

Science for Environment Policy

Increasing impact of oestrogen pollution through climate change and population growth

Oestrogens are 'female' hormones that can enter the aquatic environment after excretion by humans and animals, causing 'feminisation' of male fish. This study carried out a risk assessment for oestrogen-like endocrine disruption in the UK in the 2050s, based on likely changes to the human population, river flows and temperature. The authors found that risk is likely to increase under future conditions and recommend further research to assess whether improving sewage treatment could reduce oestrogen pollution.

Endocrine-disrupting compounds can enter the aquatic environment via a number of different pathways and in particular via certain urban wastewater discharges, atmospheric deposition, etc. There, they can persist for years and bioaccumulate up the food chain. Exposure to these chemicals can disrupt several bodily systems, leading to changes in a number of wildlife species.

For example, the presence of both male and female characteristics within the same fish (intersex) is increasingly being observed, causing serious reproductive dysfunction. In humans, too, there is evidence that endocrine disruptors can have adverse effects on health. A number of concerning links have been made between endocrine-disrupting compounds and human health, including declining sperm counts, increased incidences of certain cancers and congenital malformations in children.

This study focused on their effects on fish in rivers in England and Wales, where the main chemicals responsible for intersex in male fish are three steroid oestrogens: oestrone, oestradiol (natural hormones) and ethinyl oestradiol (a synthetic hormone used in oral contraceptive pills). The European Commission proposed annual average environmental quality standards for the latter two in 2012¹, but instead they were placed on a watch list of substances to gather monitoring data to facilitate the determination of appropriate measures to address the risk posed by them.

In order to accurately regulate these substances, it is important to identify where and to what extent they pose risks, both under current and future circumstances. In the coming years, [climate change](#) will alter river flows and temperature, and is likely to affect the risk posed by steroid oestrogens by affecting their dilution and degradation in the aquatic environment. Increases in human populations will also increase the emission of steroid oestrogens.

This study tested the hypothesis that climate change and population changes will increase the risk of endocrine disruption in fish due to steroid oestrogens in England and Wales by 2050.

The researchers reproduced a risk assessment made in their previous [study](#), in which risk was determined by comparing predicted environmental concentrations with threshold levels based on endpoints likely to cause a population response in fish (e.g 100% feminisation for oestradiol and reduced fertilisation effects for ethinyl oestradiol). The researchers incorporated changes in river flows, water temperatures and populations in order to assess future risk.²

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Contact: rjw@ceh.ac.uk

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1. [European Commission, 2012. Proposal for a Directive of the European Parliament and of the Council Amending Directives 2000/60/EC and 2008/105/EC as Regards Priority Substances in the Field of Water Policy – COM\(2011\), p. 876 \(final\).](#)

2. Full details in Chapter 3 of the report to the Environment Agency, available from the NERC Open research Archive <http://nora.nerc.ac.uk/2810/>

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A model was used to predict the environmental concentrations of oestrogens in each river in England and Wales, and a combined toxic equivalent concentration was used to assess their collective biological effects. The risk of fish endocrine disruption in each river was classified as 'no risk', 'at risk' or 'at high risk'.

To determine the potential impact of climate change, the researchers used three different scenarios based on the UK Met Office's [2009 UK Climate Projections](#): average, wet and dry. These scenarios differ in average annual rainfall and river flows. The authors also accounted for differences in river temperature, which affects the rate of decay of chemical substances.

The researchers analysed the effects of human population increases using figures based on population projections for England and Wales in 2050 generated by the UK [Office for National Statistics](#). They also accounted for ageing of the population, which for a given number of inhabitants will reduce excretion of ethinyl oestradiol due to the increase in menopausal women, and, therefore, fewer women taking the contraceptive pill.

The results suggest that risk will increase in the future, because the percentage of high risk sites increased across all three climate change scenarios. The combined percentage of river reaches at risk or at high risk was predicted to increase from 39% under the current conditions to 48%, 50% and 50%, for the wet, average and dry future scenarios, respectively.

However, climate change was not the primary driver of increased risk. The findings suggest that an increase in temperature would increase biodegradation within streams, and thus reduce concentrations of harmful compounds, and only a small fraction of the changes could be attributed to changes in river flow. By far the main driver of the increased risk was population growth.

These findings represent a warning to policymakers that current risk assessments may look much different in the future, largely driven by the increasing — and ageing — population. The pollution of the aquatic environment by oestrogens is not specifically regulated at the level of the [Urban Waste Water Treatment Directive](#) (91/271/EEC), which is essentially targeted at the removal of organic pollution in general from wastewater. However, additional treatment may be necessary to remove specific substances that could impact upon aquatic flora or fauna. This need for treatment should be determined in each Member State on a case-by-case basis in order to fulfil the requirements of other Directives such as the [Water Framework Directive](#).

