

# Science and Technology

The Foundation for Policy,  
Regulation and Service



Environment  
Canada

Environnement  
Canada

Canada

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## Our Vision and Mission

*Environment Canada's vision is to see a Canada where governments and citizens make responsible decisions about the environment, and where the environment is thereby sustained for the benefit of present and future generations. Canadians know that our health and the health of our children, the quality of life in our communities and our continued economic prosperity depend on a healthy environment. Our mission is to make sustainable development a reality in Canada by helping Canadians live and prosper in an environment that needs to be respected, protected and conserved.*

*The primary tools at our disposal to achieve this goal are sound science and innovative technologies.*



Credit: Meredith Carter



## Environment Canada's Evolving Role

Our world, our environment and our Department are works in progress. When the federal *Department of the Environment Act* came into being in 1970, Canadians' environmental awareness was only just emerging. This awareness was primarily driven by mounting scientific evidence and a growing realization that many commonly-used chemicals such as PCBs and DDT were having negative effects on the environment and human health. The legislation was an "in the moment" attempt to capture, organize and anticipate the Minister's role in all matters relating to preserving and enhancing the quality of our natural surroundings and protecting Canadians from environmental threats.

Since 1970, the range of environmental issues and challenges facing Canadians has evolved considerably, requiring the creation of subsequent acts and regulations. Today Environment Canada's responsibilities encompass water, air, land and soils, wildlife, meteorology (weather and climate) and the dynamic interactions between these elements



Credit: Tim Nye

that make up ecosystems; managing environmental quality issues between the United States and Canada; enforcing regulations related to toxics, boundary waters, migratory birds and species at risk; and coordinating environmental policies and programs for the federal government.

Over the past few decades the global scale of environmental challenges has become much more apparent. Environmental issues know no boundaries. As we see with climate change, air quality, and persistent organic pollutants, our ecosystems are affected not only by our own actions but also by actions in other countries. Environment Canada's work stretches far beyond our own borders to include shared efforts with the international community on issues of common concern.

The many facets of Environment Canada's work—exploring and monitoring our changing environment, predicting change, and telling Canadians what is happening and what can be done about it—all share a common foundation: sound science and innovative technology.

## Environment Canada's Science & Technology Capacity

It should not be surprising that Environment Canada is a science-based department. Science, after all, is all about understanding nature. In fact, over 70% of the Department's budget is devoted to science and technology (S&T) activities, and about two-thirds of its employees are in S&T occupations. Within the federal S&T family, Environment Canada is one of the major performers of S&T, second only to the National Research Council.

Environment Canada's S&T efforts and facilities are Canada-wide in scope. The Department has national S&T centres and institutes, including the Environmental Technology Centre, the National Wildlife Research Centre, the National Water Research Institute, the Wastewater Technology Centre and the Climate and Atmospheric Research Centres. It has regional S&T facilities in most provinces and territories—including the Atlantic Environmental Science Centre in Moncton, the Centre Saint Laurent in Montreal, the Prairie and Northern Wildlife Research Centre in Saskatoon, and the Pacific Environmental Science Centre in Vancouver. Our S&T efforts also extend

outside of these laboratories and institutes, with many scientists working in the field throughout the country.

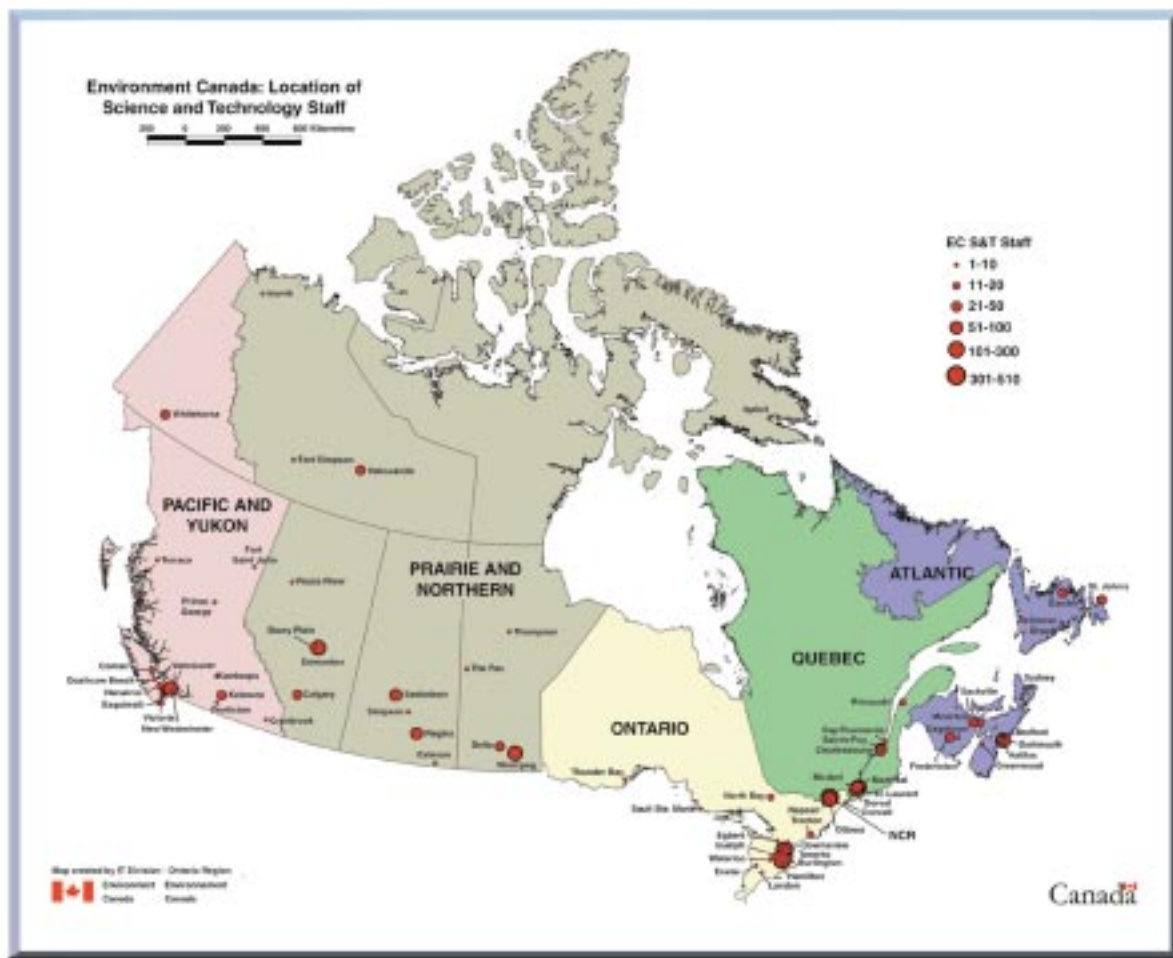
At the heart of the Department's scientific activities is its research and development (R&D) capacity, which comprises about a quarter of Environment Canada's S&T effort. This R&D focuses on understanding what is changing in our ecosystems and why it is changing, predicting future changes, and developing approaches and techniques to address these changes. The Department's R&D keeps its scientific activities at the cutting edge, and yields significant benefits to the public and the Canadian economy.

While these R&D activities are extremely important, the majority of Environment Canada's S&T effort is comprised of other scientific activities such as weather forecasting, environmental monitoring and data collection, scientific and environmental assessment, emergency preparedness activities, production of technical reports and feasibility studies, and development of guidelines and indicators. These activities are all



performed regularly and the work is often national in scope. Some of these activities support the essential services Environment Canada provides to Canadians, while others provide critical scientific information for the development and implementation of policies, regulations, and other management decisions.

The Department's in-house S&T capacity gives us the means to do the essential public good S&T that others can't or won't do. It establishes our credibility with the public, among the scientific community, and at decision-making venues, which helps us to advance our own agenda and allows us to contribute to and influence



other agendas that impact on the environment. And it enables us to absorb and interpret the scientific findings of

others to ensure our decisions are based on the best available S&T.

### **The Benefits of Research: Health, environment and economic impacts of ozone depletion research**

Canada has a long and active history in ozone research that dates back to the 1930s. In the mid 1970s, Environment Canada's Atmospheric Environment Service (AES, now called the Meteorological Service of Canada) responded to evidence of stratospheric ozone depletion by significantly expanding its research and monitoring program.

R&D on stratospheric ozone depletion conducted by AES between 1975 and 1997 focussed on developing measurement technology, monitoring ozone and ultraviolet radiation (UV) and identifying trends, improving understanding of ozone chemistry and transport, and developing ozone and UV forecasts. Key achievements were the development of the Brewer Ozone Spectrophotometer—the most practical and accurate ozone-measuring device available—and the launch of Canada's UV Index to raise public awareness and help Canadians protect themselves from the harmful effects of UV rays.

Environment Canada's investment in research contributed to the creation of the Montreal Protocol on Ozone Depleting Substances, thereby resulting in the avoidance of over 57,000 cancers, 30,000 cases of cataracts, and 625 deaths. Although regulations adopted to protect the ozone layer imposed costs to Canadian industry, they also prevented significant damage to natural resources. Overall, the R&D resulted in an estimated increase in Canada's GDP of \$210 million and the creation of 3780 person-years of employment. This represents measurable economic returns to Canadians of \$7.90 in health benefits, \$3.03 in environmental benefits, and \$1.94 in economic benefits per dollar of research.

# S&T in the Service of Canadians

## Science for all Canadians

Science for public good is uniquely the business of government. The goal of government science is to help address pressing societal challenges, thereby protecting and enhancing human health and well-being, assuring our national security, improving economic strength, sustaining the environment, and advancing quality of life for all Canadians.

Unlike science in universities or in private firms, government science is not conducted primarily for the sake of science itself or for profit. The Department's S&T efforts are focused on serving the public interest, and they cover a very broad range of activities

within the areas of research and development, monitoring, prediction and reporting.

Environment Canada's S&T capacity—its people, skills, facilities and equipment—generates the knowledge and tools needed to fulfill its mandate and achieve intended results. It supports the Department's ability to:

- develop and implement policy, regulations and management decisions,
- deliver important services to Canadians, and
- develop new and innovative environmental technologies.



Credit: Services Clients and Partners Directorate, MSC



## The foundation of sound decision-making

The work of Environment Canada's S&T community—its scientists, engineers, technicians, and technologists—is critical to the government's ability to make decisions that can effectively manage threats to the environment and human well-being and preserve Canada's natural heritage. S&T provides the knowledge

needed to develop and implement policies, regulations and management decisions.

Our S&T is also an important input to environmental decision-making at the provincial and territorial level.

Scientific issue assessments, monitoring, modelling and prediction help us to identify emerging threats, understand how the environment is changing, identify and assess risks, determine the best actions

### Understanding the effects of toxic substances on wildlife

Environment Canada's National Wildlife Toxicology Program is the principal source of scientific knowledge in the federal government on the impacts of toxic substances on wildlife and on the use of wildlife as indicators of environmental quality and ecosystem health. The Program focuses on migratory birds, with some attention on amphibians, reptiles, mammals, and plants.

The Program's scientists carry out research and monitoring, conduct evaluation studies and expert review of available data, and undertake advisory activities. This information is used to build science-based cases for regulation and other interventions to control the contaminants that are causing concern, and to assess the effectiveness of the interventions. The science contributes to wildlife legislation, as well as to laws governing the use and release of toxic chemicals, such as the *Canadian Environmental Protection Act* and the *Pest Control Products Act*.

For example, lead poisoning of waterfowl and their predators has been studied for many years in Canada. Lead shot from shotgun cartridges can accumulate in sediments of wetlands heavily used for hunting, where it can be ingested by waterfowl. As a result of past studies by Environment Canada, Canada put in place a ban on the use of lead shot for hunting of most migratory birds, under the *Migratory Birds Convention Act*.

that can be taken, and evaluate the effectiveness of policy measures and management decisions. Developing and promoting innovative environmental technologies enables decision-makers to design regulations, establish standards, and make international commitments that are achievable and that provide optimum benefits to Canadians. All of these activities have the parallel goal of establishing information which is publicly credible, and helps to build consensus on

complex, often controversial scientific issues where risks must be weighed and balanced policy options must be identified and implemented.

### **The basis for essential services**

Environment Canada's S&T supports essential services to Canadians, such as responding effectively to environmental emergencies, reporting to Canadians on environmental threats and conditions using

#### **Helping Canadians take action on smog**

**Canada's first smog-prediction pilot program demonstrated that Canadians will take action to help the environment, when they are provided with accurate, credible and understandable information.**

**Poor air quality affects the health of all Canadians, especially children, the elderly and those with respiratory and cardiac conditions. In response to this threat to the health of Canadians, Environment Canada launched a pilot smog-prediction program in Saint John, New Brunswick in 1997. Developed in partnership with the New Brunswick Department of Environment, the program's goal is to deliver better air-quality information to the public.**

**Public polling conducted after the introduction of the forecasts found that area residents are now more aware of their local air-quality problems and how to reduce smog. The surveys also indicate a better popular understanding of the health hazards associated with poor air quality.**

**This program would not be possible without Environment Canada's expertise in monitoring current atmospheric conditions, modelling and forecasting future conditions, and communicating our understanding to Canadians on an ongoing basis.**





indicators and trends, and providing weather forecasts and warnings of extreme weather events. Over 90% of Canadians listen to at least one weather forecast daily, making it one of the most frequently used federal government services.

Environment Canada is committed to providing Canadians with the knowledge and tools they need to make responsible decisions about the environment and to protect themselves from threats posed by environmental conditions. To do this, we must not only provide reliable and timely environmental information, but also teach Canadians of all ages about the science behind environmental issues. Enhancing public understanding of the facts, context, uncertainties and impacts of environmental issues is the first step in the process of changing behaviour and decisions. Communicating effectively with Canadians is an essential part of our stewardship role.

## Technology innovation for the environment

Environment Canada is taking action to improve the availability and selection of environmentally sound technologies and to enhance their adoption by Canadian industry and communities. The Department collaborates with many

partners to catalyze the development and demonstration of practical solutions that address the challenges of sustainable development both within and beyond our own borders. Sound science provides the foundation for these activities by helping to identify strategic priorities and directions.

Environment Canada works with funding programs and initiatives managed by other departments and third party organisations to conduct technology assessments and promote targeted technology demonstration and deployment. It collaboratively researches and develops new tools and technologies necessary for the delivery of its programs,



Credit: Victoria Hudec

### **Using microwaves to reduce energy use and toxic solvents**

Energy requirements can be reduced by as much as 99% using the Microwave-Assisted Process (known as MAP™) developed by Environment Canada. Using the same kind of microwaves that heat a cup of coffee, MAP™ is an energy-efficient way of reducing or eliminating the need for solvents in various applications, including chemical extraction and remediation of contaminated sites. Less energy use also means fewer greenhouse gas emissions.

With financial support from Technology Early Action Measures, a component of the Climate Change Action Fund, CanAmera Foods and BC Research Inc. are using MAP™ to explore the extraction of edible oils from agricultural products such as canola, flax and soya. This approach to extracting cooking oils is more efficient than conventional energy-intensive extraction methods. If all 10 CanAmera plants in Canada were converted to this cleaner production process, a 1.2 megatonne reduction in annual carbon dioxide emissions is predicted.

MAP™ has now been licensed to a number of companies around the world. New uses for this innovative technology are continuing to be developed by Environment Canada's Environmental Technology Advancement Directorate, which will lead to further energy-saving process applications.

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such as technologies for environmental monitoring, testing and remediation. The Department transfers technologies and expertise to build international capacity for global environmental protection. It also provides policy advice on environmental technology applications through involvement in initiatives such as the Canadian Biotechnology Strategy.

Through the establishment and nurturing of partnerships among technology users, developers and funding agencies, Environment Canada is providing technology tools to address Canada's sustainable development priorities and ultimately broadening market uptake of innovative technology solutions.

# Innovation Through Collaboration and Networking

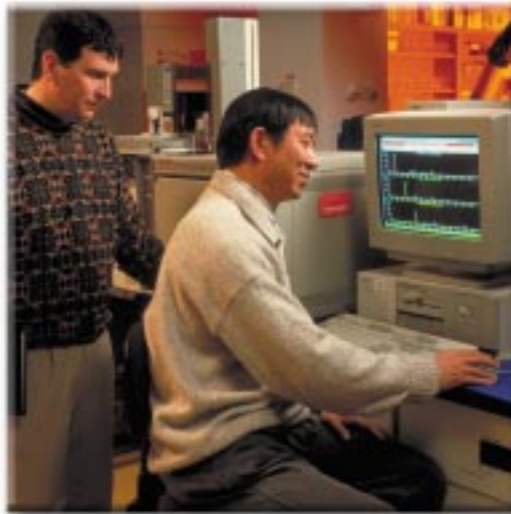
Environment Canada is developing new and more effective ways of engaging with the wider S&T system, both domestically and internationally, in order to leverage external resources and build synergies.

The Department engages in a variety of arrangements with other researchers, institutions, and organisations in order to fulfill its mandate. These arrangements include networks, partnerships, joint ventures, collaborations, research chairs, co-location

arrangements, adjunct professorships, and grants and contributions programs.

Today, about half of the Department's research work is conducted in collaboration with external researchers—a higher proportion than the average

collaboration rate for the whole of the federal government. In addition to being the single largest institutional performer of environmental research in Canada,



Credit: © Her Majesty the Queen in Right of Canada, (Environment Canada) 2003

Environment Canada is the main partner of each of the other top ten performers. The Department has already built significant S&T networks across the country, and is actively exploring new models of partnership and collaboration involving universities, the private sector, and non-governmental organisations.

The cross-cutting nature of many of the major environmental issues facing government has made partnering with other federal departments an essential part of doing business. Environment Canada collaborates extensively with other



departments to conduct S&T on issues such as climate change, the health and environmental impacts of toxic substances and pesticides, managing watersheds and coastal zones, biotechnology, and emergency responses to natural hazards.

Environment Canada will continue to be in the vanguard, looking for innovative

ways of managing and integrating the government's environmental S&T capacity. Its sustained effort on partnerships and networking serves to leverage resources, ensure that the Department's S&T is relevant, and maintain public trust in its S&T and thereby in federal environmental policy.

### **Ecological Monitoring and Assessment Network**

**The Ecological Monitoring and Assessment Network (EMAN) links organisations and individuals involved in ecological monitoring in Canada to better detect, describe, and report on ecosystem changes. The network is a cooperative partnership of federal, provincial and municipal governments, academic institutions, aboriginal communities and organisations, industry, environmental non-government organisations, volunteer community groups, elementary and secondary schools and other groups/individuals involved in ecological monitoring.**

**Environment Canada's EMAN Coordinating Office (CO) brings together those with common interests in ecological monitoring and research for the purpose of developing common techniques and protocols, promoting the sharing of data and information, and attempting to catalyse the production of integrated reports and information. EMAN CO, in partnership with the Canadian Nature Federation, hosts a series of NatureWatch programmes—FrogWatch, IceWatch, PlantWatch and WormWatch—which encourage schools, community groups, naturalists, backyard enthusiasts, Scouts and Guides to participate in environmental monitoring.**

# Managing for Excellence

Within Environment Canada, S&T covers a wide range of endeavours which are geographically distributed across the country and represented by different scientific communities and diverse institutional and disciplinary cultures. Because S&T is one of the most complex activities conducted within the Department—and of fundamental importance—the Department takes the management of its S&T very seriously.

Environment Canada's S&T management system ensures that the Department's S&T is of high quality, aligned with the priorities of the federal government as a whole, linked to Canadian and international environmental S&T efforts, and effective in addressing the needs of Canadians.

The Department has a number of special management committees focused on the strategic management of its S&T. These committees, made up of senior managers and S&T managers from across the

Department, deal with common issues and share best practices in S&T management. In addition, the Science & Technology Advisory Board, composed of experts from the broader Canadian S&T community, provides expert external advice to the Deputy Minister. This institutional structure, reinforced

by the support and leadership of senior management champions, has allowed Environment Canada to ensure sound and innovative management of its investment in S&T.



Credit: National Water Research Institute, Environment Canada

## Quality and credibility

The quality of Environment Canada's S&T is key to maintaining and enhancing the public trust. Canadians look to Environment Canada as the credible voice for unbiased scientific assessments and advice.

Excellent science begins with excellent scientists. Environment Canada's world class scientists pursue leading-edge science and publish their results extensively in the international peer-reviewed scientific literature. Our scientists have received many prestigious national and international grants, awards and fellowships. They hold adjunct professor positions at many universities and have mentored hundreds of graduate students. They also lead and serve in professional associations and national committees, and on the editorial boards of top science journals.



Credit: Microwave Assisted Processes Division, Environment Canada

Bibliometric studies of the Department's environmental science activities have shown that Environment Canada's R&D is of equally high quality as that conducted in Canadian universities—work that together has made Canada the world's third-ranked country in the environmental

sciences in terms of scientific impact. A recent international peer review underscored the excellence of our meteorological and atmospheric research and development.

Environment Canada has instituted programs to ensure the quality

of not only our own laboratories and facilities but also external facilities that perform contracted research for the Department. For example, our strong partnership with provincial environment departments and commercial laboratories through the Canadian Association for Environmental Analytical Laboratories

(CAEAL), together with our internal Laboratory Data Quality Policy, provides assurance that all analytical data

generated or received by the Department meets consistent and high standards.

### **The National Water Research Institute: A well-managed research organisation**

The Auditor General's document, *Attributes of Well-Managed Research Organizations*, outlines ten attributes grouped under the themes of people focus, leadership, research management, and organisational performance. In 2001, these attributes formed the basis of an audit of Environment Canada's National Water Research Institute.

The audit found that the research facility performed very well in all four areas. The auditors noted the Institute's strengths in consulting its users and clients on research priorities and in linking planning to departmental priorities and results. The Institute is held in very high regard for the quality of its science, staff are generally proud to be part of the Institute, and clients were found to be very satisfied with the science products they receive.

## The Challenges Ahead

The environmental challenges facing Canadians are becoming increasingly complex and interconnected. The more we learn about the relationships between the natural and human-constructed worlds, the greater the need to acquire even more environmental knowledge. And the long-term nature of most environmental issues means that we have an increasing inventory of issues to address. Each decade has brought new environmental challenges and added to the demand for accurate and timely scientific and technological knowledge to support policy-making, international agreements, services, new management practices and technologies, and decision-making by ordinary Canadians. We need new scientific knowledge on emerging issues such as ecosystem impacts of endocrine disruptors and biotechnology, as well as



Credit: © Her Majesty the Queen in Right of Canada, (Environment Canada) 2003

continued work on ongoing or recurring issues such as acid rain and ozone depletion.

Despite the increasing demand for environmental S&T, Environment Canada's S&T capacity has remained relatively

static since the reductions to the Department's budget during Program Review in the mid-1990s. At the same time, there have been dramatic increases over the past few years in the resources invested by the Government of Canada in the Canadian S&T system as a whole and in university research in particular.

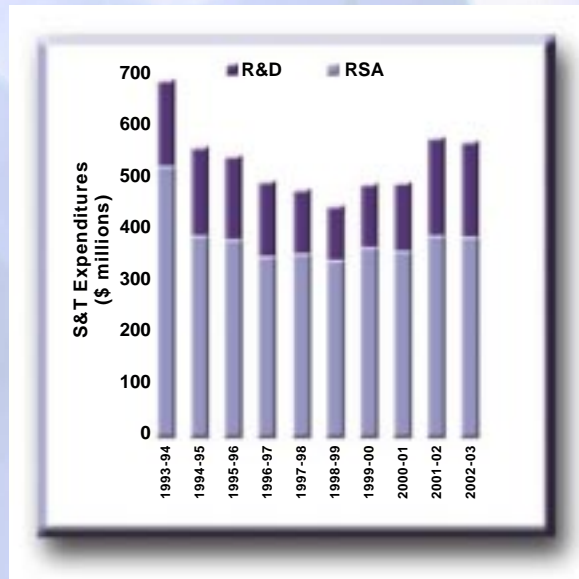
This trend represents a shift in the landscape of Canada's S&T system.

Environment Canada must continue to adapt to this changing landscape and find new ways of managing our S&T capacity to deal with the challenges ahead. It must find ways

to coordinate and integrate the environmental S&T performed throughout the Canadian S&T system and focus it on the priorities of Canadians. A strong, integrated environmental science system in Canada is critical to ensuring that S&T,

wherever it is performed, provides Environment Canada and all Canadians with information and tools needed to find the most effective and efficient solutions to the challenges of sustainable development.

### Environment Canada's funding for science & technology



**Note:**

- Figures shown above do not include one-time R&D grants for initiatives outside the department that did not result in increases in Departmental resources.
- Related scientific activities (RSA), such as scientific assessments and data analysis, are performed in support of Environment Canada's regulatory, service and science-based policy responsibilities. Research is often needed in order to ensure the availability of up-to-date scientific knowledge for RSA (e.g., improved atmospheric models for more accurate weather forecasting).



# Building for the Future

Science and technology are the foundation of Environment Canada's work, and the Department has a solid record of performing high-quality S&T in the interest of Canadians. This is reflected in the trust that citizens place on the information we provide—information that Canadians rely on, both day-to-day and over the long term. The quality and effectiveness of our science and technology continues to be a Department-wide priority. Through attentive management and a commitment to networking and partnerships, the Department has been able to make adjustments in response to shifts in funding while maintaining its level of scientific excellence.

As a new generation of complex issues emerges, Environment Canada intends to approach them on a number of fronts. We need to ensure that our internal S&T capacity is well-managed, that the broader Canadian environmental S&T system is



Credit: © Jim Moyes - 2002

strong, and that both our own S&T and that performed externally are brought to bear on the issues that matter to Canadians. We will do this by encouraging cooperation with other institutions;

exploring multidisciplinary approaches to issues; promoting communication and networking among scientists; and fostering better linkages among researchers, policy makers, and investors.

Environment Canada remains focused on practising high-quality, relevant science and presenting it to non-experts in

an understandable way. We are committed to enhancing Canadians' ability to protect and conserve our environment and thereby improve our quality of life, and building on the support of Canadians for developing a competitive, sustainable economy. To do this, we will continue to be proactive and responsive in marshalling sound science and innovative technologies to serve Canadians now and in the future.