

# Monitoring Ecosystems

Real World Ecosystems  
Backgrounder  
Grade Level: 5-8



## DDT Linked to Bird Deaths

About 50 years ago, people in the United States noticed a strange thing: the number of birds of prey, especially osprey, falcons, and bald eagles began to change drastically.

The same thing was observed among populations of fish-eating birds such as cormorants and pelicans. Initially, people blamed illegal hunting, mysterious epidemics, parasites, and other causes. Eventually the problem was traced to a **pesticide** (Pesticides: A product that is applied to control undesirable bugs or other “pests”. Sometimes the term “herbicides” is used interchangeably with pesticides meaning both plants and animals) called DDT that was sprayed on crops to kill unwanted insects. This chemical was found in extremely high concentrations in the tissues of the threatened bird species. Somehow, DDT had gotten from farmers’ fields and into the food supply of these birds. The result was weakened eggshells that crushed when the birds tried to incubate them in their nests.

When it was first produced and used, DDT was promoted as safe for use around humans and animals, other than insects. But scientists, farmers, governments and the general public did not know that DDT would accumulate in the tissues of food organisms, and that it would be concentrated through the food chain, with disastrous effects on bird populations. When this was discovered, the use of DDT as a pesticide was banned in the United States, Canada, and most European nations. It is still

used by some developing countries in South America and Africa. Since its ban, DDT levels have dropped dramatically in bird populations, and the populations of some birds have risen almost as dramatically.

The story of DDT was one of the first to show people the importance of environmental **monitoring** (Monitoring: A method of gathering information used to evaluate the general health of an environment). Since the 1960s, many hundreds of government departments, universities, and private organizations have become involved in environmental monitoring. As human populations grow in North America and other places in the world, it becomes increasingly important to understand the health of the environment, since so many human needs, such as agriculture and water supplied, depend on it.

## Phosphate in Detergents Cause Harmful Algae Overgrowth

Back in the 1960s there was a lot of concern over the problem of algae in freshwater lakes.

Each summer, many lakes were turning bright green with thick, smelly algae. Some people thought it had to do with the phosphates in detergents, which were leaking into the lakes from cottages. The soap companies denied it many times, but scientists were not so sure. It took an experiment by Dr. David Schindler, of the University of Alberta, working at the Experimental Lakes Area in Ontario, to provide beyond all doubt.

Dr. Schindler used a plastic curtain to divide a lake into two identical halves. One side received a treatment of phosphate, and the other side didn't. The results showed that phosphate, and not some other **pollutant** (Pollutants: Contaminants that produce undesirable effects on the environment) was the cause of the problem. Since then, detergent companies have been forced to use less harmful chemical in their products. Partly as a result of these experiments, government agencies have been on the lookout for phosphates from sewage leaking into fresh water lakes. Because of the constant monitoring for this and other chemicals, the quality of water in many freshwater lakes has improved substantially since the 1960s.

### Walkerton Water Disaster

Walkerton is a small farming community in southern Ontario. Water for the town is supplied by a series of wells located in the countryside outside the town. Normally, water from these wells is treated and tested frequently to make sure it is clean. But because of human error, Walkerton's water supply was not being properly treated or tested. Walkerton residents were in danger and didn't know it.

Scientists suspect that a flood in late 1999 caused one of the town's wells to be contaminated with bacteria-laden (**Bacteria**: Microscopic one-celled organisms, some of which are helpful, others may cause diseases) water from a local cow pasture. The presence of bacteria was missed by faulty testing. Contaminated water was delivered to people's homes through the town's water supply system. The bacteria caused more than 1,000 people to become sick, and 5 people died.

This is an example of how important environmental monitoring is, and what can happen if it breaks down. In this case, a town's drinking water supply was involved. The consequences of failure in such a vital system can be very serious. Other environmental monitoring programs keep track of air pollution, water pollution in lakes and streams, and contamination of soil, food, the health of forests and wildlife populations, and many other things that are

important to us. These systems tell us about the health of the environment, and warn us of problems before they turn into disasters.

### Environmental Monitoring

Environmental monitoring means making detailed observations about the condition of the environment and analyzing this information for evidence of changes. For example, the number of fish in many Alberta lakes is continuously monitored. Biologists take samples to estimate the fish population in a lake and use this information to control how much fishing is allowed on the lake. The purpose of environmental monitoring is to help people spot possible problems in the environment, allowing them to take corrective action if necessary.

### Environmental Indicators

Environmental monitoring depends on having environmental indicators. An environmental indicator is some aspect of the environment that can be accurately measured that can tell us how clean air, soil, or water are, or can tell us if there are problems with forests, oceans, or other natural ecosystems. There are literally thousands of different environmental indicators, so let's look at a few examples:

#### Air Quality

Air Quality is monitored daily in many towns and cities, and around many industrial sites all across Canada.

Special monitoring stations take samples of air and measure things such as **particulate matter** (tiny particles such as dust, ash, or soot); **pollutants** (ozone, carbon monoxide, sulfur dioxide, and nitrous oxide); and **volatile organic compounds** (vapors from fossil fuels, alcohols, and other carbon-based liquids).

Usually, these measurements are reported in units of parts per million, or parts per billion. For example, in a sample of city air on a smoggy day, there may be 10 parts per billion of sulfur dioxide. This means that for every billion molecules of air, 10 of them will be sulfur dioxide.

Air quality is monitored at stations such as the one below. Many of these stations work automatically, gathering samples, testing them, and sending the results to a central office through a telephone line.



Photo: D Mussell, greenlearning.ca

### Water and Soil Quality

As with air, water quality is monitored all over Canada. Monitoring stations collect information about the number of bacteria and algae, and the concentrations of pollutants such as dissolved lead, organic compounds, fertilizers, and many more.

Often, lake or stream water is sampled by simply scooping up a small amount and pouring it into a special ultra-clean container. The sample is taken to a lab for analysis.

Checking the condition of **groundwater** (Water held in porous rock layers deep beneath the ground) is a little more difficult. Groundwater testing requires water wells, or test wells, to be drilled. A well consists of a sealed pipe that has small holes at the level of the water in the soil or rock. Water flows into the pipe that has small holes at the level of the water in the

soil or rock. Test wells are used near sanitary landfills, industrial sites, and other places where groundwater could be contaminated. They are checked on a regular schedule. The pollution is found, steps are taken to stop the pollution at its source.

### Forests, Fish and Wildlife

Plants and animals can tell us a lot about the health of the environment. By watching for changes in the numbers of wild birds, we can tell if human activities are having an effect. Because there are so many industries active across the landscape, it is important to know if their activities are causing problems.

In Alberta, both government agencies and private companies conduct research to determine the health of wildlife populations. In the photo below, a biologist is attaching a leg band to a bird. Leg bands are numbered so biologists can identify individual birds. This information can help the biologists estimate the total population of this species, where they go during migration, and what factors are affecting their survival. Similarly, there are biologists who study fish, small mammals, large mammals (such as bears, wolves, and elk) and, of course, insects and other invertebrates. This work helps government officials to make decisions on how to best protect wildlife.



## The Big Picture: Global Environmental Monitoring

There are many national and international organizations that monitor important environmental indicators on a global scale. These organizations are often concerned about the state of large parts of the **biosphere** (The part of the Earth in which living species are found. Most organisms are found within a few metres of the Earth's surface, either in the soil, water or atmosphere) that cross international borders, such as the world's oceans, Antarctica, and the **atmosphere** (The mixture of gases (air) that surrounds the Earth.)

One of the biggest of these organizations is the United Nations Environment Program (UNEP). UNEP has teamed up with another "heavy" in international monitoring, the World Meteorological Organization (WMO) to gather information about the state of the world's climate system. Together, these organizations lead the Intergovernmental Panel on Climate Change (IPCC), which is the single largest environmental monitoring program in human history. The IPCC represents thousands of climate scientists, policy experts, and government representatives from all over the world. The IPCC gathers information about greenhouse gases and climate information from almost 200 countries, and information about climate change at thousands of locations around the world. The organization is responsible for analyzing all this information and reporting the results to the international community, along with advice on how to deal with climate change.

Another important organization is the US government's National Oceans and Atmosphere Administration, which monitors global climate, air quality, and the marine environment. Other international organizations are also interested in oceans.

### Key Points to Remember

- Environmental monitoring is a highly quantitative applied science. Monitoring is often based on environmental indicators, or quantities that are assumed give us a picture of some aspect of the

health of the environment. Indicators are used to quantify water quality, forest health, air quality, toxicity or pollution in soil, the health of wildlife populations and hundreds of other components of our environment.

- Technicians, scientists and even members of the general public can be involved in environmental monitoring. Often, samples or observations are made over time, and the results are compared and analyzed to see if there are discernible trends in the information. The results are used to help the provincial or federal government set regulations and rules governing the environment.

### Think About...

- There are many studies that could be completed on your schoolyard ecosystems. Don't be limited by this list. Can you think of others? Try searching for alternative ideas.