WWF

briefing

Salmon Migration and Breeding Impaired by Atrazine

While OSPAR launches the first ever intergovernmental report on the health of the North-East Atlantic (Quality Status Report 2000), new findings with regard to the impact of hazardous substances on marine biodiversity are revealed by contemporary research. The following example demonstrates that low level and long term impacts of man-made pollutants on NE Atlantic wildlife are often triggered by combined effects with other environmental factors to which organisms are exposed during certain stages of life.

This example illustrates the urgent need to work towards the target of cessation of discharges, emissions and losses of hazardous substances by the year 2020 at the latest.

Introduction

Atrazine is an organochlorine herbicide previously used as a weed-killer on non-agricultural land such as roadsides, railways and industrial areas. However, due to drinking water contamination its usage in non-agricultural application was banned in the UK. Despite this it is still widely used to control weeds in maize and sweetcorn crops in the UK and Europe.

Quality Status of the North-East Atlantic: Salmon Migration and Breeding Impaired by Atrazine

Atrazine is very persistent in water after contamination it can be present in the water column for more than a year. The high mobility and persistence of this herbicide means it can be found in many estuaries and coastal waters throughout Europe. Continued inputs of this herbicide give cause for concern due to its endocrine disrupting properties such as changes in testis and disturbances in sperm production in mammals and reduced reproductive success in common frogs.

Atrazine is also a possible human carcinogen and concerns arise from atrazine's role in mammary cancer. In addition to this experimental studies on aquatic organisms such as the water flea have documented various endocrine related effects such as atrazine's influence on sex determination, increasing male proportionality with possible reduced breeding success.

A striking example of the effects of atrazine occurs in salmon. At low concentrations of atrazine water regulation (osmoregulation 1) capabilities are disrupted which means the fish may be adversely affected during migrations due to decreasing ability to move between fresh and salt water. In addition to this atrazine can also affect olfactory (sense of smell) systems in salmon which in turn impairs breeding as salmon use this system to locate mates.

Routes of Input into the Marine Environment

Atrazine is applied to the soil surface and to emerging weeds. Spray drift, surface runoff, or drainage outflow may transport atrazine into surface waters where it concentrates. Through leaching residues of atrazine may percolate into deeper soil layers and into ground water. Due to atrazines high mobility it rapidly travels to water-bodies by leaching, because it is highly persistent within the water column it will remain in the rivers until it reaches estuaries and coastal waters.

Atrazine's Effects on Salmon

There have been well documented reductions in numbers of returning salmonids in European and North

For information, contact:

Stephan Lutter
WWF North-East Atlantic Programme
Am Güthpol 11 · D-28757 Bremen · Germany
Tel: +49 421 65846-22 · Fax: +49 421 65846-12
E-mail: lutter@wwf.de

American rivers. Along with this concern has arisen that xenobiotic pollutants may contribute to at least part of this decline. Researchers have now linked environmentally realistic levels of atrazine with negative affect on osmo-regulatory (water balance*) processes in salmon. This has far reaching consequences as this will limit the ability of the salmon to migrate. This is of particular relevance when one considers that the first migration of the salmon from fresh to sea water (smoltification) is an essential part of the salmons lifecycle and this could be severely disrupted. The research described showed significant mortality of salmon smolts exposed to environmentally relevant levels of atrazine when they were exposed to seawater, hence highlighting the disruption in salmon migration.

The same researchers have also carried out experiments which highlight the fact that atrazine also has a negative impact on olfactory (sense of smell) systems in salmon. Inhibition of olfactory (smell) detection of female pheromones occurs in male salmon exposed to environmentally relevant levels of atrazine. Which in affect means impaired breeding as the male salmon will not be ready for breeding at the same time as the females.

Concerns

The effects of atrazine on osmoregulation and on the olfactory system in salmon are very subtle but both could have devastating effects at the population level. These findings again exemplify the inadequacy of conventional toxicity testing used to set environmentally safe levels for marine organisms. These subtle effects occur at low concentrations, would not be picked up using standard toxicological methods, have potential interactive effects of exposure to several substances and other stresses and could have severe consequences especially at a population level. Hence, these findings highlight the need to eliminate exposure of such chemicals irrespective of data gained from conventional toxicity testing. Atrazine could at least be part responsible for the decline in salmon in European rivers.

Recommendations and Conclusions

WWF feel that atrazine should be added to the OSPAR list for Priority Action, due to its persistence and its frequent presence in estuaries and coastal waters. Its possible low dose effects and potential synergies with other substances and environmental parameters are also of concern.

The findings of the research described highlight the inadequacy of standardised toxicological methodologies due to the fact that these subtle sub-lethal effects would not be picked up using conventional toxicity tests.

In light of these findings WWF advocates the use of the precautionary approach when selecting chemicals to receive priority action and to be eventually phased out.

* "As a salmon moves from fresh to saltwater it must alter its water regulation (osmoregulation) as it will begin to loose water and visa versa". "This is due to a process known as osmosis whereby water molecules move form a high concentration to a lower concentration".

Text prepared by Simon Vowles

References / Further Reading

Waring, C.P. & Moore, A. (1996). Environmental atrazine: Physiological effects on Atlantic Salmon (Salmo salar) smolts in fresh water and after seawater exposure. Presented at International Congress on the Biology of Fishes, San Francisco, July

Waring, C.P. & Moore, A. (1998). Mechanistic effects of a triazine pesticide on reproductive endocrine function in mature male Atlantic salmon (Salmo salar) parr. Pestic Biochem Physiol. 62: 41-50.