in the lake to determine if this low concentration had any chronic effects on these animals, and particularly on their abilities to successfully reproduce.

ELA Lake 260, site of the synthetic estrogen addition experiment

A field assistant adds estrogen to the surface waters of Lake 260 using an automated pump.

Dr. Vince Palace, one of the research team, samples a lake trout from Lake 260

The outflow stream from Lake 260 is small, and the next downstream lake is much larger than Lake 260. If the estrogen was not continuously replenished, about half of it would disappear (break down) over a twelve-day period. While there was little chance of downstream contamination from the estrogen, the researchers monitored the downstream flows to ensure that there were no effects in downstream waters.

All estrogen additions to the lake were halted in October of 2003.

A Fathead Minnow

While some of the longer-lived fish populations are still being monitored, the researchers observed a number of impacts caused by the estrogen. A number of species, both invertebrate and vertebrate, showed physiological changes, particularly in males. Most dramatically, the fathead minnows (*Pimephales promelus*), a species where individuals seldom live much longer than 3 years, suffered a major population collapse in Lake 260 during the years of estrogen addition. Apparently, the male fathead minnows were feminized to such an extent that they were no longer capable of successfully fertilizing eggs from females, and reproduction within the fathead minnow population effectively ceased. A few older fish did survive, and we will be watching to see whether the population can recover on its own, now that estrogen concentrations are undetectable.