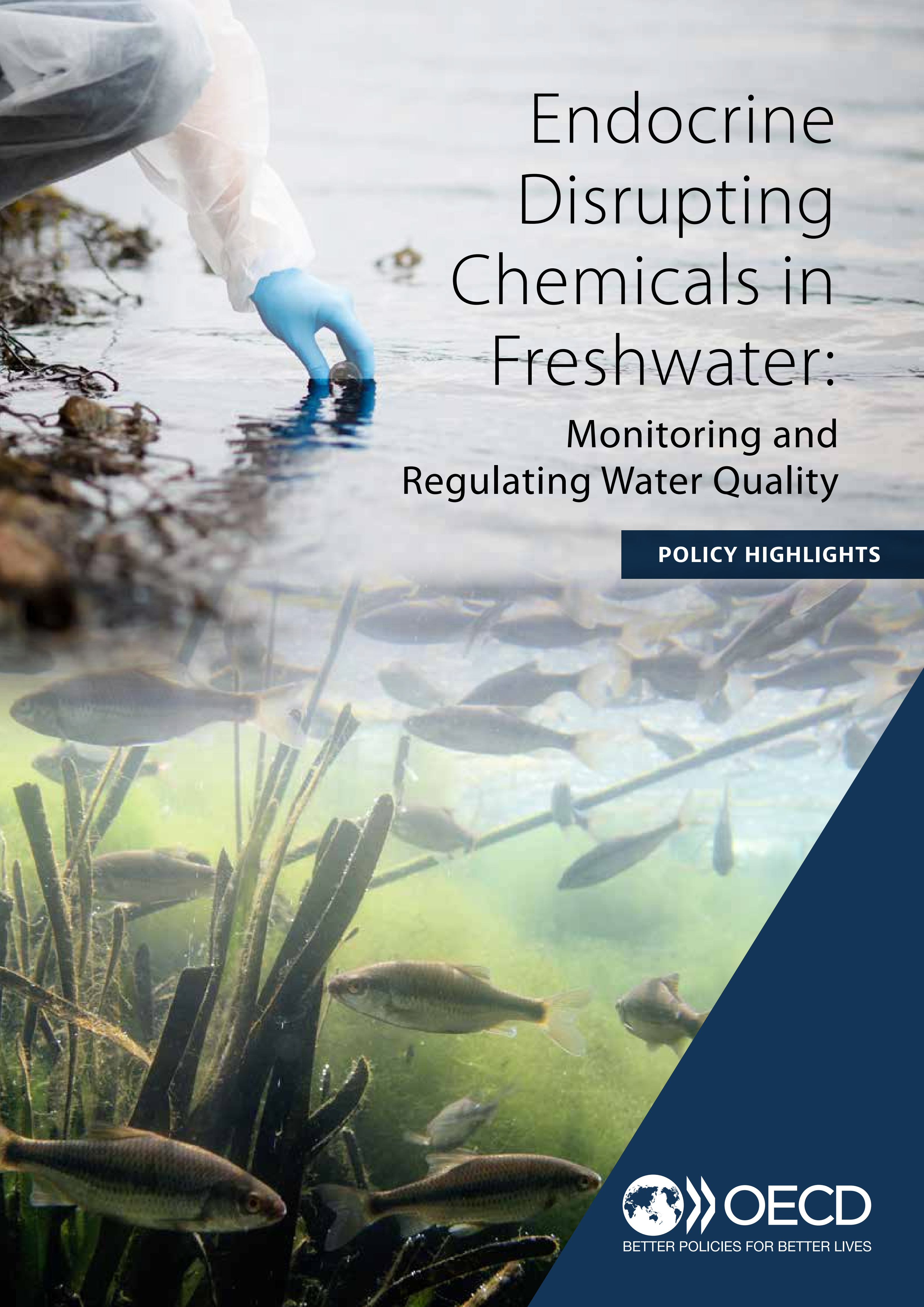
Endocrine Disrupting Chemicals in Freshwater:

Monitoring and Regulating Water Quality

POLICY HIGHLIGHTS

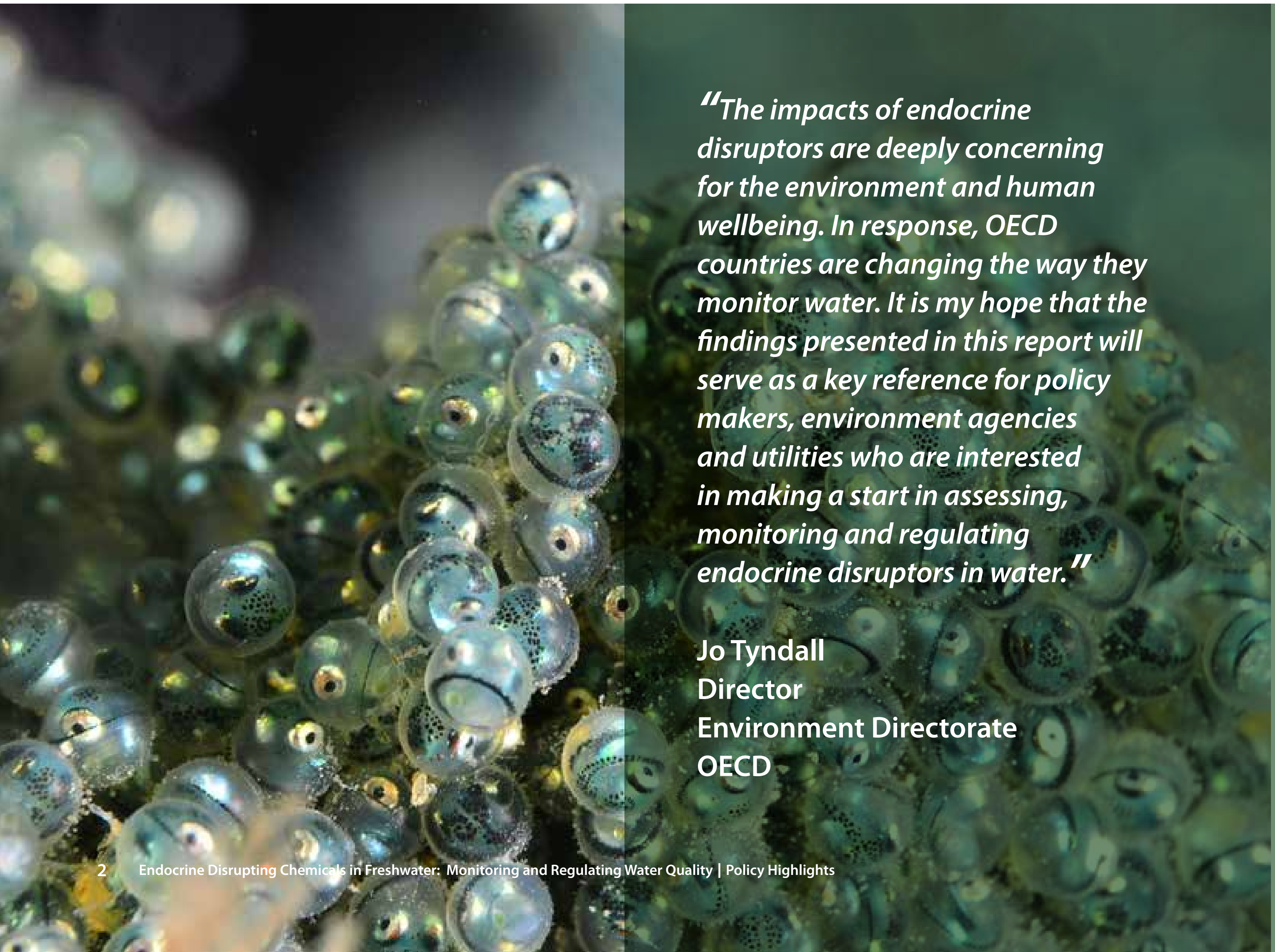


BETTER POLICIES FOR BETTER LIVES

Contents

The OECD (2023) report Endocrine Disrupting Chemicals in Freshwater: Monitoring and Regulating Water Quality calls for a better understanding, better monitoring, and policy actions to prevent and remedy emerging concerns. The Policy Highlights:

- Characterise the state of knowledge about endocrine disrupting chemicals in water, whether it be surface water, groundwater, wastewater, reused wastewater, or drinking water.
- Prioritise traditional and emerging tools for water quality monitoring, including chemical analysis, bioassays as effect-based methods, non-targeted analysis, and in situ wildlife monitoring, based on good practices from OECD countries.
- Explore policy responses to address the presence and impact of endocrine disrupting chemicals in water.



"The impacts of endocrine disruptors are deeply concerning for the environment and human wellbeing. In response, OECD countries are changing the way they monitor water. It is my hope that the findings presented in this report will serve as a key reference for policy makers, environment agencies and utilities who are interested in making a start in assessing, monitoring and regulating endocrine disruptors in water."

Jo Tyndall
Director
Environment Directorate
OECD

Endocrine disrupting chemicals in water: an emerging concern

Endocrine disrupting chemicals interfere with the endocrine system of hormones and glands, in humans and in wildlife (Figure 1). Exposure to endocrine disrupting chemicals, for example through food, consumer products, air, or water, can lead to negative health effects to humans and wildlife.

Some of the reported effects from human exposure to endocrine disrupting chemicals are birth defects, neurodevelopment conditions, reproductive health impacts, obesity and metabolic diseases. As for wildlife, well-known impacts are alterations of the hormonal system, reproductive dysfunctions, and the feminisation of male fish. The negative effects of contamination can be passed on to other organisms, populations, communities, and even generations.

Endocrine disruptors are constantly discharged into water through excretion, wastewater treatment plants, landfills, runoff from agriculture and urban areas, industry and leaching of wastes (Table 1 and Figure 2).

Climate change-related stressors such as increasing water temperatures and acidification, combined with chemical pollution, can worsen the impact of endocrine disruptors on wildlife and ecosystems. Intense rains can increase agricultural runoff and sewer overflows. Endocrine disruptors trapped in glacial ice or sediments may be released under climatic extremes. Climate change can also have an indirect effect on pollution, for instance when regions resort to wastewater recycling to adapt to droughts. Urbanisation, population increase, population ageing, economic growth, and the non-communicable diseases epidemic may also increase the discharge of endocrine disrupting chemicals in water.

Monetising the economic costs of endocrine disruptors

Environmental pollution from chemicals has substantial economic effects, in spite of the benefits that chemicals offer. A handful of studies have assessed and monetised the costs of human exposure to endocrine disrupting chemicals.

Figure 1. The endocrine system with its main glands and organs and their respective hormones

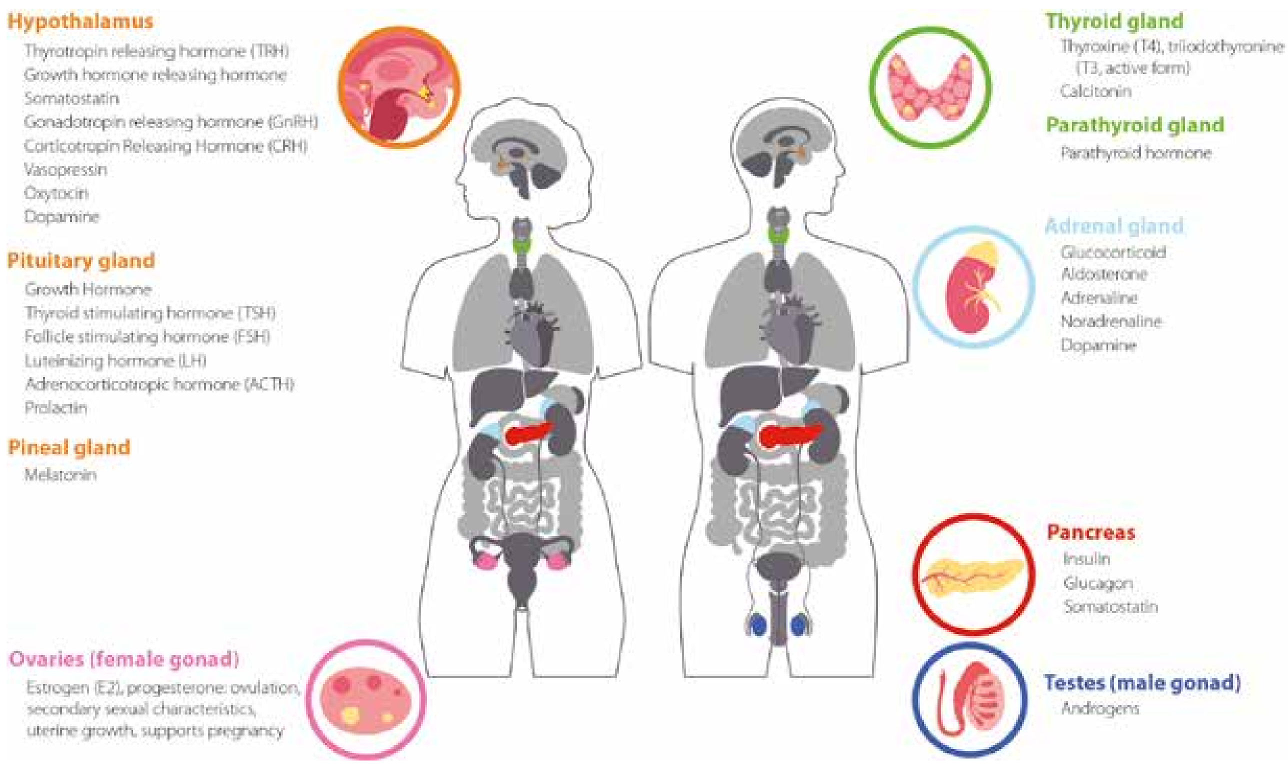


Table 1. Summary of sources, environmental pathways and sinks of EDCs in freshwater and oceans

Sources	Entry pathways into the environment	Sinks
Household and consumer uses	***Point sources***	Aquatic organisms (biological retention) Freshwater bodies (rivers, lakes, groundwater) Soils Sediments Cryosphere Oceans
e.g. Cleaners, Electronics, Food packaging, Personal care products, Pharmaceuticals, Plastics, Toys	Wastewater treatment plants	
Agriculture and aquaculture	***Diffuse sources***	
e.g. Treated sewage sludge, Pesticides, Pharmaceuticals, Poultry and fish feed	Agricultural runoff Urban runoff Industrial outfalls Waste disposal Leaching (wastes, septic tanks)	
Industrial production	***Environmental migration***	
e.g. Combustion, Disinfection by-products, Metals, Plasticizers	Atmospheric currents River flows Ocean currents Groundwater-surface water exchange Fish spawning	
Transportation		
e.g. Fossil fuel combustion, Ships		

Figure 2. Summary of sources, environmental pathways and sinks of endocrine disrupting chemicals in freshwater and oceans

What are the economic costs of the disease burden caused by exposure to endocrine disrupters?[1]

EUR 163 billion

in the EU (1.28% of EU GDP)

(Trasande et al., 2016)

USD 340 billion

in the US (2.33% of US GDP)

(Attina et al., 2016)

CAD 24.6 billion

in Canada (1.25% of Canadian GDP)

(Malits, Naidu and Trasande, 2022)

[1] The cost estimates cannot be fully attributed to environmental exposure. Other exposure routes significantly contribute to the burden of disease, such as through food contact materials, working in occupations with high chemical exposure, or breathing in polluted air.

Managing the environment-related costs of PFAS, an endocrine disruptor, over the course of 20 years amounts to:

EUR 46 million – EUR 11 billion

per country in Denmark, Finland, Iceland, Norway, and Sweden.

(Goldenman et al., 2019)

The challenge of managing endocrine disrupting chemicals in water

Endocrine disrupting chemicals are not extensively regulated in OECD countries to date. Endocrine disrupting chemicals in water are a challenge to manage for several reasons:

1

Endocrine disruptors are not "ordinary" chemicals. Endocrine disrupting chemicals can work at low doses, with concentrations as low as less than a nanogram per litre, and in mixtures with other chemicals. Because of these properties, some endocrine disrupting chemicals circumvent traditional ways of monitoring. They can trigger adverse effects at doses below the threshold values of traditional chemical analysis. Moreover, only a fraction of the approximately 800 endocrine disrupting chemicals are regularly monitored in water.

2

Regulators have only partial control over the release of endocrine disrupting chemicals into the environment, as endocrine disruptors are not completely removed by wastewater and drinking water treatment processes. They are also released into the environment through diffuse sources, transboundary sources, and as legacy chemicals long after their use has been restricted or banned.

3

Endocrine disruption is characterised by uncertainty. Causal relationships between exposure and adverse effects on humans and wildlife are not fully understood. Many chemicals are not recognised or even suspected as endocrine disruptors.

4

Endocrine disrupting chemicals stem from a very diverse group of uses, products and processes. The cross-sectoral, transboundary and multidisciplinary nature of this problem demands attention across multiple policy domains, such as those related to water resources management, chemical safety, public health, agriculture and food, environment and biodiversity, industry, trade, and waste management.

Only 5%

of all known chemicals are monitored through targeted chemical analyses.
(McCord, Groff and Sobus, 2022)

Exposure to 1.5 ng/L of EE2

is enough to cause adverse effects in juvenile trout. EE2 is a residue of the contraceptive pill.
(Rehberger, 2020)

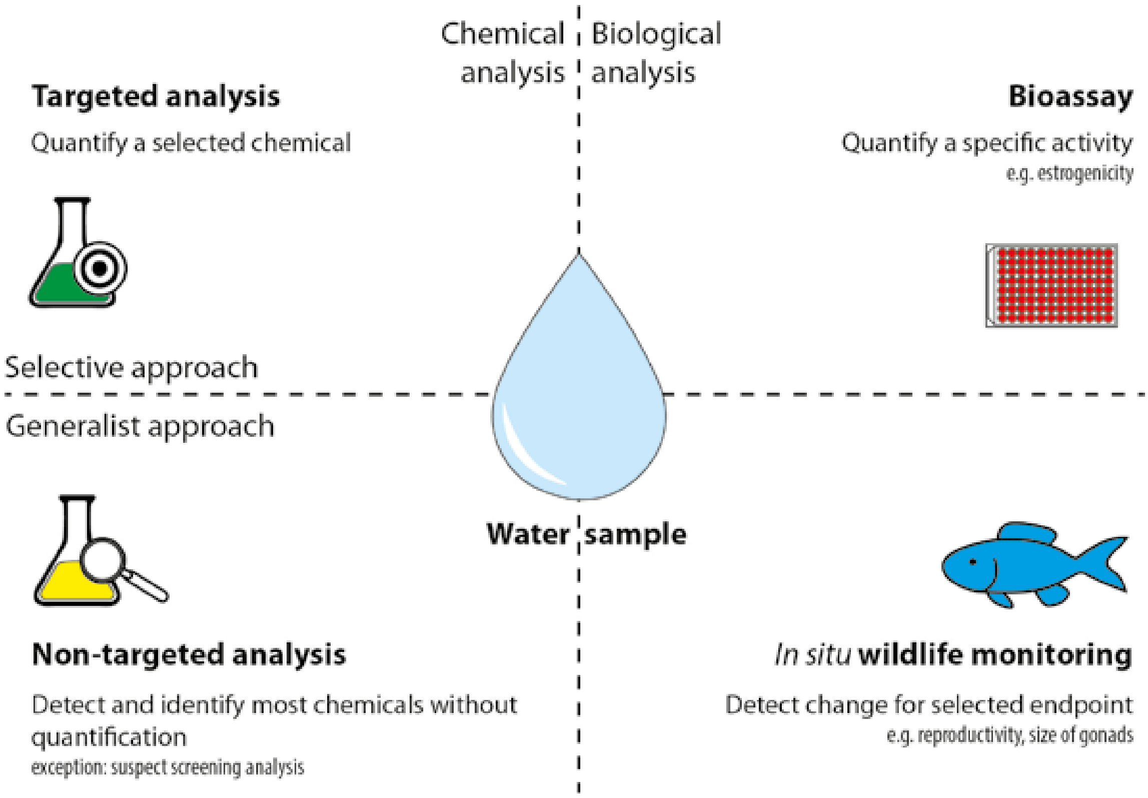
Scientist Karen Kidd demonstrated that chemicals can lead to a population decline in a lake. Kidd introduced low concentrations of the estrogen used in the birth control pill, commonly found in urban wastewater, to a lake. Result? The estrogenic compounds caused a reproductive failure in the fathead minnow fish, and its population almost entirely collapsed.

(Kidd, 2014)

Ways of monitoring endocrine disruption in water

Monitoring the presence of endocrine disruptors and endocrine activity in water can inform regulatory decisions. Supplementing traditional targeted chemical analysis with new monitoring methods may better screen the risks of endocrine disruptors in water. Some of the newer methods include bioassays, non-targeted analyses and eDNA. While each monitoring tool has its advantages and disadvantages, together they make a very strong toolbox.

Figure 3. Ways of testing a freshwater sample



Targeted chemical analysis

Targeted chemical analysis is a common good practice for water quality monitoring

Targeted chemical analysis, or substance-by-substance monitoring, is used to determine the concentration of individual chemical of interest in a selected water sample. Their concentration is then compared to the associated standard.

Non-targeted analysis

Identifies all chemicals present in water

Non-targeted methods aim to identify all chemicals present in an environmental sample without quantifying their concentration. Most methods will analyse "known unknown" chemicals of which at least the structure is classified in databases, and of which some toxicity data is available. Other methods identify "unknown unknown" chemicals for which the molecular structure is not clearly defined or registered. High-resolution mass spectrometry (HRMS) is the typical method of choice. eDNA is an emerging method to assess species richness by identifying traces of the genetic material of species.

Bioassays

Bioassays identify the adverse effects of chemicals and are a promising supplement to targeted chemical analysis

Bioassays are sensitive methods and have the advantage of detecting chemicals' activity without the need for an upfront substance-by-substance analysis. A bioassay is nothing more than a cell, fish or frog embryo, or animal used to test whether a chemical, or water, is toxic. Bioassays are biological test methods performed using in vitro (cell-based or cell-free) or in vivo (whole organism) models to detect effects in a concentration-dependent manner on toxicological endpoints of concern. The EATS modalities are well-studied: Estrogen, Androgen, Thyroid and Steroidogenesis.

In situ wildlife monitoring

Identifies all chemicals present in water

In situ wildlife monitoring methods survey species in the wild for any significant physical, molecular or behavioural changes, which could indicate changes in the endocrine system for example. This method captures impacts that are happening in the wild.

Frequently asked questions on bioassays for water quality monitoring

Bioassays are a promising method to monitor endocrine activity in water. Frequently used in academia, they are also gaining traction with water regulators and utilities.

How do bioassays work?

When a bioassay is exposed to an active chemical, the bioassay will "show" an effect. In animals (in vivo assays), bioassays can show a physical change, such as a change in the number of eggs, presence of specific proteins or steroids in blood, or a change in organs (more masculine or feminine than before). In vitro assays, for example a cell, may light up when a negative effect occurs. A bioassay is designed to observe a specific adverse health effect, such as effects on the estrogenic system or the thyroid. Some, more complex, bioassays can detect multiple effects. Bioassays are also referred to as effect-based monitoring methods.

What are the benefits of using bioassays for water quality monitoring?

Bioassays are appropriate as an early warning or screening method of potential harmful pollution of ambient water, drinking water sources, effluents, and recycled water. Bioassays detect chemical activity and are therefore not limited to a predefined list of chemicals. Due to their sensitivity, many bioassays can detect effects at concentrations as low as nanograms per litre. They can also detect effects caused by mixtures of chemicals.

What are the limitations of using bioassays for water quality monitoring?

While bioassays measure effects present in water, they do not detect the sources or "culprit chemicals" contributing to these effects. Additional analyses, such as effect-directed analysis, must be performed to point towards the responsible chemical(s). Moreover, bioassays and their sampling protocols remain largely non-standardised. Infrastructure, such as laboratory capacity and access to bioassay providers, and high costs (depending on region) also hinder large-scale adoption. Effect-based trigger values or threshold values need to be in place to interpret the level of risk of each observed effect.

20 %

Freshwater contains complex mixtures of naturally occurring and man-made chemicals. On average 20 % of aquatic species are lost due to exposure to chemical mixtures" (European Environment Agency, 2020)

EUR 1 million

The validation process of an in vitro bioassay takes at least two years and can cost as much as EUR 1 million, or even more. This excludes the costs of method development. (Philippe Hubert, Director of the Pepper Platform)

How are the results of bioassays interpreted?

Effect-based trigger values are the threshold values for bioassays. Effect-based trigger values help interpret whether the effects detected in a bioassay are acceptable or not. Effect-based trigger values are necessary as not all levels of activity are a risk to humans or aquatic species, particularly given that bioassays are very sensitive to even low doses of contamination.

Are bioassays appropriate as a regulatory water quality standard?

There is potential in adopting bioassays as a water quality objective or a regulatory standard in the future. There are few regulatory applications to date. California's State Water Board (United States) have adopted effect-based water quality standards. The European Commission is preparing for potential regulatory application in the future. Some requisites are: sufficient data collection on chemicals and their subsequent effects in bioassays, a sufficient choice of bioassay providers (which can be achieved through standardisation of bioassays and sampling and by developing performance standards), laboratory infrastructure, and threshold values or trigger values.

What are the costs of monitoring with bioassays?

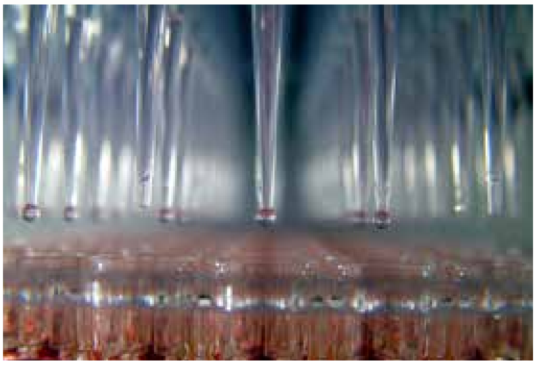
The comparatively high costs of bioassays can be a barrier to their widespread adoption in water quality monitoring programmes. However, these costs highly vary per region and could be lowered over time. The costs of a bioassay-based monitoring programme vary depending on access to cell line providers, laboratory capacity, in-house analytical capacity, and country. The costs of bioassays that require a license are generally higher than license-free bioassays. The costs of bioanalytical methods are expected to go down when the global market of bioassays matures and demand increases.

Do bioassays stimulate animal testing?

The *in vivo* bioassay methods are a form of animal testing. Fish species are commonly used in freshwater and effluent testing. Caution should be made in designing a monitoring programme or regulatory standard that unintentionally and undesirably stimulates animal testing, particularly if non-animal methods are available. *In vivo* methods should be avoided where possible, but sometimes there is a reason to use them for water monitoring. For some endpoints, *in vivo* methods may be the only method sufficiently sensitive or reliable to make statements on toxicity of a water or effluent sample. *In vivo* methods can also be used as a second-step test to confirm effects found *in vitro* settings.

EUR 800-1100

The implementation of a complete set of bioassays costs about EUR 800-1100, which comes down to around EUR 100 per bioassay.
(De Baat, Van Den Berg and Pronk, 2022)



EUR 140-200

The cost of estrogenic effect monitoring has been estimated at approximately EUR 140-200 per sample within the European Union (Working Group Chemicals, 2021)

Country practices of monitoring and regulating EDCs in freshwater

Canada - Canada has been monitoring effects of endocrine disruption in fish through its Environmental Effects Monitoring programme since. Paper & pulp mills are obliged to monitor the impacts of their effluents on the growth, health, and reproductive potential of fish, report the outcomes, and make changes in the production process when effects are observed in two monitoring cycles.

California, United States - In the United States, the California State Water Board has adopted endocrine effects, ER and AhR, as water quality standard in its Recycled Water Policy. These effects are routinely monitored by utilities, using bioassays.

France - France applies a decision tree to adjust existing Environmental Quality Standards by factoring in the endocrine disruptive effects of chemicals. This could lead to more stringent water quality standards for those compounds that have endocrine effects.

Rhine River (Basel, border between Switzerland and Germany) - The monitoring station of the International Commission for the Protection of the River Rhine uses, on a daily basis, non-target screening to detect accidental spills for the safety of drinking water production, and to collect data for long-term monitoring.

The Netherlands - Water authorities in the Netherlands combine targeted chemical analysis with bioassays in water quality programmes. Bioassays serve as an early warning system for potential chemical risks in surface water quality. Information toolkits on bioassays for water quality monitoring are available for beginners and frontrunners.

Victoria, Australia - The Environmental Protection Agency Victoria, in Australia, has conducted two monitoring campaigns using targeted chemistry to set a baseline and improve understanding of presence and absence of endocrine disrupting chemicals in wastewater and waterways.

Switzerland - The Swiss Ecotox Centre stresses combining chemical analysis and bioassays to provide cost-effective pre-screening with high sensitivity and to capture the risk of mixtures of chemicals in surface water. Switzerland has put steroidal estrogens (E1, E2, EE2) and pharmaceuticals (diclofenac, a non-steroidal anti-inflammatory) on its surface water quality watch lists.

European Union - The European Commission submitted a proposal to include estrogenic compounds (E2, E1 and EE2) on the list of priority substances in the Water Framework Directive. The proposal also requires countries to deploy bioassays to assess the presence of estrogenic hormones in water bodies, in view of possible future setting of threshold values.

Chemical life cycle approaches to manage endocrine disruptors in freshwater

A policy mix, combining sourced-directed approaches, use-oriented approaches, and end-of-pipe measures, of chemicals and product groups, can protect human health and the integrity of ecosystems (Figure 4). Three relevant instruments are highlighted to manage endocrine disrupting chemicals:

Source-directed measures: chemical assessment

At the source, environmental protection agencies, water authorities, river basin organisations and utilities can support initiatives that decrease the identification time of endocrine disruptors.

Water managers have access to public databases that inform about the suspected or confirmed endocrine disrupting properties of a substance, such as EDLists.org, the Endocrine Active Substances Information System, Database of Endocrine Disrupting Chemicals and their Toxicity Profiles. Such databases can support the prioritisation of problematic endocrine disrupting chemicals in activities such as monitoring, permitting and designing policy interventions.

Use-oriented measures: support waste disposal campaigns, consumer awareness campaigns, labelling schemes, and private sector initiatives

Water authorities would benefit from stimulating and getting involved in use-orientated initiatives even if these are not directly linked to the water sector, such as waste disposal campaigns, consumer awareness campaigns, labelling schemes, and private sector initiatives. Household decisions on avoiding endocrine disruptors in their daily consumption, often motivated by personal health reasons, ultimately co-benefit the environment.

End-of-pipe measures: wastewater treatment and discharge permits

A "one size fits all" treatment for EDCs does not exist and no single technology can remove all EDCs. End-of-pipe measures should therefore only be used in combination with source-directed and use-orientated measures. An over-emphasis on upgrading wastewater treatment infrastructure is not a sustainable, optimal use of limited financial, technical and natural resources. Regulators could prioritise more stringent treatment standards to those discharges that pose a particular pressure to health or ecosystems.

In setting quality standards for wastewater discharge permits, it may be obvious to opt for standards based on human health parameters, given public concerns about the safety of recycled water. However, more stringent criteria based on wildlife protection may be a better choice, as aquatic organisms are continuously exposed to water and can trigger cascading consequences.

Figure 4. Selected life cycle instruments that contribute to water quality improvements

Source-directed instruments

- Substance ban
- Market authorisation
- Group assessment of chemicals
- Green public procurement
- Positive material lists
- Good manufacturing practice and audits
- Prevention of emissions
- Subsidies for green action or innovation
- Pollution charges
- Information campaigns
- Voluntary initiatives
- Water safety planning

Use-oriented instruments

- Substance ban
- Substance restriction
- Best environmental practices for sectors (agriculture, food, pharmaceuticals, other)
- Product charges
- Substance charges
- Subsidies for "green" action
- Public environmental campaigns
- Eco-labelling of EDC-free products

End-of-life and end-of-pipe instruments

- Best available technique
- Wastewater treatment standards
- Discharge / pollution permit
- Waste collection / takeback schemes
- Disposal requirements
- Buffer zones and nature-based solutions
- Effluent/ emission charges
- Wastewater tariffs or taxes for WWTP upgrades
- Subsidies for improved wastewater treatment
- Extended Producer Responsibility schemes
- Advisory services on treatment or waste management
- Voluntary agreements on wastewater treatment

Effect-centred approaches to manage endocrine disruptors in freshwater

Effect-centred approaches can accompany the development and the increasing availability of effect-based technologies to monitor endocrine disruption in freshwater. They help make the best use of these technologies.

Response plans

The lag time between observing a risk of endocrine disruption - whether this is in the wild, through bioassays or chemical analysis – and taking action to mitigate the effects can take several years. Predefined response plans can significantly reduce this lag time. A response plan could contain: i) accepted methods for collecting evidence, including methods that do not require animal testing, ii) a selection of temporary no-regret or low-cost mitigation options, iii) a clear description of the roles and responsibilities of involved authorities and the actor behind the source of emission, iv) guidance on the interpretation of exceeded trigger values, and v) a communication plan that details out how potential risks can be explained and what kind of actions are being taken, particularly in relation to health concerns for human health and wildlife.

A regulatory fitness check

The European Commission published a regulatory Fitness Check on endocrine disrupting chemicals in 2019-2020, assessing whether the different pieces of EU legislation are fit to address the impacts of endocrine disrupting chemicals (European Commission, 2020). Belgium's National Action Plan on Endocrine Disrupting Chemicals also contains an analysis of regulatory strengths, weaknesses, and gaps. (Government of Belgium, 2022)

National strategies on endocrine disruptors

National strategies and action plans send a policy signal on the priorities of government related to endocrine disruptors. They can act as a first step towards developing policy instruments and monitoring programmes. National Action Plans involve many sectors, at least including the human health, chemical, agricultural, food safety, and environmental sectors, as well as academia, industry, and consumer organisations. Some of the topics that could be covered in water-relevant national strategies are i) an analysis of regulatory strengths, weaknesses, and gaps; ii) research and pilot priorities to fill knowledge gaps, iii) actions targeted at the reduction of endocrine disruptors in the (aquatic) environment, iv) water quality monitoring and assessments, and v) communication and outreach activities, including for vulnerable populations.

Environmental quality norms

Environmental quality norms or water quality criteria could be developed for specific endocrine disrupting chemicals. Moreover, many existing environmental quality standards for chemicals do not consider the endocrine disrupting properties of substances. Existing standards could therefore be made more stringent by reflecting the endocrine disruptive properties of substances into the equation. Some authorities are considering introducing water quality regulation based on bioassays. This involves setting effect-based trigger values or threshold values that determine the acceptable level of risk observed in a bioassay.

Policies that consider the impacts on vulnerable populations

The risk of exposure to endocrine disrupting chemicals can be higher to certain groups within a population, because of biological factors such as age and sex, or a higher risk of exposure due to socio-economic factors such as residence, occupation, or diet. Humans can also be culturally affected by endocrine disruptors when the existence of culturally important species or cultural keystone species is under threat. This can be especially relevant to indigenous peoples. Some policy options to targeting vulnerable groups are i) chemical risk assessments targeting vulnerable groups and populations, ii) information campaigns targeting specific groups, such as dietary advice campaigns during pregnancy, and iii) assessing, modelling and reporting biodiversity changes, particularly targeting endangered species and cultural keystone species.

Effect-based water quality standards in practice

The California State Water Board, United States, adopted effect-based water quality criteria for recycled water. The estrogen receptor-α (ER-α) cannot exceed a threshold level of 0.5 ng/L. The ER-α receptor can be activated by different contaminants, such as estradiol, bisphenol A and nonylphenol. The threshold levels can be adjusted based on new insights.

(California State Water Board, 2018)

France's Second National Strategy

In 2019, France launched its Second National Strategy on Endocrine Disruptors to tackle endocrine disrupting chemicals in all spheres of society, including freshwater.

(Ministère de la transition écologique et solidaire, 2019)

International actions at the forefront

International coordination of actions that mitigate the risk of endocrine disrupting chemicals in freshwater is warranted on two grounds: i) endocrine disruptors cross administrative boundaries through international water basins and trade; and ii) international coordination can make responses more cost-effective. Several options for international coordination are listed below.

Standardisation and validation of test methods

The standardisation and validation of test methods that are appropriate for water quality testing, need to be upscaled at international level. Currently, there are only few international guidelines and standardised methods for sampling and analysis of water quality testing for endocrine disruptors. These guidelines are provided by the International Organization for Standardization (ISO) and the OECD Test Guidelines programme.

Stimulate the demand for bioassays

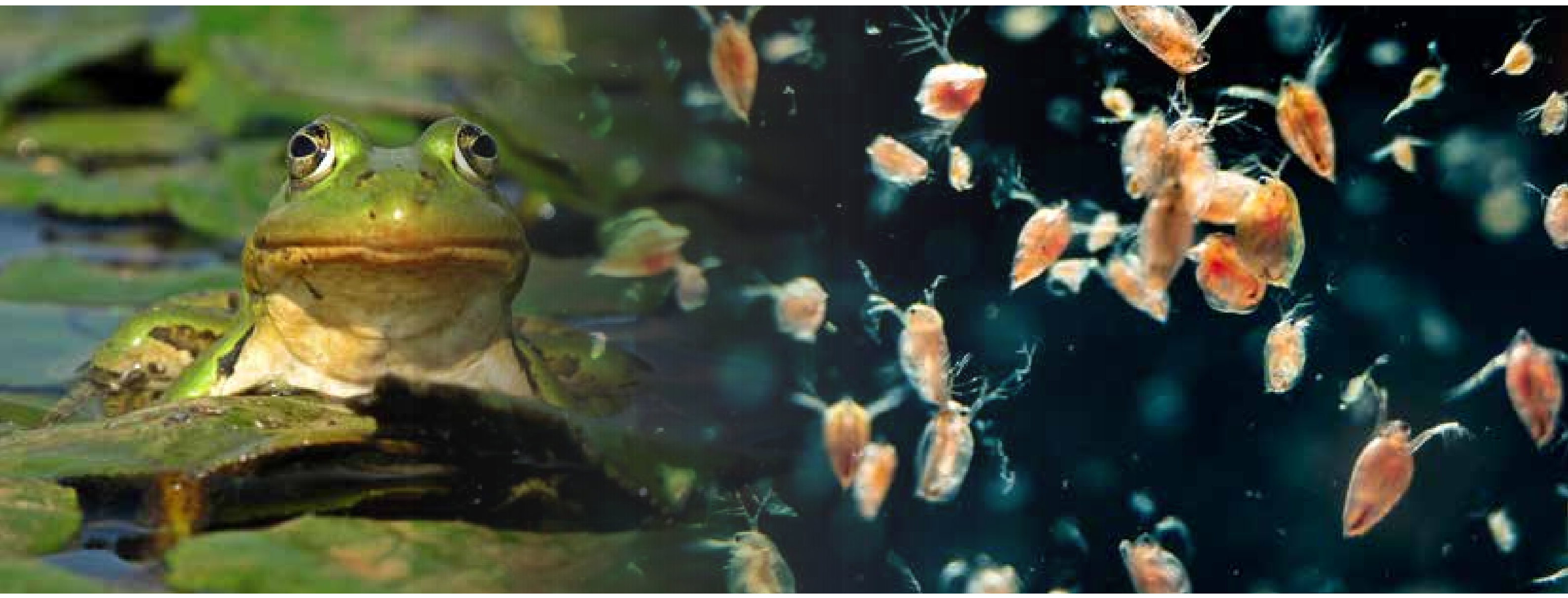
Governments, at national and international level, could stimulate the uptake of new methods, by developing user toolkits and by training laboratories to perform bioanalytical methods for water quality testing. The international market of bioassays - specifically for water quality testing - needs to be expanded in terms of suppliers, bioassay variety and geographical service areas. Governments could play a role in opening up the market to bioassay vendors through (international) environmental technology verification programmes, developing performance standards, standardising and validating methods, or by transferring technologies from other sectors to the water sector.

International research partnerships

International research partnerships have proven to be instrumental in monitoring, supporting regulatory action and sharing knowledge and data on endocrine disrupting chemicals. Examples of research partnerships are the NORMAN Network, the Global Water Research Coalition (GWRC), the European Partnership for the Assessment of Risk from Chemicals (PARC), and the Intersectoral Centre for Endocrine Disruptors Analysis (ICEDA) in Canada.

International science-policy agendas

The issue of endocrine disruption could be mainstreamed across international science-policy agendas on, for instance, pollution, plastics and One Health.



Pepper Platform

The Pepper Platform is a public-private platform, based in France, that supports bioassay developers in the process of pre-validation of test methods for the identification of endocrine disruptors. This is an expensive and thorough process. For example, the validation of *in vitro* bioassays in an OECD Test Guideline requires that three laboratories, without prior experience with the method, acquire the know-how to apply the method, demonstrate the repeatability, predictability, and reproducibility of the results for 30 chemicals, replicating the experiments at least three times. For *in vivo* bioassays, this process is even longer and more expensive. An intermediate party, such as Pepper, pools the resources and expertise to validate test standards.

Intersectoral Centre for Endocrine Disruptors Analysis

To remove barriers and decompartmentalise knowledge between and across sectors of industry and academic disciplines, researchers in Canada founded the Intersectoral Centre for Endocrine Disruptors Analysis (ICEDA) in 2020. ICEDA's work is divided into three axes: intersectoral collaboration, knowledge sharing - with publications ranging from children's books to journal editions - and the active involvement of policymakers in all committees.

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Endocrine Disrupting Chemicals in Freshwater: Monitoring and Regulating Water Quality

This Policy Highlights is based on the OECD publication *Endocrine Disrupting Chemicals in Freshwater: Monitoring and Regulating Water Quality*.

Endocrine disrupting chemicals (EDCs) are contaminants of emerging environmental and health concern that have been detected in freshwater, wastewater and drinking water. They interfere with the endocrine system in humans and wildlife, and produce adverse effects such as developmental, reproductive, neurological and immune effects. Their presence in water raises concerns for the integrity of ecosystems and biodiversity. Addressing the challenges of EDCs in water is particularly complex due to their ability to trigger adverse effects at very low concentrations, their potency in mixtures with other chemicals, and the vast range of sources and entryways of this group of chemicals into the environment. This report presents new water quality monitoring methods, such as bioassays and non-targeted analysis, that are well equipped to capture the impacts of EDCs in water. These new methods supplement the traditional substance-by-substance chemical analysis of water quality. The report also outlines policy instruments to manage the chemicals' lifecycle from source to end-of-pipe. It proposes tools and regulations that respond to the negative effects of endocrine disruption, even if the culprit chemical is still unknown. The analysis draws on case studies from OECD countries to provide practical examples and concrete policy actions.

To access the full report:

OECD (2023), *Endocrine disrupting chemicals in freshwater: Monitoring and Regulating Water Quality*, OECD Studies on Water, OECD Publishing, Paris, https://doi.org/10.1787/5696d960-en.

For more information:

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