

## Introduction

There is growing scientific consensus that numerous industrial and agricultural chemicals have the ability to interfere with endocrine systems and hormonal activities of all animals including fish. These endocrine disrupting chemicals (EDCs) are thought to be especially important at the larval or developmental stages of fish, disrupting sexual development, behaviour and fertility. The viability of commercial and ecologically important marine and freshwater fish stocks may be threatened by the feminisation of male fish by a range of EDCs.

WWF believes there is already sufficient evidence to suggest that a precautionary approach should be adopted to try to minimise the effects of these chemicals now.

## Exposure of Fish

Both marine and freshwater fish are exposed to a variety of EDCs from a range of sources. Effluents from industrial sites containing EDCs such as alkylphenol ethoxylates or bisphenol A, agricultural run-off which contains a number of endocrine disrupting pesticides and residues, sewage effluent which has shown to exert an oestrogenic effect on male fish, and sewage sludge dumped at sea all result in the exposure of fish to EDCs.

## Impact on Fish

Research in Germany has shown changes in sex ratios in zander in the Havel and in perch in the Lower Elbe. This is being related to the exposure of fish in these rivers to EDCs. Research has been carried out by the Environment Agency of England and Wales and the UK's Natural Environment Research Council (NERC) into the incidence of reproductive effects in fish in five different rivers in the UK. The research has suggested that *"the incidence of the feminisation of male fish is higher than previously thought and is associated with discharges from sewage treatment works"*. Effects found have included:

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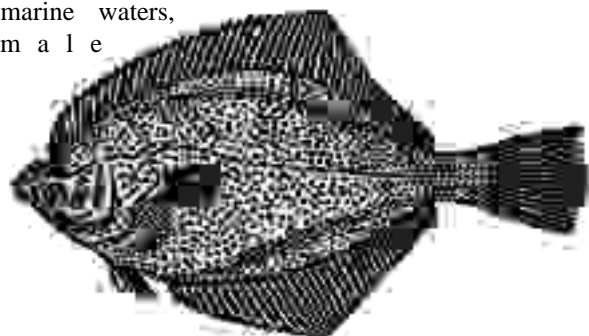
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- Egg-producing cells in the male testis
- Reduced testis growth rates and size
- Female reproductive tracts
- Increased liver size
- Increased levels of vitellogenin (egg protein)

Recent evidence from the University of Newcastle suggests that there are oestrogenic effects on wild population of marine fish exposed to sewage effluent. In marine waters, male



flounder in the Tyne, Mersey and Solway estuaries have been found to show signs of feminisation. This has raised fears over the long-term effects on fish populations in waters receiving significant volumes of effluents.

### Examples of Substances Known or Suspected to be Endocrine Disrupting Chemicals (EDCs)

**Pesticides:** atrazine, 2,4-D, DDE, DDT, diazinon, diuron, endosulfan, fenthrothion, glyphosate, lindane, linuron, parathion, permethrin, simazine, TBT, trifluralin, vinclozolin.

**Industrial chemicals or breakdown products:** bisphenol A, dioxins, nonylphenol, PCBs, some phthalates.

### North-East Atlantic and International Action

Unnaturally high prevalence of diseases and larval malformations in commercially and/or ecologically important marine fish stocks have been the subjects of much debate since the 2nd International Conference on the Protection of the North Sea in 1987.

The 4th International Conference on the Protection of the North Sea in 1995 acknowledged the significance of hormone mimicking substances for marine organisms including fish. The Ministerial Declaration on the Protection of the North Sea at Esbjerg specifically highlighted EDCs and requested the Oslo and Paris Commissions (OSPAR) and the European Commission to *"adopt necessary measures"* by the year 2000.

WWF proposed to the Intermediate Ministerial Meeting (IMM) for the Fifth International Conference on the

## Effects of Endocrine Disrupting Chemicals on Fish

### Case Study: Effect on Fish in UK Rivers \*

In the UK, male fish downstream of sewage treatment works on the River Lea in North London and the River Aire in Yorkshire were found to be producing vitellogenin, a female egg protein as a result of oestrogenic substances being discharged from the sewage works. The work on the River Lea and River Aire was confirmed in joint studies by the Environment Agency and the NERC on five UK rivers, which showed significantly higher oestrogenic effects in male fish downstream of sewage treatment works. Wild roach were sampled at sites both upstream and downstream of sewage treatment works on five different rivers (sites F-J) and downstream on a further three rivers (sites K-M). For comparison, fish were also sampled at four reference sites at lakes and canals that do not receive effluents from sewage water treatment works (sites B-E) and from a population held in clean water in a laboratory (A). The results strongly suggest that the incidence of feminisation of male fish is higher than previously thought and is associated with discharges from sewage works.

Figure A - Proportion of male roach with signs of feminisation (oocytes within testes; and/or possess female reproductive tracts)

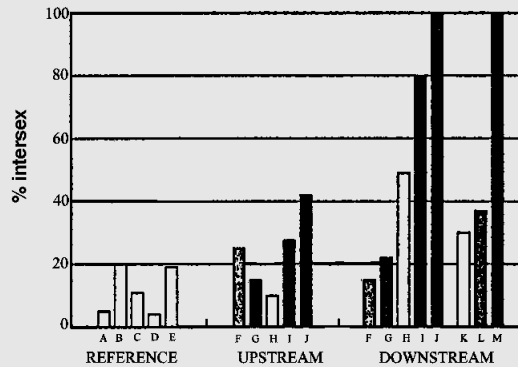
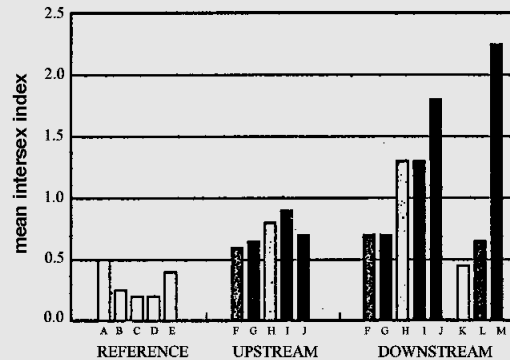


Figure B - Degree of intersexuality in male roach (defined by mean intersex index)



As a reaction to this research, in January 1998, the Environment Agency for England and Wales called for unilateral action from industry to minimise the entry of known or potential endocrine disruptors to the environment by phasing out the use of existing products and developing substitutes. The Agency specifically suggested identifying potential EDCs, developing a complete set of environmental quality standards which take into account endocrine disrupting activity, using integrated Pollution Control and the new Integrated Pollution Prevention and Control (IPPC) Directive to minimise the discharge of EDCs by industry and carrying out further research to look at the effects of EDCs on wildlife. Furthermore, in February 1998, the House of Commons Environment Sub-Committee called on the water industry in particular to carry out more research as “*a matter of highest priority*” to establish which substances within effluents are responsible for hormone disruption and the UK Government Panel on Sustainable Development has raised the question of synergistic and dose-related effects of these chemicals and asked whether some EDCs “*should be phased out as a precautionary measure as safer substitutes become available*”. \* **Reference:** Environment Agency for England and Wales (1998) Endocrine disrupting substances in the environment: what should be done? Consultative Report. Environmental Issues Series.

Protection of the North Sea in 1997 that it should address the risk of sub-lethal effects on fish stocks and recruitment caused by EDCs and take measures to protect the viability of fisheries from such impacts. The Ministers indeed recognised the need for additional protection for North Sea ecosystems and to give the highest priority to the actions already agreed to eliminate pollution by hazardous substances from land-based sources. The IMM Assessment Report on Fisheries and Fisheries-Related Species and Habitat Issues noted as an issue of concern the “*direct or indirect impact on fish and shellfish of hazardous substances (eg hormone-like substances, TBT, PCB, PAH etc) through for example reduced reproduction and increased prevalence of disease*”, stating that “*it is suspected that a number of substances with endocrine or hormone-like effects might impact the ability of many types of marine organisms to reproduce*”.

Also in 1997, the United Nations Economic Commission for Europe (UNECE) negotiated a Protocol on Persistent Organic Pollutants to focus initially on 15 or so groups or substances, some of which are EDCs. However by no means all identified EDCs are covered by this Protocol. The Intergovernmental Forum on Chemical Safety (IFCS), set up after UNCED in 1994 between the EU and USA has formed a joint working group to co-ordinate research and the OECD is developing testing methods for endocrinicity.

#### In relation to all EDCs, WWF believes that

- The OSPAR Commission should take immediate action to phase out and eliminate already identified endocrine disruptors. Furthermore endocrine disrupting properties should rank high under the prioritisation process for hazardous substances to be considered for such measures;
- Current toxicity tests need to be improved with re-testing of substances undertaken;
- Research needs to be adequately funded, prioritised and co-ordinated;
- An international task force needs to be set up to assess the potential effects of hormone disrupting chemicals and opportunities to reduce their use;
- The European Commission should establish a unit or working group on endocrine disrupting chemicals.

Text prepared by Guy Linley-Adams

#### Further Reading:

Rolland R.M, Gilbertson M, Peterson R.E (eds) (1997) Chemically Induced Alterations in Functional Development and Reproduction of Fishes: Proceedings from a Session at the 1995 Wingspread Conference, SETAC, Pensacola, Florida.