Hazardous Substances & EU Chemicals Policy

From Sintra to Bremen - milestones...
WWF welcomes the intergovernmental progress made with regard to hazardous substances since the OSPAR and HELCOM Ministerial Meetings and the adoption of the Strategy with regard to Hazardous Substances in 1998. In particular, the further development of the List of Chemicals for Priority Action, of Background Documents for such chemicals, and the launch of the OSPAR List of Substances of Possible Concern are highlighted in this context.

... and drawbacks: WWF however expresses concern that no measure has yet been implemented to meet the 2020 cessation target for such chemicals and/or eliminate them from the marine environment. Furthermore, the OSPAR and HELCOM Objectives and Targets have only partly been translated into the EC Water Framework Directive.

Hazardous Substances and the EU Chemicals Policy

Towards a new chemicals policy...
WWF also welcomes the progress with regard to hazardous substances in the framework of the EU Chemicals Policy and in particular highlights three major achievements:

- Under the future EU REACH System, every producer and user of chemicals will have the duty to evaluate the environmental properties of the substances used and in particular determine whether they would meet the criteria for hazardous substances as defined under the OSPAR Strategy.
- The particularities of the marine environment have been translated into an additional element in the EU Risk Assessment Methodology on Chemicals. Based on this approach, the use of hazardous substances can be eliminated in all applications from which releases into the environment could occur. Authorities do not need to prove anymore at which quantitative level of emissions or losses a persistent and bioaccumulative substance could harm a seal or a cetacean.
- In the proposal for a REACH Regulation, the European Commission includes PBTs, vPvBs and endocrine disruptors into the group of substances of very high concern. These substances will not be allowed to be used anymore unless a producer or users applies for a special authorisation.

...preventing marine pollution?
However, there are also some concerns that the new EU Chemicals Policy might fail to contribute to meeting the OSPAR cessation target by 2020:

- Already now, the REACH legislation process is nearly two years behind schedule and more delays could be expected. In particular, if the EU Council in which nearly all OSPAR Contracting Parties are represented fails to sufficiently back DG Environment’s proposal it may undermine the goals set in the OSPAR framework.

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Glossary

REACH = Registration, Evaluation, Authorisation of Chemicals
PBT = Persistent, Bioaccumulative and Toxic substance based on the following criteria as set up by OSPAR DYNAMEC: half-life in water > 50 days or failing to be inherently degradable (P), acute aquatic toxicity < 1 mg/l or CMR (carcinogenic, mutagenic or toxic to reproduction) properties (T), bioconcentration factor (BCF)>500 or LogPow > 4 (B). EU Technical Guidance: < 0,1 mg/l (T) and BCF > 2000 (B)
vPvB = very Persistent: half-life in water > 60 days and very Bioaccumulative: BCF > 5000
• The proposed REACH Regulation still contains several possibilities to maintain secrecy on the uses and amounts of chemicals in the EU market. Access to such information, however, is definitely needed to protect the marine environment, since it has not been possible and will not be possible to identify threats for the marine ecosystems through extensive marine monitoring programmes.

• The criteria to determine whether a substance is of very high concern or not under the new EU framework are less protective compared to those agreed under OSPAR for the identification of hazardous substances. In order to get the approaches consistent, the new EU system needs to build in some flexibility to take on board what has already been agreed among those OSPAR countries represented in the EU Council.

WWF calls upon Ministers to
• reaffirm the Regional Seas Conventions’ Objective with regard to hazardous substances and promote its inscription into a new EU Chemicals Policy.

Text prepared by Andreas Ahrens

Further reading


The Metamorphosis of the „One Generation Target“

§ 17 Esbjerg Declaration, 1995
„The Ministers agree that the objective is to ensure a sustainable, sound and healthy North Sea ecosystem. The guiding principle for achieving this objective is the precautionary principle. This implies the prevention of the pollution of the North Sea by continuously reducing discharges, emissions and losses of hazardous substances thereby moving towards the target of their cessation within one generation (25 years) with the ultimate aim of concentrations in the environment near background values for naturally occurring substances and close to zero concentrations for man-made synthetic substances.”

Sintra Statement, 1998
„We agree to prevent pollution of the maritime area by continuously reducing discharges, emissions and losses of hazardous substances (that is, substances which are toxic, persistent and liable to bioaccumulate or which give rise to an equivalent level of concern), with the ultimate aim of achieving concentrations in the environment near background values for naturally occurring substances and close to zero for man-made synthetic substances. We shall make every endeavour to move towards the target of cessation of discharges, emissions and losses of hazardous substances by the year 2020.”

EU Water Framework Directive (WFD), 2000
„The Commission shall submit a proposal setting out a list of priority substances selected amongst those which present a significant risk to or via the aquatic environment. Substances shall be prioritised for action on the basis of risks to or via the aquatic environment, identified by: (a) risk assessment ... (b) targeted risk assessment ... When necessary ... substances shall be prioritised for action on the basis of risk .... identified by a simplified risk assessment procedure. For the priority substances the Commission shall submit proposals of control for: - the progressive reduction of discharges, losses of the substances concerned and in particular - the cessation or phasing-out of discharges, emissions and losses of the substances as identified ......, including an appropriate timetable for doing so. The timetable shall not exceed 20 years after the adoption of these proposals by the European Parliament and the Council ......
MEP BRIEFING ON:
REACH
A NEW SYSTEM FOR REGULATING CHEMICALS

REACH offers a once in a generation opportunity to secure safer chemicals, a healthier future for wildlife and people, and a stronger chemicals industry. Members of the European Parliament can shape a valuable law that reduces the risks to wildlife and people by identifying and phasing out the most harmful chemicals.

WWF firmly believes that, to ensure a truly effective and workable chemicals reform, the current REACH proposal needs strengthening. The European Commission has severely weakened its final proposal in response to heavy pressure from the chemical industry.

WWF therefore urges the European Parliament to improve REACH, in four priority areas:

- **Phase out** the use of known/identified hazardous chemicals and **replace with safer alternatives** whenever available.
- Uphold the principle of **one registration per chemical** to avoid duplication of animal and other tests, by ensuring consortia formation between different companies using the same chemical.
- Protect from **chemicals in imported products** by ensuring that bans or restrictions on use of certain chemicals are upheld, and that all chemicals in imported products are registered.
- Ensure proper **safety assessment of all chemicals produced between 1 and 10 tonnes** per annum, by reinstating three key (non-animal) tests - deleted in final Commission discussions.

1. **Chemicals – a benefit and a threat**

Chemicals have brought enormous benefits to society, but they also pose a threat to wildlife and people. Wildlife and people are exposed to thousands of chemicals, many in everyday products, that lack basic safety information. Many chemicals are known to be potentially dangerous. Some do not break down in nature, but accumulate in the bodies of wildlife and people, and are passed from one generation to the next – from mother to baby via the placenta and breast milk. Others can interfere with the hormone systems of animals and humans. Research increasingly links chemicals to cancers, allergies and reproductive problems.

2. **REACH**

**WWF key priorities for REACH:**

**WWF believes that in order to protect human and wildlife health, REACH should:**
- Ensure that **enough safety information is publicly available** to make it possible to identify the most hazardous chemicals – a system based on knowledge, not ignorance.
- **Identify the chemicals of very high concern**, under the authorisation system and ensure their use is phased out whenever safer alternatives are available. These chemicals should include those that accumulate in the environment and in our bodies, and those that disrupt hormones.
- Be **open and transparent** for safety information to industry, suppliers and consumers, including a general right to know about chemicals used in any products.
The need to reform existing EU chemicals legislation was recognised by Council in 1998, and a new regulatory system, REACH (Registration, Evaluation and Authorisation of Chemicals) was first proposed in a Commission White Paper on Chemicals Policy in 2001, debated and approved by Parliament in November 2001.

REACH involves four procedures:
Registration – chemical producers will be obliged to send a registration dossier containing safety data to a central chemicals agency on all chemicals produced in quantities above one tonne a year.
Evaluation – National experts will evaluate this safety data for certain chemicals: higher volume chemicals and other chemicals of concern. This may lead to ‘authorisation’, risk reduction, or no further action, depending on the evaluation of hazards from the chemical.
Authorisation - Chemicals deemed to be of very high concern will be submitted to authorisation, which first identifies and prioritises the chemicals, and then allows industry to submit a case for their continued use. Chemicals of very high concern are defined as those that are carcinogens; mutagens; reproductive toxins; are persistent, bio-accumulative and toxic; very persistent and very bio-accumulative; and of similar concern, eg endocrine disrupters.
Restriction – Chemicals with other properties of concern (e.g. toxic to the nervous system) may have their uses controlled through this system.

The timetables for implementing REACH will give industry:
11 years to provide safety data on chemicals they produce in quantities of between 1 and 100 tonnes
6 years for safety data for chemicals produced 100-1000 tonnes
3 years for those manufactured in volumes above 1000 tonnes.

3. Strengthening REACH

WWF calls on MEPs to vote to strengthen the current Commission proposal for a Regulation on REACH in vital areas in order to protect people, wildlife and the environment effectively.

1. Authorisation – known hazardous chemicals should be replaced
   - WWF calls for deletion of the loophole permitting industry to continue using chemicals identified as being of very high concern if they can show that their use will be “adequately controlled”. We do not believe that any controls will be “adequate” protection for hazardous chemicals; therefore, the use of such chemicals should be phased out in favour of safer alternatives where available.
   - Where safer alternatives do not exist immediately, WWF supports the Commission proposal’s system of permitting (authorising) continued use of chemicals of very high concern. WWF believes that these authorisations should be time limited (maximum 5 years) to encourage the development of safer alternatives.

2. Registration – one registration per chemical to avoid duplication of tests
   - The current REACH proposal allows companies using the same chemical to register separately, and does not provide for companies to share safety data on the chemical. This will lead to unnecessary animal and other tests. **WWF recommends one registration per chemical, with a mandatory provision for consortia formation by industry.**

3. Registration – missing safety data for 1-10 tonne per annum chemicals
   - WWF calls for reinstatement of three (non-animal) tests in the registration requirements for 1-10 tonne per annum chemicals in order to provide sufficient information to evaluate the hazards posed by these chemicals. These tests were in the original consultation proposal of May 2003, including one determining how rapidly a chemical breaks down in the environment.
• WWF also calls for reinstatement of the obligation for producers to assess the exposure of both humans and the environment to these chemicals, and the requirement to define safe uses to for downstream users.

4. Protection from chemicals in imported products
• WWF believes that **importers should have the duty to ensure that all the chemicals in products they import comply with any restrictions on use and are registered in the EU**; if not, then they (or their supplier) should apply to register the chemicals contained in them.
• WWF proposes that **importers of articles be required to register under REACH any unregistered chemicals imported by them in quantities of 1 tonne per annum or more**. The commission proposal proposes a registration requirement based on tonnage imported per article; WWF considers that tonnage per importer will offer better protection and be more workable. In addition, WWF opposes the current exemption of unregistered chemicals in imported products, as long as they are not ‘released’ from the product in quantities that may cause harm to the environment or human health. The current proposal will allow unregistered chemicals to be imported into Europe ‘outside’ the REACH system, through import in articles.

5. Evaluation – minimum number of checks by Member States needed
Member States should be required to carry out a **minimum annual number of evaluations of the safety data provided by industry on chemicals**. The current voluntary system may lead to some countries performing no evaluations at all, as government finance departments may not supply the resources for a voluntary system.

6. Registration – independent checks on registration dossiers
The Agency will only check registration dossiers for completeness, and only a limited number of dossiers will go on to be evaluated by Member State authorities. **WWF believes that a peer review or audit of each dossier should be required before dossiers are sent for registration, in order to check their accuracy.** If this is not put in place, there is a danger that the registration database will be full of poor quality information, which will jeopardise the functioning of the rest of the system.

7. Information - confidentiality
WWF believes it is essential that the REACH system is open and transparent, with information flowing up and down the supply chain, and to the wider public. This will ensure that chemicals are used safely, and that the regulatory system can be tested and trusted. WWF considers that the current proposal must be amended to increase the amount of information which is considered non-confidential, for example to include the name of the company registering a chemical.

8. Information - General right to know
In WWF’s view, the proposals should include a general right to know, allowing downstream users, retailers and consumers to find out the chemicals contained in the products they are purchasing. The Commission’s proposals do not provide for this information flow, and will lead to a situation where someone purchasing an article (e.g. a chair) will have no right to know what chemicals are within it.

For more information: [http://www.panda.org/epo/toxics](http://www.panda.org/epo/toxics)
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CAUSES FOR CONCERN: CHEMICALS AND WILDLIFE
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I. INTRODUCTION

Over the past half a century, scientists have uncovered a multitude of risks to wildlife and humans posed by toxic chemicals. Some of the most notorious chemicals have been taken off the market and others have been restricted to a narrower range of uses. Yet while a handful of these chemicals are slowly disappearing from the environment, new research is revealing that many other chemicals could be even more harmful than the infamous ones. Wildlife and humans are simultaneously suffering contamination by chemicals no longer in production, as well as chemicals currently in use – the dangers of which are becoming increasing clear.

Although manufacture and use of some chemicals has been tightly regulated, the “body burden” of chemicals in wildlife and humans is more worrying than ever. A recent study noted that only five organochlorines compounds and mercury were found in marine mammals in the 1960s. Today over 265 organic pollutants and 50 inorganic chemicals have been found in these species.¹

Since the early 1990s, WWF has been concerned about the impacts of toxic chemicals on biodiversity. Wildlife, people, and entire ecosystems around the world are threatened by chemicals that can alter sexual, neurological, and behavioral development; impair reproduction; and undermine immune systems. Urgent and precautionary action is required to address threats from the most hazardous industrial chemicals and pesticides.

Existing regulation is neither comprehensive nor effective enough in protecting wildlife and human health. Despite the widespread contamination of wildlife and people and the discovery of harmful chemical effects, there is a shocking lack of publicly available safety data on chemicals currently in use. However, in the European Union (EU) reforms are underway that could fundamentally change the way chemicals are managed in Europe, with possible global implications (see box on REACH).

Ensuring the success of the proposed reforms known as REACH (Registration, Evaluation and Authorization of Chemicals), which embraces the precautionary principle as an important part of chemicals management, is a priority for WWF.

REACH is a critically important addition to existing and ongoing efforts to improve effective chemicals management. At present, several international instruments, including the Stockholm Persistent Organic Pollutants Convention (POPs), the Rotterdam Prior Informed Consent Convention, and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, address specific chemical issues. REACH cuts across the spectrum of voluntary and regulatory initiatives that currently exist, helping to ensure that substances are used safely at all stages of their life cycle – by requiring all those manufacturing, importing, or using substances to fulfill certain obligations.

This “Causes for Concern” paper examines scientific findings concerning exposure and effects of various chemicals on wildlife, as well as research on related human health impacts. While not intended to be exhaustive, this review of recent science illustrates the magnitude of the problem, the ongoing threat some chemicals pose to wildlife and people, and the need for improved regulation of chemicals.

II. CHEMICALS OF CONCERN – WHAT DO THEY DO TO WILDLIFE?

The picture that is emerging from new scientific research on wildlife and chemicals is a disturbing one, and it does little to reassure us that chemical effects are benign. Many animals are known to pass chemicals to their offspring, mammals through the placenta and during suckling, and reptiles and birds through their eggs. In the last decade, a great deal of research has concentrated on unraveling the possible effects of chemicals on the endocrine system, particularly the reproductive hormones such as estrogens and androgens. Recent research has focused on how chemicals affect the thyroid and pituitary systems. Some chemicals have been identified as endocrine disruptors because they can interfere with the body’s own hormones, which are secreted by the endocrine glands.

It is also emerging that endocrine disruptors can have many physiological effects not directly associated with the primary system. For example, the thyroid system is well known to regulate metabolism, but it is also a crucial component in fetal brain development in mammals, and too much or too little thyroid hormone at crucial points can do permanent damage. The immune system is also vulnerable to hormone-mediated disruption. Chemicals can cause neurological problems, reproductive and developmental abnormalities, and cancers as well. And researchers are only just beginning to disentangle the questions about the effects of chronic low-level exposure (as opposed to brief high doses of chemicals), combinations of chemicals, and interactions between chemicals and other physiological and environmental factors.
This new evidence of chemical contamination in wildlife, coupled with corresponding information on widespread human exposure, underlines the urgency of international policy reform. The European Commission estimates there are now slightly over 30,000 chemicals on the European market produced or imported at over 1 tonne per annum. Existing European Union rules allow continued use of chemicals that were put on the market prior to 1981, without submission of safety data. Such chemicals still make up over 90% of the market, and research has shown that for the vast majority of chemicals now in use there is inadequate publicly available scientific data to assess their safety.

The European Union is currently considering the most sweeping chemicals regulation legislation in the world to date. The proposal, called REACH (Registration, Evaluation, and Authorisation of CHemicals) will, for the first time, require manufacturers and importers to provide safety information on those industrial chemicals annually marketed in Europe in volumes of 1 tonne or more. Much of the resulting information will be publicly available in a database to be administered by a new chemicals agency. The required amount of safety data, including information on toxicity, environmental fate, and usage will be determined by the amounts of the chemical produced and the level of concern. Manufacturers, importers and downstream users will have to ensure that chemicals they produce, import or use do not adversely affect human health or the environment.

REACH will go beyond existing regulation of chemicals in other parts of the world, including the United States. It will require industry to obtain prior authorisation before using chemicals of very high concern. These are defined as:
- carcinogens, mutagens or reproductive toxins (categories 1 & 2);
- chemicals that are persistent, bioaccumulative and toxic;
- chemicals that are very persistent and very bioaccumulative irrespective of their currently known toxicity; and
- chemicals that are of a similar level of concern, such as endocrine disrupters.

NB: The draft regulation published by the European Commission in October 2003 ‘raised the bar’ for the addition of such chemicals by changing this requirement to “causing serious and irreversible effects to humans or the environment which are equivalent to...”

This proposal would mean that serious or irreversible effects would have to be demonstrated prior to a chemical being added to authorisation - this will not be an effective precautionary action.

Despite the progress in controlling chemicals that REACH represents, it is not sufficiently protective with regard to these chemicals of very high concern, as it allows continued use of such chemicals even if safer alternatives are available. Following the adoption of draft legislation by the European Commission on October 29, 2003, REACH is now being considered in the European Parliament and by the Council of Ministers. Depending on decisions taken by these bodies REACH is expected to be adopted as a binding regulation throughout the European Union by late 2005 or early 2006.
A. NEW CAUSES FOR CONCERN

Many chemicals in wide use today are assumed to be safe by consumers and other downstream users. However, some of the chemicals used to produce a variety of products such as clothing, food containers, computer equipment, and toys are contaminating the environment and can have dangerous effects.

1. Perfluorooctanes

Over the past four years, perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS) and similar compounds have emerged as an important class of persistent global pollutants referred to as perfluorochemicals (PFCs). The first public indication that PFOS and PFOA were problematic came on May 16, 2000 when 3M, the primary global manufacturer of many perfluoroalkanesulfonates and PFOA, announced plans to phase out by the end of 2001 the production of perfluorooctyl acid (PFOA), perfluorooctane sulfonate (PFOS), PFHxS and other perfluorooctanes.

Exposures

Of the perfluorinated compounds, PFOS appears to have the widest distribution. A 2002 European study of PFOS, PFOA and PFHxS, a related compound, detected these compounds in bottle nose, common and striped dolphins, whales, bluefin tuna, swordfish and cormorants in the Mediterranean, and in ringed and gray seals, sea eagles and Atlantic salmon in the Baltic. PFOS was the predominant compound. Other research shows that this chemical is now contaminating many wildlife species around the world, including polar bears in the Arctic, seals in Antarctica, dolphins in the river Ganges in India, albatrosses from Midway Atoll in the Pacific, turtles in the United States, gulls in Korea, cormorants in Canada, and fish in Japan. Fluorinated telomers are used to keep grease from soaking through fast food containers such as pizza boxes, French fry holders, and food wrapping paper. The digestive system can break telomers down into PFOA and related chemicals. Newly revealed tests conducted by 3M showed that a metabolite specific to the telomers was found in 85 per cent of the children tested. Telomers are not regulated, so manufacturers are not obligated to disclose their presence to consumers or any downstream users.

A 2003 study of PFOS and PFOA in the U.S. Red Cross blood banks, conducted by a team including scientists from the 3M Company, estimated the average concentrations in humans to be 30-40 parts per billion (ppb), with males having higher levels. By comparison, levels in wildlife have been measured at 940 ppb in common dolphin liver; 1100 ppb in ringed seals from the Bay of Bothnia; and 270 ppb in long-finned pilot whale liver from the North Thyrrenian Sea. This study noted that PFOS concentrates in the liver and lowers cholesterol levels in the blood.

Effects

3M has known for decades that perfluorinated compounds were not the benign, inert chemicals it claimed they were. In 1979, 3M administered four doses of PFOS to monkeys and all the monkeys in all treatment groups died within weeks. Typically, when a study like this is conducted, the researchers predict that the lowest dose will not cause any harmful health effects. In 1981 both DuPont and 3M re-assigned women of childbearing age working in their production plants after they learned that PFOA caused developmental abnormalities in laboratory animals. Within weeks of this discovery, DuPont found PFOA in the women’s blood. Eventually they returned the women to the plants, and both companies continue to downplay adverse consequences even as demonstrated by their own research of perfluorinated compounds. It was known as early as 1975 that fumes from hot pans coated with polytetrafluoroethylene can kill pet birds, and broiler...
chicks have died after exposure to polytetrafluoroethylene-coated light bulbs.13 Laboratory experiments reported in 2003 showed that in rats, PFOs exposure can lead to loss of appetite, interrupted estrus cycles, and elevated stress hormone levels. PFOs was found to accumulate in brain tissue, particularly the hypothalamus, suggesting that PFOs crosses the blood-brain barrier and may interfere with reproductive hormones through the pituitary-hypothalamus process that stimulates their production.13 Recent laboratory studies with PFOA involving rats show low birth weight, small pituitary gland, altered maternal care behavior, high pup mortality, and significant changes in the brain, liver, spleen, thymus, adrenal gland, kidney, prostate, testes and epididymides.13 Several studies indicate PFOA increases estrogen and leads to testosterone dysfunction in males. There is even more evidence that PFOA as well as chemicals that metabolize to PFOAs and PFOA lead to underactive thyroid; thyroid dysfunction during pregnancy can lead to many developmental problems, including faulty brain development and neurological and behavioral problems that affect not only infants and young animals (or humans) but continue into adulthood. The EPA considers both PFOS and PFOA to be a carcinogen in animals, with testicular, pancreatic, mammary, thyroid and liver tumors most frequent in exposed rats. All studies to date indicate perfluorinated compounds damage the immune system. In one experiment, a chemical very similar to PFOA called PFDA resulted in such atrophy of the thymus gland, (the source of T cells that attack bacteria, viruses and cancer cells) that the gland was undetectable upon clinical examination. Although every species has its individual profile of vulnerabilities and protections from exposures to chemicals, there is no reason to believe that the pathologies exhibited by laboratory animals are confined to one or two species; both wildlife and humans are likely to suffer similar effects.

PFOAs are a perfect example of the need for REACH. The chemical industry claims that REACH’s testing requirements will be financially burdensome, yet 3M and DuPont were obviously willing to conduct detailed research on PFOAs voluntarily for 30 years; they just were not willing to share the results. If REACH’s transparency provision had been in place during that time, the public would have known the risks of such perfluorinated compounds in time to make informed decisions about their use before exposures had reached such high levels.

2. Phthalates

Exposures

Phthalates are a group of chemicals used as softeners in a variety of plastic products, including the ubiquitous polyvinyl chloride (PVC). Products containing phthalates include medical devices (intravenous tubing, blood bags, masks for sleep apnea devices), building products (insulation of cables and wires, tubes and profiles, flooring, wallpapers, outdoor wall and roof covering, sealants), car products (car under-coating, car seats etc.) and children’s products (teething rings, squeeze toys, clothing and rainwear). They are also used in some lacquers, paints, adhesives, fillers, inks and cosmetics. The most common phthalate in the environment is di-(2-ethylhexyl)phthalate (DEHP), which comprises half of all phthalates produced in Western Europe, with 450,000 tonnes used per year. Concern about children’s exposure to phthalates prompted the EU to ban six types of phthalate softeners in PVC toys designed to be mouthed by children under three years of age. Both humans and wildlife may be exposed to various phthalates. For example, a 2003 study of two groups of pregnant women, one in New York City and one in Krakow, Poland, compared the levels of four phthalates in the women’s personal ambient air and measured the levels of the metabolites of these phthalates in the urine of the New York women.15 All four phthalates were present in all the air samples, but air concentrations of DBP, di-isobutyl phthalate and DEHP were higher in Krakow than in New York. The study found that air was a significant source of exposure, that some women receive doses high enough to cause concern, and that there was a correlation between air and urine levels of some phthalates.

Other studies in the EU have also raised concerns with regard to current exposure levels. A recent study in Germany, for example, has concluded that exposure to DEHP may be far higher than previously thought. It reported that in 12 per cent of the Germans studied, phthalate levels exceeded the tolerable daily intake (TDI) used by the EU Scientific Committee for Toxicity, Ecotoxicity and the Environment. Exposure to DBP and BBP was also ubiquitous.16

Effects

Some phthalates appear to exert endocrine disrupting effects, and can act against the male hormone, androgen, through pathways other than binding to androgen or estrogen receptors. While there is little research on the effects of phthalates on wildlife per se, some studies suggest that there may be serious consequences for both wildlife and humans. Of particular concern is phthalate exposure in pregnant females: some researchers have proposed that the anti-androgenic properties of phthalates might be linked to testicular dysgenesis syndrome, the manifestations of which range from birth defects in males, including undescended testes, to low sperm counts and testicular cancer.17 Numerous Laboratory studies underpin the concern. For example, a study has shown that DEHP, BBP, and DINP administered to pregnant rats induced feminized breasts in the male offspring, as well as other reproductive malformations, including small testes in the case of the DEHP and BBP.18 There are also worries that exposure to man-made chemicals with hormone disrupting properties may be affecting the age of puberty. A study of Puerto Rican girls with premature breast development suggested a possible association with exposure to certain phthalates.19 U.S. researchers recently reported the effects of DEHP on Leydig cells (testosterone-producing cells in the testes) in rats.20 They found that pro-
longed exposure to DEHP caused the number of Leydig cells to increase by 40 per cent-60 per cent while simultaneously reducing testosterone production. At the same time, blood levels of both testosterone and estrogen increased by 50 per cent. It is known that males with high levels of serum testosterone and luteinizing hormone (a hormone that triggers testosterone production) are at higher risk of early puberty and testicular tumors.

With regard to cancer, a recent study supported other research associating DEHP with liver cancer in rodents.23 A 2003 Harvard study suggested another mechanism for carcinogenic effect of phthalates. The researchers measured levels of eight phthalates in subjects and found an association between monoethyl phthalate (MEP) and increased damage to the DNA in the subjects’ sperm.24 This is the first study showing that phthalates can induce such damage at levels presently found in the environment. Other studies with phthalates show that additive effects can occur when there is exposure to more than one phthalate.25 This underlines the growing concern with real life exposures to multiple pollutants, and the increasing realisation that current regulatory practices, based on testing chemicals in isolation, may not be protective.

### 3. Phenols

The first study showing that certain phenolic compounds produced estrogenic effects was published in 1936,26 but only recently have researchers begun to explore its implications. Evidence for endocrine disruption by the widely used phenol compounds bisphenol A (BPA) and nonylphenol is mounting. BPA is mostly used to make polycarbonate plastic, which has a diverse range of application in making bottles, computer and electronics shells, CDs, crash helmets, and many other consumer products. Certain compounds that can leach BPA are also used in the plastic linings of food cans and in dental fillings, through which people can ingest small quantities. In December 2003, concerned about BPA in the plastic linings of food cans, the EU reduced the amount of BPA migration permitted by 80 percent to 0.6 milligrams per kilogram of food.27 However, BPA remains widely distributed in consumer products. Nonylphenolic compounds have been used in degreasing solutions, and in leather and textile processing, as well as in de-icing fluid, paints, plastics, and pesticides. The EU has imposed restrictions on the marketing and use of nonylphenol and nonylphenol ethoxylates to a certain extent in cleaning products, textile and leather processing, agricultural teat dips, metal working, pulp and paper, cosmetics including shampoos, and personal care products except spermicides.28

Fish have been shown to be susceptible to the endocrine disrupting effects of both nonylphenol29 and BPA.30 Exposure to either of these chemicals can cause male fish to make vitellogenin (an estrogen-regulated protein produced by female egg-laying vertebrates and not normally produced by males or juveniles), and can also affect the formation of sperm. Before improved regulation, male fish in the river Aire in England were found to be feminised downstream of a wastewater treatment plant discharge containing alkylphenol ethoxylates from the textile industry. Many male fish were found with egg producing cells in their testes, and reduced testis growth rate and size.31,32

Aquatic invertebrates seem particularly sensitive to these chemicals. For example, nonylphenol affects the freshwater algae, *Scenedesmus subspicatus* at levels of 3.3 micrograms per litre.33 Molluscs in particular have shown effects at very low dose levels. For example, in the mullusc *Potamopyrgus antipodarum*, BPA and octylphenol, as well as a mixture of these and other chemicals in treated sewage effluent, stimulated egg and embryo production at low doses and inhibited such production at high doses.34 This work supported a 2000 study by some of the same researchers showing that extremely low levels of BPA and octylphenol triggered malformed genitals of female ramshorn (freshwater) snail, *Marisa cornuarietis*, and the (saltwater) dogwhelk *Nucella lapillus*.35 In some of the freshwater snails, the excessive growth of the female glands and the egg masses ruptured the egg tube, and the snails died. This syndrome was referred to as superfeminisation. A number of other adverse changes were observed in both species. Another important finding was that in the freshwater snails, the moderate doses of octylphenol produced more changes than either the highest or lowest doses.

Other researchers have shown that a single 48-hour exposure to 1 microgram per litre of nonylphenol, comparable to environmental levels, altered the sex ratio of oysters, reduced the survival of offspring, and caused some oysters to become hermaphroditic.36 A 2001 study exposing barnacles to concentrations of nonylphenol similar to those in the environment (0.01-10 micrograms per litre) disrupted the timing of larval development.37 In addition to fish, other vertebrates also show effects when exposed to BPA. For example, in 2003, researchers reported that BPA at environmentally comparable doses resulted in sex-reversals and altered gonadal structures in the broad-snouted caiman, an alligator relative native to mid-latitude South America.38 In another study, the offspring of pregnant mice exposed to BPA showed changes in ovarian and mammary gland tissues and disrupted fertility cycles as adults.39 BPA was reported for the first time in 2001 to induce reproductive malformations in birds—specifically, in female quail embryos and male chicken embryos. The female embryos’ oviducts developed abnormally, and the male’s testes were feminized.40 The exact mechanism by which BPA and nonylphenol exert their effects is not clear, but a recent *in vitro* study demonstrated a molecular mechanism by which BPA and nonylphenol interfere with both the activation and function of cellular androgen receptors.41 In a 2002 study, nonylphenol tested on barnacle larvae induced DNA damage, possibly including mutations, and the authors speculate that this effect may be a mechanism by which higher-level reproductive abnormalities are caused.42 Despite evidence from these and other studies, the low dose effects of BPA are still in dispute. Regulators in the EU have been reluctant to act, and further studies have been demanded.
4. Polybrominated Flame Retardants

Brominated flame retardants (BFRs) in furniture, building material, and clothing have become a serious concern, as their levels are showing sharp increases in living organisms. The first BFRs were taken off the market in the early 1970s after a spill led to poisonings of livestock and farm families in Michigan. Three BFRs now dominate the market: TBBPA, the most widely used, primarily in printed circuit boards and in some plastics; HBCD, and the deca-BDEs. The other commercial PBDEs (octa-BDE and penta-BDE) will be banned in the EU as of August 2004, and the state of California has taken similar action. However, because of their alarming spread and rate of accumulation in humans and animals, Europe’s ban does not provide complete reassurance, particularly regarding the penta-BDE form used as a flame retardant in polyurethane foam elsewhere in the world.

Researchers recently reported levels of PBDEs in U.S. breast milk. Forty-seven Texas women had an average level of 73.9 ng/g lipid; such levels are sharply higher than those found in European studies. There are serious concerns about the transfer of BFRs to nursing infants, and some scientists are worried that BFRs might affect fetal development, including disruption of the thyroid system’s role in fetal brain development. In 2003 a WWF-UK biomonitoring program found deca-BDE in the blood of seven percent of those tested. New research from Sweden has found high levels of several brominated flame retardants in the eggs of peregrine falcons from 1987-1999. The eggs of falcons living in the wild had significantly higher concentrations of the essentially unregulated deca-BDE than eggs of captive falcons. The fact that deca-BDE was found in eggs demonstrates that the chemical can cross cell membranes, contrary to what scientists had previously thought. The peregrine study represents the first time that the deca formulation has been found in wildlife.

In 2002, one research team predicted that within 10 to 15 years, concentrations of BFRs in Great Lakes herring gull may be higher than those of PCBs. BFRs have also been found in sperm whales, ringed seals from the Canadian Arctic, mussels and several kinds of fish in Norwegian waters, and harbour seals in San Francisco Bay, among other wildlife. Essentially, BFRs are being found wherever we look.

Effects

Laboratory studies show that certain BFRs are highly toxic to aquatic animals (crustaceans), and suggest effects on pubertal development, thyroid and liver in rats, as well as developmental neurotoxicity in mice. A recent paper reported behavioral effects in mice pups at a relatively low dose. In 1999 Swedish researchers reported that PBDEs and HBCD may have health effects similar to those of DDT and PCBs because of their ability to induce genetic recombination.

While there are no published epidemiological studies on effects of BFRs on humans, the possible thyroid effects, based on tissue culture and animal studies, are a red flag. As with other chemicals, anything that affects fetal development merits particular study because of the profound, long-term, and often irreversible influence that early exposures have on the entire life of an organism.

The Precautionary Principle

In the context of chemicals, the precautionary principle responds to the complexity of environmental health problems, the paucity of information and subsequent uncertainty about cause-effect relations, and the slow pace of testing and government decision making. At its core, the principle calls for preventive, anticipatory measures to be taken when an activity raises threats of harm to the environment, wildlife, or human health, even if some cause-and-effect relationships are not fully established scientifically.

The precautionary principle has taken root in international statements of policy and legally binding agreements dealing with high stakes environmental concerns of low scientific certainty. From UNEP’s Governing Council Report on its 15th Session (1989), to the Rio Declaration on Environment and Development (Principle 15), Ozone Layer Protocol, Climate Change Convention, London (Dumping) Convention, OSPAR and North Sea-related decisions, UN Fisheries Agreement, and the Stockholm Persistent Organic Pollutants Convention (POPs), among many other agreements, the principle has gained widespread international acceptance as a guiding principle for decision making.

Although there is no universally agreed upon, specific definition that fits all situations, acceptance of the principle nonetheless reflects a significant paradigm shift in the environment-development realm of decision making.
B. LESSONS FROM THE PAST

There is continuing evidence of widespread contamination and impacts on wildlife of chemicals that are now banned or restricted. This growing body of scientific evidence should act as a warning: unless action is taken now other chemicals in widespread use today will leave a similar legacy.

1. DDT/DDE and PCBs

Because of the persistence and bioaccumulative properties of the many pesticides and PCBs known collectively as organochlorines or chlorinated hydrocarbons, animals at the top of the food web tend to have high levels of these chemicals in their tissues. This is especially true of animals whose diet is mostly fish, including mink, otter, polar bears, whales, dolphins, and birds such as eagles, ospreys, gulls, and skuas (a predatory and scavenging gull-like seabird).

Because of temperature and circulation patterns in the atmosphere and oceans, many chemicals tend to concentrate at the poles. Most is known about the consequences in the Arctic, but the Antarctic is by no means exempt. One recent study documented for the first time the presence of PCNs (polychlorinated naphthalenes) in Antarctic silverfish, adelie penguins, South polar skua, and Weddell seals from the Ross Sea.55 These chemicals have been used as insulating fluids in electrical equipment and in paints, lubricants and preservatives. The study also showed that adult female penguins and skua, like many other birds, transfer chemicals to their eggs, and thus to their offspring.

Polar Bears The polar bear rates as one of the wildlife species most threatened by chemicals. As the apex of the Arctic food web, polar bears collect the highest doses of many chemicals. They also undergo periods of fasting or starving during ice melts and breeding, which may mobilize the toxic chemicals they retain. Most is currently known about the effects of the PCBs, but in future it is likely that concern will also focus on other chemicals or interactive effects due to the many contaminants now found in this species.

A comparison of polar bears from Svalbard in the Norwegian Arctic with those in less polluted areas in the Canadian Arctic found very high concentrations of PCBs in older male bears.56 Females have lower levels because they pass the chemicals on to their young through their fat-rich milk.

PCBs reduce the ability of the immune system of Svalbard bears to combat common infections such as influenza, REO virus and herpes virus. This poses a particular threat to these long-living, slowly reproducing animals which have few offspring. Bears with higher PCB contamination also produce lower levels of the male sex hormone testosterone. Similarly, in females, those with the highest concentrations of PCBs have higher levels of progesterone in their blood.57 Other research into Svalbard bears found four of 269 females to be masculinised. Some researchers consider that this pseudohermaphroditism could result from excessive androgen excretion by the mother caused by a tumor, or it could be a result of endocrine disruption from environmental pollutants.58 Levels of newer-generation chemicals such as brominated flame-retardants59 and artificial musks60 are also rising in the Arctic. The toxic properties of these flame retardant chemicals are similar to PCBs and if the current trend of increasing global production is not halted, levels will surpass those of PCBs within the next 50 years.62 Although a direct link between these chemicals and adverse effects on arctic wildlife has yet to be established, it is becoming increasingly clear that the wildlife of the Arctic may face a new PCB-like problem from chemicals that can disrupt thyroid hormone function, affect the immune system, disrupt brain development and affect coordination, learning abilities and memory.

Mink and Otter In 1999 a correlation was found between the PCB mixture Aroclor 1260 and short baculum (penis bone) length in wild juvenile mink in the Canadian Fraser River and U.S. Columbia River systems.62 Scientists have suggested that baculum length may be a factor in breeding success. Similarly, a study in the polluted lower Columbia River revealed young otter with shorter bacula and smaller testes compared to otters in less polluted areas.63

Salmon A new laboratory study of Chinook salmon indicates that even brief exposures to low doses of DDE can impair the fish’s immune systems.64 Newly fertilized salmon eggs were immersed in a 10 parts per million solution of DDE for one hour and then again at hatching for two hours. When the fish were a year old, their spleens were significantly impaired in their ability to produce white blood cells, a major component of the immune system. Salmon are high in the food web and can accumulate significant levels of toxic chemicals in their fat. An alarming study published in January 2004 indicates that consumption of...
salmon and other fish high in essential fatty acids may pose serious health risks for humans. Researchers measured a total of 14 contaminants, including PCBs, dieldrin, dioxins, furans, toxaphene, lindane and DDT/DDE. The highest levels of PCBs, dioxins, toxaphene and dieldrin were found in salmon from Scotland and the Faroe Islands. The concentrations of these contaminants were significantly higher in all European fish than in the comparison salmon from Chile and Washington State in the U.S. The researchers suspect that the fish used to make the salmon feed were taken from European waters that are more contaminated than Pacific waters. They also note that under U.S. regulations, the levels found in European fish would trigger advice to consumers to eat less than half a meal of salmon per month. This study starkly illustrates the magnitude and ubiquity of the contaminant problem and underlines the fact that humans cannot insulate themselves from a dangerous cocktail of chemicals.

Seals In the 1970s, common seals in the Wadden Sea (the eastern part of the North Sea) produced few pups and the population went into decline. The animals were heavily polluted with PCBs. Seals fed on contaminated Wadden Sea herring had only half the breeding success of those feeding on less contaminated North Atlantic herring. Embryos failed to attach to the womb, and while this phenomenon can be associated with low levels of the female hormone, PCBs are known to stimulate the production of enzymes that break down that hormone, PCBs are known to stimulate the production of enzymes that break down that hormone. The seals’ immune systems were also affected, and this combination is believed to have contributed to the mass deaths of common seals in the North Sea and Baltic by distemper in the late 1980s. Those areas where the seals were most exposed to pollution, such as the Wadden Sea, had the highest death rates.

Few now doubt that the decline of Baltic ringed and grey seals was the result of pollution. Many spontaneous abortions and deformed wombs were observed. Seventy per cent of ringed seals and 30 per cent of grey seals had problems reproducing. An analysis of PCB and DDT levels in grey seals between 1969 and 1997 implicated PCBs as the leading cause of reproductive failure. The grey seals also suffered an impaired immune system, associated with high PCB and DDT levels. Other pathologies included hyperactivity of hormonal glands, bone degeneration, intestinal ulcers, claw malformations, arthritis, cancer of the womb and skin thinning.

Researchers are now also looking at the role of chemicals in the disruption of vitamin A (also known as retinol) physiology. Laboratory studies have shown that many contaminants, including PCBs, polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzo-furans (PCDFs), can disrupt vitamin A and alter the distribution of its essential metabolites. Field studies also suggest that complex environmental mixtures of chemicals disrupt vitamin A in wild marine mammals and other fish-eating wildlife. Vitamin A is important in immune function, growth and development, reproduction, vision, and other bodily processes. It has also been noted that many of the symptoms of contaminant exposure resemble those of vitamin A deficiency, including stunted growth and impaired reproductive function, implying that vitamin A disruption may be a mechanism by which contaminants interfere with normal physiology.

Lake Apopka wildlife Lake Apopka, Florida, has been the subject of extensive study since a chemical spill in 1980 dumped a number of DDT-related compounds into the water, after which the alligator population declined sharply. Runoff from farming in the area has also added several other pesticides, including dieldrin and toxaphene. Ongoing research continues to reveal aspects of chemical endocrine disruption in wildlife.

Alligators Many studies have reported reproductive disorders in Lake Apopka alligators as well as an overall decline in the alligator population. For example, compared with less polluted waters, fewer viable eggs were found, and juvenile survival was lower. Also Lake Apopka alligators had reproductive effects including smaller phalli in males. The pesticides polluting the lake are generally accepted as the cause.

Mosquitofish In 2003 researchers reported a study comparing male mosquitofish in Lake Apopka with those in two other nearby lakes which had not been affected by the 1980 chemical spill. Male fish from Lake Apopka had slightly shorter gonopodia and on average 32 per cent and 47 per cent fewer sperm cells per milligram testis, when compared with the fish collected from the other two lakes.

Human cancer. New research shows how chemicals long banned can still exert harmful effects. A 2003 Swedish study measured levels of PCBs, hexachlorobenzene and chlordane in the mothers of men with testicular cancer. Most of the men in the study were born in the 1970s, the period when these chemicals reached their highest concentrations in the population. Testicular cancer incidence has been rising in Western countries, with Swedish rates rising 2.2 per cent between 1980 and 1999. Because testicular cancer is thought to begin in the fetus, and because mothers are known to transfer POPs to their offspring, maternal levels during pregnancy and lactation would be an important source of exposure. The study found that concentrations of the chemicals were significantly higher in the mothers of men with testicular cancer than in the control group.

2. PAHs

Beluga whales The approximately 650 remaining beluga whales in the St. Lawrence River estuary are subjected to multiple and severe chemical threats from the highly industrialized Great Lakes system. In 2002 researchers published the results of a study of 129 carcasses of beluga stranded between 1983 and 1999. More
than a quarter of the animals suffered from cancer, and cancer accounted for 18 per cent of the deaths in the whales studied. Tumors and cancer in general are very rare in cetaceans. Intestinal cancer, the most common found in the belugas, was seen at rates exceeding those for humans, domestic cats, and cattle; the overall cancer rate was higher than that reported for any other wild animals. The researchers found three cases of breast cancer among the belugas—the first ever reported for cetaceans.

The St. Lawrence beluga whales are contaminated with a variety of heavy metals, PCBs and DDT compounds, including polycyclic aromatic hydrocarbons (PAHs), of which some 36,000 tonnes were released into the St. Lawrence watershed from aluminium smelters upstream between 1937 and 1980. Benzo(a)pyrene, a PAH known to be a human carcinogen, is suspected as a possible culprit in the cancers, although the belugas’ immune systems may also have been stressed by PCBs and other chemicals, perhaps in interaction with high natural hormone levels during the relatively long pregnancy and lactation periods of cetaceans. It is likely that the belugas ingest the contaminants as they dig into sediments and feed on bottom invertebrates.

3. Atrazine

Atrazine is a very commonly used herbicide; in the U.S., 27,000 tonnes are applied every year to farmland to kill weeds. It is so widespread that it has been measured in rainwater in parts of the world where it is not used. Although atrazine and simazine use is to end in the EU,75 that it has been measured in rainwater in parts of Africa, where they are still being used.76 Despite this evidence, the researchers concluded that atrazine concentrations in the environment were significantly lower than those in adults shown to have damaged reproductive organs.77

Researchers have investigated a number of causes ranging from increased UV exposure as a result of a depleted ozone layer, chemical exposures, and infectious agents. The explanation for the global phenomenon is likely to involve a combination of factors, but chemicals remain suspect, and atrazine is high on the list of likely chemical culprits.

The scientific evidence concerning the threshold of atrazine’s effects on organisms has evolved dramatically. A study published in 2001 using frog embryos, larvae and adults showed a dose-dependent increase in larval deformations, as well as respiratory distress in adults.78

Exposures at 0.1 ppb of atrazine produced retarded gonadal development and hermaphroditism. Laboratory tests on the frogs. Frogs living wild in atrazine-contaminated sites exhibited similar characteristics.

A two-year study of northern red-legged frogs along the northwest coast of California found male frogs producing vitellogenin, an egg yolk protein normally produced only by females, in nine of 13 populations sampled.79 The researchers noted the previous research that had raised concerns about atrazine but the study did not identify an estrogenic agent in the red-legged frogs’ environment.

4. Tributyltin

Tributyltin (TBT) belongs to a group of chemicals called organotins that are used to kill both microbes and fungi and to keep barnacles and other organisms from sticking to ship hulls. TBT is a known endocrine disruptor, and has been shown to be toxic in a wide variety of aquatic organisms, including dog whelks, barnacles, mud snails, newts, sea anemones, coral, crabs and prawns.80

Imposex has been documented in 140 species of African clawed frog tadpoles to varying concentrations of atrazine ranging from .01 ppb to 200 ppb. Then they measured changes in the frogs’ bodies after metamorphosis. They found that tadpoles exposed to as little as 0.1 ppb developed reproductive abnormalities, exhibiting characteristics of both sexes, and at concentrations of 1.0 ppb the larynges of the males were significantly smaller. In a second experiment, they exposed adult frogs directly to atrazine and then measured testosterone and estrogen levels, finding a 10-fold decrease in testosterone in the adult males exposed to 25 ppb of atrazine. The males’ vocal cords were also much smaller than normal. In 2003 the same team published a study of American leopard frogs both in the wild and in the laboratory which supported their earlier research.78 Exposures at 0.1 ppb produced retarded gonadal development and hermaphroditism in laboratory tests on the frogs. Frogs living wild in atrazine-contaminated sites exhibited similar characteristics.

Frogs Frogs around the world have suffered catastrophic declines in population, as well as a number of malformations including extra limbs and limbs growing in the wrong places. Researchers have investigated a number of causes ranging from increased UV exposure as a result of a depleted ozone layer, chemical exposures, and infectious and/or parasitic agents. The explanation for the global phenomenon is likely to involve a combination of factors, but chemicals remain suspect, and atrazine is high on the list of likely chemical culprits.

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In certain gastropods (a type of mollusc including snails, whelks, limpets and slugs), tributyltin causes a condition called imposex, in which the females develop male sexual organs. Imposex has been documented in 140 species...
of snails. Although the International Maritime Organization (IMO) has agreed to eliminate TBT-based paints on ships’ hulls by 2008, and TBT levels in marine biota have begun to decline, there is still significant endocrine disruption among gastropods in heavily used shipping lanes and harbors. A 2003 study of whelk in the Skagerrak region of the North Sea between Norway, Denmark and Sweden indicated high levels of imposex in common whelk (Buccinum undatum) living in areas with the highest ship traffic and the most thoroughly mixed water. A survey of snails in Sicilian coastal waters published in 2003 found that in four of the five sample sites almost all female snails showed signs of imposex even though the organotin concentrations in both the snails and the sediment were low. Despite the IMO ban on organotin biocides, some researchers are concerned that new chemical substitutes may be just as damaging as those removed from the market.

Research on mammals is more limited. Japanese researchers reported in 2002 that exposure of cells from Dall’s porpoises, bottlenose dolphins, California sea lion, larga seal and humans to tributyltin and dibutyltin significantly suppressed cell processes important in immune response. The researchers suggested that butyltins could also pose a serious threat to immune functions in free ranging marine mammals and humans. Experiments also show that TBT may disrupt mammalian thyroid hormones.
C. CHEMICAL MIXTURES IN EFFLUENTS

Effluents from sewage treatment plants, cattle feedlots, and paper mills have been implicated in endocrine disruption, although researchers have not always been able to identify all the specific compounds at work. Endocrine-disrupting chemicals in these environments are likely to be naturally-occurring ones, such as natural hormones excreted by humans and farm animals, and phytoestrogens from plant material. However, some sewage treatment effluents also include industrial chemicals such as BPA and nonylphenol as well as nitrates found in fertilizers and animal excrement.

Cattle Feedlot Effluent

Feedlot effluents have been under suspicion for some time because livestock in the United States are treated with, and excrete, significant amounts of androgens and estrogens. Concern about their effects on wildlife is building.88 The EU took action in the 1980s to ban growth promoters with steroid-like action.89 New research is emerging showing that fish living in feedlot effluent undergo reproductive alterations.90 One new study of fathead minnows living in water contaminated with such effluent found demasculinised males and defeminised females.91 The researchers suspect there are either potent androgens or a complex mixture of androgens and estrogens in the effluent.

Paper Pulp Mill Effluent

Paper mill effluent contains a complex brew of chemicals, only a few of which have been identified, including polychlorinated dibenzofurans and dibenzothiophenes.96 In a 2003 study, 80 per cent of the wild female mosquitofish living in a river downstream from paper mills were shown to be partially masculinised, with altered anal fins, a feature known to be androgen-dependent; 10 per cent of the fish were fully masculinised.97 Although the researchers did not identify a specific androgenic compound in the pulp mill effluent, tests of the effluent produced a variety of androgen receptor reactions.

Household Chemical Effluent

Wastewater effluent carries hundreds, probably thousands, of ordinary household chemicals. The study of their distribution and effects in the environment is just beginning, but the implications of early research are unsettling. A laboratory study of two compounds used in many household products and an antibiotic were found to reduce the biodiversity of algae found in a river receiving wastewater effluent.98 The compounds are triclosan, a microbicide used in kitchen cleaners and toothpaste; tergitol NP10, a nonylphenol ethoxylate surfactant used in hair dye and spermicidal lubricants; and ciprofloxin, a widely used antibiotic. This illustrates the potential ecological impact of chemicals in personal care products.
III. CONCLUSION

There is considerable and growing scientific evidence of damage to wildlife from chemical exposures, and even more indications of widespread contamination. A large amount of research has focused on the most notorious historical contaminants such as PCB and DDT. The fact that these chemicals continue to have an impact clearly demonstrates the long-term threats posed by persistent and bioaccumulative chemicals: even after they are banned it takes many years for environmental contamination to decline. Research has begun on chemicals of concern that have yet to gain broad public attention, such as brominated flame retardants and perfluorinated compounds. However, scientists are already demonstrating that these chemicals are contaminating wildlife across the globe, and there are many indications of potential impacts. It took a long time to identify conclusive evidence that PCBs have an impact on wildlife and humans; it will similarly take a long time to prove impacts from these newer chemicals of concern.

We know that globally chemical production is increasing, wildlife contamination is widespread, and a variety of troubling threats to species health are becoming more prevalent. Scientific research is only just beginning to uncover the extent of the chemical threat. To suggest there is no link between the development of these chemicals and the doubt, is reckless. To assume a link and to begin an immediate precautionary phase-out of certain chemicals in the face of unknown risks before it is too late is prudent and necessary—because the safety of people and the environment is paramount.

The experience with specific chemicals already known to endanger humans and the environment should motivate action to confront new chemicals before they create a legacy of unintended consequences. Such an approach should help to avoid unpleasant surprises in the future. This represents a major improvement on the status quo where ignorance and short-sightedness have created long delays before problems were identified and remedied.

Existing chemicals that threaten the health of wildlife and people can be substantially reduced, and future dangers averted, by ensuring that no chemicals are allowed on the market without basic information on their impacts. Those that pose the greatest concern -- including especially persistent and bioaccumulative chemicals and those that disrupt endocrine systems, reproduction, and other essential biological functions, deserve the greatest scrutiny. The use of chemicals of very high concern should only be authorized when there is an overwhelming social need for the use and safer alternatives are not available. This will require new international regulations, such as REACH, that promise to disclose missing data, to promote the innovation of safer alternatives, and to demand environmental accountability in global trade.

The Johannesburg Summit’s 2020 Challenge

In September 2002, the Johannesburg World Summit on Sustainable Development adopted a Plan of Implementation that contains over thirty targets – framing specific actions to be achieved by prescribed dates. With regard to the sound management of chemicals, the 191 participating governments agreed that the global community should renew its commitment, made in Rio de Janeiro in 1992:

“…to sound management of chemicals throughout their life cycle and of hazardous wastes for sustainable development and for the protection of human health and the environment, inter alia, aiming to achieve by 2020 that chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment….”

Achieving that 2020 target will be challenging, requiring a diverse mix of REACH and other regulatory and voluntary actions at global, regional, national, and local levels. Without enactment of effective REACH-type measures, in conjunction with other initiatives to phase out and replace toxic chemicals with safe alternatives, the 2020 target will likely be little more than a “paper tiger” that provided a false sense of future security while chemical contamination worsened.
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