IOWA'S WATER
Ambient Monitoring Program

Emerging Water Quality Issues

The purpose of the Ambient Water Monitoring Program is to provide a comprehensive assessment of Iowa's water resources, both in terms of the types of resources included (lakes, rivers, wetlands, groundwater and precipitation) and the scope of measured parameters (chemical, physical, habitat and biological). A key component of this comprehensive program is to adapt the monitoring efforts to reflect emerging water quality issues. Often as we gain more knowledge about our water resources, new questions arise. Sometimes these questions reveal gaps in our data collection efforts. We may learn that previously untested compounds are valuable to understanding the development and possible solution to water quality problems. Similarly, changes in human activities on the landscape or new technological advances may introduce new chemicals into the environment, which are subsequently transported to our water resources. This monitoring program has identified some of these emerging water quality issues and is beginning to incorporate these parameters into the statewide program.

New Pesticides and Pesticide Breakdown Products

The commercial use of synthetic pesticides began following World War II as a result of technological advancements made during the war effort. The 1960s and '70s marked a dramatic change in agriculture with the widespread use of herbicides and insecticides to control unwanted plants and insects (photo, left). When concerns arose that insecticides such as DDT were responsible for declining eagle and hawk populations, some insecticides were banned from use in the United States. During this time, little concern was expressed about the use of herbicides and their potential

Herbicide Breakdown Products

Parent Compound	Herbicide Class	Breakdown Products (Degradates)
Acetochlor	Acetanilide	Acetochlor ESA (Ethane Sulfonic Acid) Acetochlor OXA (Oxanilic Acid)
Alachlor	Acetanilide	Alachlor ESA Alachlor OXA
Atrazine	Triazine	Deethylatrazine Deisopropylatrazine Hydroxyatrazine
Cyanazine	Triazine	Cyanazine-amide
Dimethenamid	Acetamide	Dimethenamid ESA Dimethenamid OXA
Metolachlor	Acetanilide	Metolachlor ESA Metolachlor OXA

presence in water resources. This changed in the 1980s when research began to show that the commonly used corn and soybean herbicides atrazine (AAtrex*), alachlor (Lasso*), cyanazine (Bladex*) and metolachlor (Dual*) were being detected frequently in surface and groundwater resources. As a result, the U.S. Environmental Protection Agency (EPA) began to restrict the use of these "older" herbicides and promote the development of new herbicides that would be applied at much lower concentrations (ounces per acre rather than pounds per acre), break down more quickly in the environment (days rather than weeks or months), and be less toxic to animals. Industry responded to the EPA's new directive, and the 1990s experienced rapid changes in the number and types of new herbicides. Alachlor use plummeted; cyanazine was to be phased-out by 2001; the use of low-application rate herbicides such as sulfonylurea (Classic*, Accent*, Pinnacle*) and imidazolinone types (Pursuit*, Assert*, Raptor*) skyrocketed.

The changing face of herbicide use presented two challenges. First, the new chemicals were not detectable by traditional laboratory techniques. The low application rates translated to small concentrations and the chemical structure made these compounds nearly impossible to separate from water. It is important to note that while it may be beneficial to have these new herbicides occur in lower concentrations, it is still imperative that we know the levels of these compounds in the environment. The ambient monitoring program is partnering with industry laboratories, the United States Geological Survey (USGS), and the University of Iowa Hygienic Laboratory (UHL) to add these new herbicides to the monitoring program.

The second challenge related to herbicide monitoring during this time was an increased awareness of the importance in understanding the fate of chemicals in the environment. Early testing procedures looked only at the original compound, but did not track the occurrence or toxicity of the pesticide degradates. (Pesticides degrade in a stepwise process that results in a series of intermediate chemical compounds.) Research by the USGS has shown that the degradates of the acetanilide herbicides (alachlor, acetochlor and metolachlor – see sidebar above) are found more frequently and in much higher

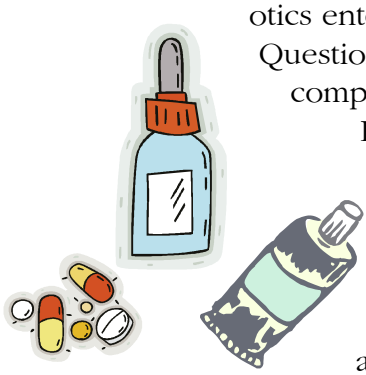
concentrations than the original herbicide. There is also some evidence to suggest that these degradates are much more persistent in groundwater and surface water than the parent herbicide and therefore, it is vital to determine the extent of their occurrence. The ambient monitoring program is working with the USGS to gather samples and analyze for these degradates in Iowa's surface and groundwater resources.

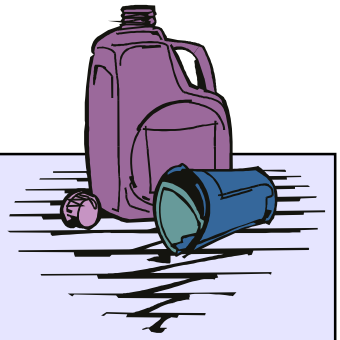
Endocrine Disruptors and Pharmaceuticals

Endocrine Disruptors. During the 1990s, researchers began to suspect a link between the occurrence of certain types of chemicals in the environment and reproductive problems in animal populations. These chemicals were theorized to have properties that would allow them to mimic the natural animal hormones that regulated reproductive function. Researchers called this phenomenon "endocrine disruption" since the endocrine system, which controls the balance of hormones in an animal, was tricked by the presence of the mimicking compounds. Of particular concern is the ability of some compounds to mimic the presence of estrogen (a female hormone), possibly reducing the fertility of male animals and stimulating the growth of cancers of the reproductive and endocrine systems.

A wide variety of materials have been suspected of acting as endocrine disruptors including PCBs (polychlorinated biphenyls), pesticides (such as DDT), plastic additives, flame retardants and pharmaceuticals (birth control pills, hormone supplement drugs). See the sidebar on last page for list of suspected endocrine disruptors.

Pharmaceuticals. As attention began to focus on the endocrine disruption issue, some researchers began to question the likelihood of commonly used drugs and antibiotics entering the rivers and streams through wastewater disposal systems. Questions began to arise surrounding the occurrence of these pharmaceutical compounds in water resources and their viability once in the environment. Researchers wonder what the effects of long-term exposure to sub-therapeutic doses (below the level given to a patient in a prescription) might be on wildlife as well as humans. For example, could low-level exposure to antibiotics increase the occurrence of antibiotic-resistant bacteria? The answers to these questions must rely on the collection of water-quality information to establish when, where and in what amounts these compounds are found.





Endocrine Disrupting Compounds

Compound Name	Common Use of Compound
17-beta Estradiol	Hormone Replacement Therapy
Bisphenol A	Flame Retardant, Plastic Additive
Ethynyl Estradiol	Oral Contraceptive
Nonylphenol	Detergent By-Product
Octylphenol	Detergent By-Product
Diazinon	Insecticide
Chlorpyrifos	Insecticide
DDT	Insecticide
PCBs	Degreaser, Solvent

Pharmaceutical Compounds

Compound Name or Class	Common Use of Compound
Acetaminophen	Pain Reliever
Codeine	Narcotic Pain Reliever
Cotinine	Nicotine By-Product
Triclosan	Disinfectant; Antimicrobial
Tetracyclines	Antibiotics
Sulfonamides	Antibiotics

In 2001, the ambient monitoring program, in cooperation with the USGS, will begin monitoring for a select group of suspected endocrine-disrupting and pharmaceutically active compounds. Samples will be collected upstream and downstream of ten large cities and analyzed using techniques newly developed by the USGS. This initial monitoring effort will help Iowa begin to understand the relevance of these compounds to the state's water quality.

*Use of brand names is for reference purposes only and does not constitute an endorsement by the Iowa Department of Natural Resources.

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Prepared by
Iowa Department of Natural Resources, Geological Survey Bureau
109 Trowbridge Hall, Iowa City, IA 52242-1319

Photo by Larry Kolczak