Endocrine Disruption

Researchers have linked many disturbing trends in wildlife, fisheries and human health to disruptions to developing endocrine systems. But how do endocrine-disrupting substances cause such varied health effects in both wild and laboratory animal populations?

The Endocrine System

The endocrine system helps guide development, growth, reproduction, behaviour and other bodily functions of animals and humans. It is comprised of endocrine glands and hormones.

Endocrine glands produce hormones and secrete them directly into the bloodstream. These hormones act as chemical messengers, traveling through the blood to distant tissues and organs where they bind to specific cell sites called receptors. By binding to receptors, hormones trigger various responses in the tissues containing the receptors.

Endocrine Disruption

Endocrine disrupting substances can interfere with the above process, disrupting normal hormonal function in wildlife and humans in a number of ways:

- they can block natural hormones from binding with their cell receptors;
- they can mimic natural hormones and bind to the receptor, sending a message to cells at the wrong time; or
- they can alter the production and availability of natural hormones.

Endocrine disruption has been well studied and well exploited for several invertebrates, especially the insects. The endocrine systems of insects have been intentionally targeted for insecticidal activity and several insecticides have been developed and used to suppress insect populations by disrupting their normal endocrine functions.

These insect growth-regulating compounds have also been known to have adverse effects in related arthropods such as crustaceans (crabs and shrimp, for example), including disrupting normal molting processes, limb regeneration, and reproduction.

Children and developing foetuses are thought to be most vulnerable to the potential effects of endocrine disrupting chemicals, due to the high level of hormonal activity taking place during development. The timing of exposure to an endocrine disrupting substance, rather than the level, is the crucial factor, with even minute doses during a critical stage in development causing serious abnormalities.

Endocrine Disrupting Substances

Both man-made and naturally-occurring substances can interfere with the endocrine system and disrupt normal processes.

Some of the chemicals known to interfere with the endocrine system include naturally-occurring female sex hormones, such as phytoestrogens in plants, polychlorinated organic compounds, such as dioxins, organochlorine pesticides, alkylphenols, phthalates in plastics, and nonylphenols in food.

These substances can be released into the environment from several sources, including incineration of waste, chemical manufacturing, textile processing, pesticide applications and domestic sewage.

Once in the environment, these substances can contaminate soil, plants and water on which wildlife live and depend. When substances enter the food chain, some are able to pass from one species to another, and can accumulate in the species at the top of the food chain.

Effects on Wild Populations

A variety of endocrine-related effects have been observed in fish and wildlife populations in many parts of the world, including Canada. Some examples include:

- deformities and embryo mortality in birds and fish caused by exposure to industrial chemicals or organochlorine insecticides;
- impaired reproduction and development in fish exposed to effluent from pulp and paper mills;
- abnormal reproduction in snails exposed to antifouling substances applied to the hull of ships;
- depressed thyroid and immune functions in fish-eating birds;
- feminization of fish near municipal effluent outlets.

Cellular and molecular processes common to insects, fish, shellfish, amphibians, reptiles, birds and mammals are not different from the cellular and molecular processes in humans. The observed effects of endocrine disruption in wild animal populations can also occur in human populations. That is why it is important to prevent and minimize the release of these endocrine-disrupting substances into the environment.