Environment Canada Environnement Canada

Endocrine Disrupting Substances in the Environment

RECENTLY, SCIENTISTS HAVE SEEN A VARIETY OF ENDOCRINE-RELATED EFFECTS IN FISH AND WILDLIFE IN MANY PARTS OF THE WORLD, INCLUDING CANADA

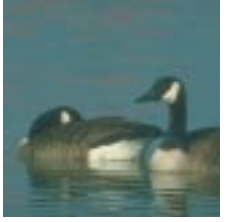
Endocrine disrupting substances in the environment have become a concern over the past few years.

Studies in Canada and other countries have shown that these substances can interact with the endocrine systems of many species and adversely affect growth, development or reproduction.

Even at very low levels commonly found in the environment, many of these chemicals may have biological impacts. Scientists had previously thought low levels presented little risk to the environment.

The consequences of endocrine disrupting substances to the health and sustainability of wildlife populations are subject to considerable scientific research and debate in Canada and around the world.

Canada



Endocrine Systems

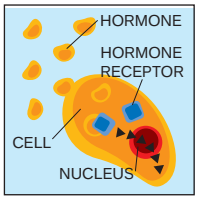
Endocrine systems are complex mechanisms, coordinating and regulating internal communication among cells. Endocrine systems release hormones that act as chemical messengers. The messengers interact with receptors in cells to trigger responses and prompt normal biological functions such as growth, embryonic development and reproduction.

Endocrine Disruption

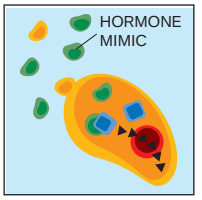
Scientists know that endocrine systems can be adversely affected by a wide variety of substances. A substance can interfere with the normal communication between the messenger and the receptor in the cell, so that the chemical message is not interpreted properly. Even very subtle effects on the endocrine system can result in changes in growth, development, reproduction or behaviour that can affect the organism itself, or the next generation. The specific mechanisms by which substances disrupt endocrine systems are very complex, and not yet completely understood.

Substances can interact with endocrine systems and cause a disruption to normal functions in several ways.

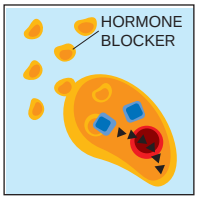
- They can act like a natural hormone and bind to a receptor. This causes a similar response by the cell, known as an agonist response.
- They can bind to a receptor and prevent a normal response, known as an antagonistic response.
- A substance can interfere with the way natural hormones and receptors are synthesized or controlled.



Normal response



Agonist response
e.g. estrogenic



Antagonist response – normal response inhibited
e.g. anti-estrogenic response

Public attention has been drawn to substances that mimic or block the feminizing effects of natural female sex hormones: for example, estrogens such as 17 ß-estradiol. This is only part of the story, however. Substances can also affect male sex hormones or other endocrine systems that influence growth, development and behaviour.

What Type of Substances Disrupt Endocrine Systems?

Given the complexity of endocrine systems, it is not surprising that the range of substances thought to cause endocrine disruption is wide and varied, and includes both natural and manufactured (synthetic) chemicals.

Industrial, agricultural and municipal wastes can expose organisms in the environment to unusually high concentrations of natural substances such as sex hormones, or phytoestrogens. Manufactured chemicals may be released intentionally – pesticides, for example; as by-products of industrial processes and waste disposal – dioxins or PCBs; or as discharges from industrial or municipal treatment systems – alkylphenols. The wide variety of sources and substances presents an enormous challenge to environmental managers in industry and government.

Sources, category (type), and examples of substances that have been reported as potential endocrine disruptors

Examples of Sources	Category (Example of Uses)	Examples of Substances
Incineration, landfill	Polychlorinated Compounds (from industrial production or by-products of mostly banned substances)	polychlorinated dioxins, polychlorinated biphenyls
Agricultural runoff / Atmospheric transport	Organochlorine Pesticides (found in insecticides, many now phased out)	DDT, dieldrin, lindane
Agricultural runoff	Pesticides currently in use	atrazine, trifluralin, permethrin
Harbours	Organotins (found in antifoulants used to paint the hulls of ships)	tributyltin
Industrial and municipal effluents	Alkylphenolics (Surfactants – certain kinds of detergents used for removing oil – and their metabolites)	nonylphenol
Industrial effluent	Phthalates (found in plasticizers)	dibutyl phthalate, butylbenzyl phthalate
Municipal effluent and agricultural runoff	Natural Hormones (produced naturally by animals); Synthetic Steroids (found in contraceptives)	17 ß-estradiol, estrone; testosterone, ethynyl estradiol
Pulp mill effluents	Phytoestrogens (found in plant material)	isoflavones, ligans, coumestans

Effects of Endocrine Disruptors

Some examples of endocrine-related effects in wild populations:

- *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.*

Canadian scientists are among the world's leaders in studying reproduction and developmental effects on wildlife populations. Their research, particularly in the Great Lakes, has been vital in bringing international attention to the issue.

Recently, scientists have seen a variety of endocrine-related effects in fish and wildlife in many parts of the world, including Canada. Fortunately, in many of these cases, action has been taken to reduce exposure, and at least some wildlife populations have recovered.

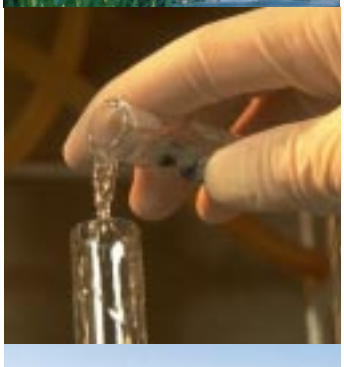
Research on Endocrine Disruptors

Until recently, much of the research has focused on persistent, bioaccumulating, toxic substances (PBTs). These are substances still widely distributed in the environment and found in birds, fish and mammals, even though their manufacture and use have been reduced or banned completely. For instance, many persistent, bioaccumulating toxic substances (such as dioxins, PCBs and organochlorine pesticides) are a concern in ecosystems across the country.

Scientists have now focused attention on a number of substances not so highly persistent, but still widespread in the environment. Even at relatively low levels, these can affect growth, reproduction and development of organisms in Canadian ecosystems. They include substances in industrial and municipal effluents and in agricultural runoff, natural estrogens in plants (phytoestrogens), and specific chemicals such as alkylphenols and tributyltin and those found in some pesticides.

Environment Canada scientists continue to study effects on reproduction and development as an important means to assess endocrine-disrupting substances. They are also gaining a better understanding of other types of biological impacts. To help in this work, scientists are re-examining and adapting many of the tools and approaches used in the past so that they can detect subtle, but critical, impacts on the endocrine systems of wild populations of fish and wildlife.

Environment Canada is a Leader in Addressing the Endocrine Disruptor Issue



Endocrine disrupting substances (EDS) are a complex problem that requires a co-ordinated response from government agencies, universities, industry and the public. Environment Canada has made EDS a research priority to produce the knowledge necessary for informed policy and regulatory decisions.

In partnership with Health Canada, Environment Canada manages the Toxic Substances Research Initiative, which includes support for research on EDS. In addition, Environment Canada has included research on EDS in each of the major Regional Ecosystem Initiatives, and has established a national multidisciplinary research program in collaboration with other government agencies, universities and industry.

To address this emerging global issue, Environment Canada is working with international organizations such as the Organization for Economic Cooperation and Development (OECD), United Nations Environment Programme (UNEP) and others.

Research on this question will produce sound scientific assessments of the potential impacts of EDS on the Canadian environment. Such assessments are essential for the development and implementation of effective regulations and controls.

Visit Environment Canada's website, **The Green Lane**, for more information on EDS at: http://www.ec.gc.ca

Other related websites:
Agriculture and Agri-Food Canada:
www.res.agr.ca/lond/pmrc
Health Canada:
www.hc-sc.gc.ca/hpb
National Water Research Institute:
www.cciw.ca/nwri
National Wildlife Research Centre:
www.ec.gc.ca/cws-scf/nwrc
Organization for Economic Cooperation and Development:
www.oecd.org
Pest Management Regulatory Agency:
www.hc-sc.gc.ca/main/hc/web/pmra-arla
Toxic Substances Research Initiative:
www.hc-sc.gc.ca/tsri
United Nations Environment Programme:
www.unep.org

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