Secondary Environmental Indicators

The environmental indicators discussed in this section are (1) carbon dioxide emissions, (2) oil spills, (3) pesticides, (4) toxic releases, and (5) wildlife. These are often cited as measures of the state of the environment but we class them as secondary because they provide information about environmental quality that is, at best, indirect. In some cases, such as carbon-dioxide emissions, it is unclear whether the indicator contributes to an environmental problem. In other cases, such as wildlife, the data available make it difficult to draw reliable conclusions. As a result, the secondary indicators presented in this section are not included in the index of environmental quality presented at the end of the report.

6 Carbon Dioxide Emissions

Carbon dioxide (CO_2) is a vital nutrient for plants. Oceans absorb and produce CO_2 in great quantities through a complex cycle and store about 50 times more carbon than does the atmosphere.[1] The combustion of fossil fuels by humans also generates CO_2.

Emissions of CO_2 correlate with fluctuations in Gross Domestic Product (GDP) (figure 6.1). Emissions of CO_2 in Canada rose with economic growth until the 1970s, then levelled off before declining in the early 1980s. Recently, emissions have risen again.

It has been suggested that human-induced CO_2 emissions are linked to global warming. As a result, controlling CO_2 emissions has been the subject of many recent policy debates. In order to understand fully the popular debate about global warming, one must appreciate the distinction between the greenhouse effect and the enhanced greenhouse effect. Scientists agree that there is a greenhouse effect that causes the earth to be warm. This effect occurs because greenhouse gases such as carbon dioxide, water vapour, nitrous oxide, and methane are transparent to the short wavelength radiation from the sun but opaque to the longer wavelength radiation emitted from the earth. In simple terms, greenhouse gases trap the heat from the sun and this warms the earth.

The popular debate revolves around the question whether humans, through their additions of greenhouse gases to the atmosphere,[2] enhance the greenhouse effect that occurs naturally and, thus, contribute to global warming. The theory of enhanced greenhouse effect gained many advocates in the 1950s but lost popularity in the 1960s and 1970s when average temperatures fell. During the 1970s, the idea that pollution was causing global cooling by reflecting sunlight away from the earth's surface was supported by many who now promote the theory of the enhanced greenhouse effect.

Although some now claim that the increase in CO_2 levels in the atmosphere will cause a catastrophic warming, there are many credible challenges to this theory. In the face of the uncertainty within the scientific community about the link between human additions of CO_2 to the atmosphere and global warming and in the absence of a proven link to global warming, CO_2 cannot be considered a pollutant but, at most, a secondary indicator of environmental quality.

The scientists who criticize the theory of global warming possess three powerful lines of attack on the apocalyptic theories: the inadequacy of the computer models being used to forecast future temperatures, the evidence from actual temperature records, and the strength of competing hypotheses that explain warming trends but are currently under-reported and insufficiently considered by policy makers.

The inadequacy of the computer models

It is important to realize that current projections of global warming and policy recommendations for dealing with the predicted crisis are based on computer models that try to forecast future temperatures based on a number of assumptions. At the present time, these computer models are incapable of modeling the atmospheric system completely. Large gaps in understanding about the way important variables such as oceans and clouds affect climate, and how the effects of these variables change with additions of CO_2 make the predictions of these models unreliable.

In fact, the computer models cannot even replicate what has already happened to temperatures. For example, according to the model used by the Intergovernmental Panel on Climate Change (IPCC), the northern hemisphere should have warmed between 1.3° and 2.3° Celsius since the beginning of the century. It has not. For the northern hemisphere, the warming measured at ground-based stations is about 0.6 degrees Celsius—less than one-third the warming that the IPCC's model predicted.

Evidence from temperature records

The second major criticism of the theory that temperatures are likely to rise as a result of increasing CO_2 emissions and cause dramatic damage to the environment is that temperature records do not support a strong link between CO_2 emissions and warming. According to ground-level temperature records, there has indeed been an increase in temperature over the past 100 years. Most of this increase, however, occurred before 1940; in other words, most of the increase in temperature occurred before the main input of human-induced CO_2 emissions. In addition, records from the satellites that have been measuring temperatures in space since 1979 do not support the hypothesis that the earth is warming. While the climate models produced by computers predict that there should have been some warming over the past 20 years, the satellite data show no warming. The evidence does not support the predictions of the models. It is considered a problem in any scientific discipline when the evidence contradicts a theory and such a discrepancy should lead to a re-evaluation of the models.

Other explanations for temperature change

There are other viable explanations that do not rely upon increased CO_2 emissions to explain atmospheric temperature change. Unfortunately, these explanations have not received widespread media attention.

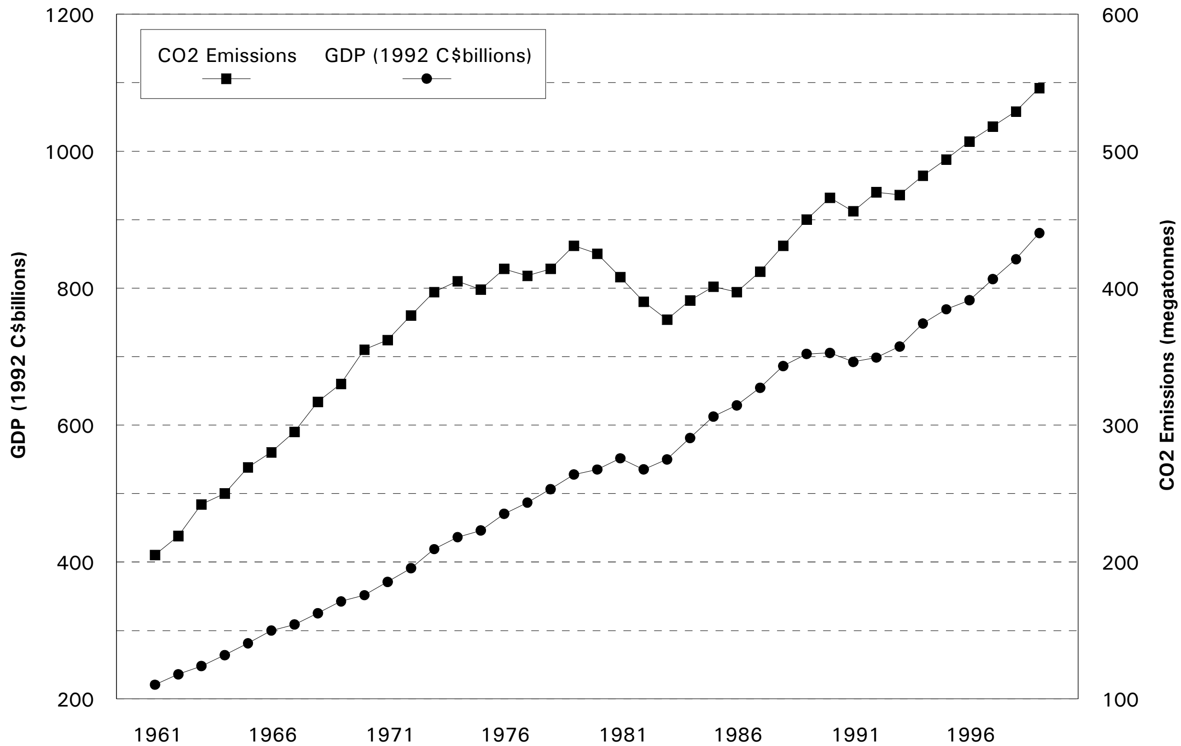
Some scientists hypothesize, for example, that much of the temperature fluctuation can be explained by changes in the brightness of the sun—something that is obviously beyond human control. Sallie Baliunas, a scientist at the Harvard Center for Astrophysics, explains:

> Most of the warming early in this century, then, must have been due to natural causes of climatic change, and these natural causes must be understood in order to make an accurate assessment of the effect upon climate of any human activities that may have been added to the natural changes . . . One possible natural cause of climatic change is variation in the brightness of the sun. (Baliunas and Soon: 81)
>
> The processes of "fingerprinting" various mechanisms of climatic change and projecting climatic change requires knowing all the relevant factors, both those that are natural and those that are the result of human activity. And, these factors must be considered simultaneously in a model. Once such a model is verified, then only can each mechanism be identified. Since the mechanisms of climatic change are not fully known—as we have shown, the question how the sun affects the climate is unresolved—and the models have not been verified, fingerprinting is not yet possible. (Baliunas and Soon: 86–87)

It is clear that a great deal of uncertainty surrounds the issue of climate change and many important questions remain unanswered. Are we experiencing a trend towards global warming? Do humans contribute to the trend through the emission of greenhouse gases? How significant is the human contribution? Would global warming cause widespread problems?

Some argue that we must take drastic regulatory action to control greenhouse gases without delay. However, because of the uncertainty and the unanswered questions, this is a simplistic approach to policy. In fact, we cannot afford to take action until we are reasonably certain that we have a problem because taking drastic measures to control greenhouse gases will come at the expense of other social objectives.

Figure 6.1: GDP compared to CO_2 emissions: Trends in Canada, 1961–1999



Sources: Environment Canada National Environmental Indicator Series 1999; OECD 1999; Canadian Economic Observer 1999; OECD 1999. Canadian Economic Observer 2001. Canada's Third National Report on Climate Change.

7 Oil Spills

Oil spills such as the Exxon Valdez spill off Alaska in 1989, and the Odyssey spill off Nova Scotia in 1988 receive intense media coverage. This coverage may lead to the perception is that the number of oil spills and the severity of those spills are increasing. However, despite the growth in freighter traffic and offshore drilling, the average number of major oil spills around the world (over 700 tonnes) has dropped from about 24 per year during the 1970s to about seven in the 1990s (figure 7.1) (International Tanker Owners Pollution Federation [ITOPF] 2001).

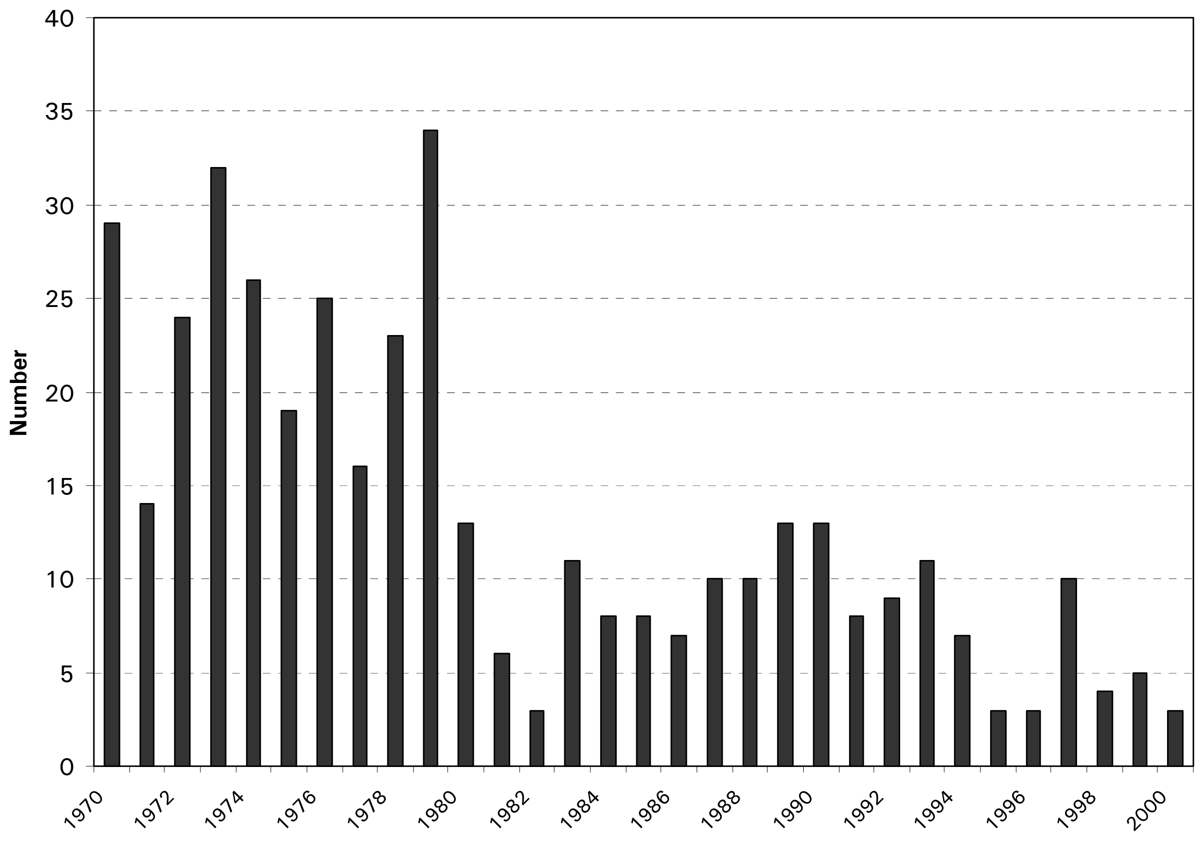
Environment Canada estimates that Canada can expect a catastrophic spill (over 10,000 tonnes) only once every 15 years based on current levels of tanker traffic. According to the US Coast Guard, tanker accidents are a minor source of water pollution contributing only about 5% of the 2.3 million tons of petroleum hydrocarbons entering the seas each year (Environment Canada 1999d). It is estimated that American households pour 1.3 billion litres of oil and oil-based products down the drain every year (Allen 1993). In comparison, the last two spills that may have affected Canada were those from the Exxon Valdez in 1989 in Prince William Sound, Alaska, which spilled 37,000 tonnes, and from the Odyssey in 1988, 700 nautical miles off Nova Scotia, which spilled 132,000 tonnes (ITOPF 2001: 5).

While oil spills are never desirable and the immediate damage can be alarming, in time nature will deal with spilled oil effectively. Since oil is a natural substance produced by the decomposition of microorganisms, it degrades naturally into the environment. The eight main processes that lead to the natural weathering of oil are: spreading, evaporation, dispersion, emulsification, dissolution, oxidation, sedimentation, and biodegradation (ITOPF 2002). Within 48 hours of an accident, 40% of spilled oil evaporates. Bacteria and other marine species break down and consume over 90% of the remaining oil over time (Bast, Hill and Rue 1994: 148–53). According to *Science News*, about 50% of the oil from the Exxon Valdez incident was degraded naturally (Environment Canada 2001d). In some cases, active cleanup can actually cause more harm than good. For example, the steam used to clean rocks kills many tiny organisms, including those that would otherwise ingest and decompose spilled oil.

Efforts are being made to ensure that oil is shipped safely. Since 1993, double hulls are required for all new tankers. Although ships are getting larger (250,000 deadweight tons [dwt] today compared to 30,000 dwt in the 1950s), limits are placed on the size of individual tanks within the ships. Technological advances are developing increasingly more precise charting, radar, and navigation equipment and, in Canada, the "polluter pays" principle applies. This means that the party responsible for causing the pollution is responsible for paying the costs of cleanup (Environment Canada 2001d). These precautions appear to be having positive results. Figure 7.2 shows the volume of oil spilled in international waters since 1970. Note that there has been a general decrease since 1992.

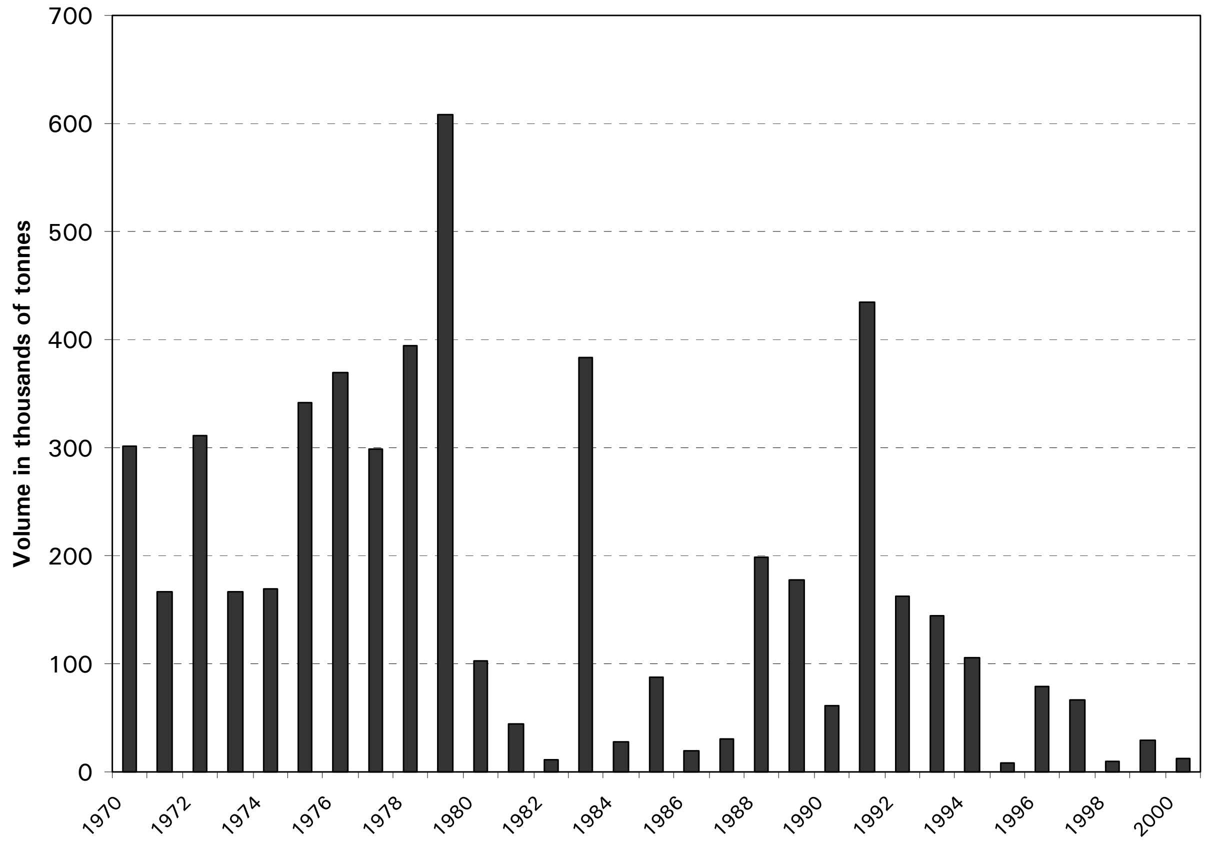
In response to the need for more accurate monitoring of spills in Canadian waters, the Environmental Response division of the Canadian Coast Guard implemented the Marine Pollution Incident Reporting System (MPIRS) in June 2001. Prior to this, data was not stored in a consistent or accessible manner. The MPIRS standardizes reporting for each of the five Canadian Coast Guard regions and ensures that reports include the pollutant spilled (chemical, petroleum, other), the region where the spill occurred, and an estimate of the quantity spilled. Between June 2001 and January 2002, 1,374 incidents had been reported, 878 of which were reported to have been petroleum spills (Armstrong 2002).

Figure 7.1: Number of spills over 700 tonnes



Sources: International Tanker Owners Pollution Federation Ltd. 2002.

Figure 7.2: Volume of oil spilled (thousand tonnes)



Sources: International Tanker Owners Pollution Federation Ltd. 2002.

8 Pesticides

Pesticides are a family of chemical or organic compounds designed to eradicate pests; the family includes herbicides, insecticides, fungicides, rodenticides and fumigants. They are widely used in many Canadian industries such as agriculture and forestry, as well as in Canadian households. Statistics Canada reports that 31% of Canadian households use pesticides (Statistics Canada 1994a).

The use of pesticides has become increasingly controversial over the past three decades. Some notorious pesticides such as DDT were banned after it was discovered they had adverse effects on birds and fish. Currently, many activists advocate a complete ban of all pesticides. The city of Halifax recently moved in this direction by passing a bylaw that phases out the cosmetic use of pesticides throughout the community and on residential properties within four years. Other municipalities are considering similar policies.

Costs and benefits

Pesticides have costs and benefits attached to them that need to be weighed in any discussion of their use. Some of the costs are obvious: increased monetary costs to farmers, possible damage to the environment, and an increased risk of health problems. However, many of the benefits of pesticides are ignored or down-played in public debates on the issue.

Pesticides are one of the most effective weapons we have in the fight against damaging and potentially deadly pests. Crops are attacked by tens of thousands of diseases caused by bacteria, viruses, fungi and other organisms; there are more than 30,000 kinds of weeds competing with crops worldwide; thousands of nematode (parasite) species reduce crop vigour; and some 10,000 species of insects devour crops. It is estimated that pests destroy a third of the world's food crops annually (Environment Canada 2000c). Without pesticides, Canada's ability to produce food would decrease by as much as 40% and production costs would increase by over 30% (Crop Protection Institute of Canada 2001).

Canadians also benefit inside and around the home from the use of pesticides to control pests like rats and insects that are nuisances and potentially dangerous. The tick, another dangerous pest controlled with pesticides, is a vector for Lyme disease, which affects 12,500 people each year on average in the United States (Center for Disease Control 2000). In Canada since 1988, Lyme disease acquired by tick-bite has been firmly diagnosed in New Brunswick, Quebec, Ontario, Manitoba and British Columbia (Ferris 1995). Pets are kept healthy and comfortable as well through the use of pesticides and amateur gardeners are able to cultivate lush gardens. A well-kept lawn could help protect children when they play because a cushioned play-surface enhances safety: sports-related injuries increase 40% when played on poorly maintained (weedy) fields (Crop Protection Institute of Canada 2001).

When weighing the costs and benefits of pesticides, it is illustrative to examine the alternative to the use of pesticides. Organic farming, a type of agriculture that forbids the use of pesticides, synthetic fertilizers, and other forms of technology, has a much lower yield than conventional farming and, as a result, much higher prices, making produce grown this way less accessible to the poor. Organic farming would have a negative impact on conserving wildlife space if it were largely implemented. Norman Borlaug, scientist and recipient of a Nobel prize, has estimated that for the United States to have achieved the level of food production it did by 1980 employing the technology of 1940 (which is similar to organic farming), it would have required the cultivation of an additional 177 million hectares of land—larger than the entire land-area east of the Mississippi River (Bast *et al*. 1994). According to the National Cancer Institute of Canada, "[t]here is no evidence that organically grown produce conveys more benefit than non-organically grown produce." They also say, "[t]he use of pesticides in food production has improved crop yields and has increased the quantity of fresh fruits and vegetables in the diet, thereby contributing to significant improvements in public health" (National Cancer Institute of Canada 1998).

Pesticides today

The types of pesticides used today are substantially different from those used in past decades. In the 1960s, about one-half of all pesticides were chlorinated hydrocarbons such as Aldrin, Dieldrin and DDT. These persist in the environment and tend to accumulate in animal tissue. Today, chlorinated hydrocarbons account for only about 5% of all pesticides (Hayward 1994). They have been replaced by a new class of pesticides that are effective in lower doses, less persistent, more directed toward their target pest, and have fewer environmental side effects. For instance, new herbicides that are used in quantities of grams per acre are replacing products that were used at kilograms per acre.

Regulations and monitoring

The main body overseeing pesticides in Canada is the Pest Management Regulatory Agency, which administers the *Pest Control Products Act* and its regulations. Some provinces also have their own departments to oversee the sale and use of pesticides and have their own regulations and standards (though these are not permitted to be less strict than the federal standard).

Canada establishes safety levels for pesticide residue on food—also known as "no observable adverse effect levels"—by testing substances on animals to determine toxicity. Once the level of no-effect is established, it is multiplied by a 10-fold factor for uncertainty in extrapolating from animals to humans (i.e. interspecies) and another 10-fold factor to account for variation within the human population (i.e. intraspecies). The United States began requiring that another 10-fold factor be added in 1996 to their assessments to give better protection to infants and children. Canada is incorporating this new standard into the evaluation of new pesticides and the re-evaluation of old ones. Therefore, pesticide residue in Canada is only permitted at or below one one-thousandth of the level at which no effect is observed. Besides meeting stringent health standards, pesticides also go through scientific evaluations, which sometimes take years to complete, to determine their effect on the environment.

After a pesticide is approved for use, the Canadian Food Inspection Agency is responsible for monitoring domestic and imported food to ensure compliance with the regulations. Between 1994 and 1998, it tested 44,379 shipments of fresh and processed fruit and vegetable products. Tests showed that 98% of samples were in compliance with standards and that 93% had no detectable residues at all (Crop Protection Institute of Canada 2001).

Due to the climate, the types of crop grown, and relatively low infestation rates, use of pesticides in Canada is lower than it is in many regions of the world. Canada applies only half the amount of active ingredients that Japan does and about a tenth of what the Unite States applies (table 8.1). Canada's use per hectare is also relatively low with 0.9 kg of active ingredients per hectare compared to 1.8 kg per hectare in the United States and 7.7 kg per hectare in Japan.

Below is a summary, by province, of the available data on the use of pesticides in Canada.

British Columbia

British Columbia tracks its pesticide usage through its *Survey of Pesticide Use in British Columbia*, which is conducted every five years. The latest edition, carried out in 1999, revealed that British Columbia purchased or used 8,102,480 kg of active ingredients[3] that year (Ministry of Environment, Lands and Parks, Government of British Columbia 2001). Of this, 86.5% were commercially applied wood preservatives and anti-sapstain chemicals that prevent fungal growth on, and staining of, cut lumber. The remainder of the pesticides used was made up of insecticides (5%), herbicides (4%) and fungicides (3%). There were 280 active ingredients used in the province in 1999, although 20 of these accounted for 95% of the total volume used.

The total weight of pesticides used or sold is not always an accurate way to gauge trends in the use of pesticides because one or two major producers having a good year of sales or changes in the forest industry could skew the numbers. Examining the total weight also tells us nothing about the toxicity of the chemicals being used, which has decreased over the years (Gilkeson 2001). Some classes of pesticides, however, have seen declines that are illustrative of significant trends. The sale of federally labeled, restricted pesticides decreased by 48% from 1991 to 1999. Other decreases were seen in the use of anti-sapstain chemicals by mills (40% decline), pesticides sold by veterinarians to control fleas (78% decline), and the amount of pesticide used by landscaping services in the Lower Mainland (40% decline).

Alberta

Alberta conducts a survey of pesticide use every five years (editions were published in 1993 and 1998, and the next is scheduled to appear in 2003) but no trends have been analyzed from the data due to issues arising from measurement changes and amalgamations in the industry (Byrtus 2001).

According to the 1998 survey, 9,300,497 kg of active ingredients was sold in, or shipped into, Alberta. The agricultural sector accounted for 96% of all pesticides bought, the commercial and industrial sectors, for 3%, and the domestic sector, for less than 1%. Herbicides were by far the biggest sellers at 77%, adjuvants (substances that improve the pesticide's physical properties, such as a spreading agent) made up 14%, insecticides 5% and fungicides 4% (Alberta Environment 2000).

Saskatchewan

Saskatchewan is still in the process of developing a database of pesticide sales so no quantitative comparisons or trends are available. Officials say, however, that they have noticed a downward trend in sales, especially of herbicides and especially in the southwest and northeast areas. One reason suggested for this decline is that many farmers have switched from crops to forage (for cattle) in response to the cutting of transport subsidies from those areas, making it more expensive to grow crops (Wilk 2001).

Ontario

Ontario has been conducting the *Survey of Pesticide Use in Ontario* every five years since 1983. The 1998 report shows that the use of pesticides, measured by active ingredients, has been declining (table 8.2). From the high of 8,700,000 kg in 1983, use declined 40% to 5,200,000 kg in 1998 (Martin 2001). There was also a significant decrease of 36% in the kilogram-per-hectare rate of application since 1983.

Quebec

Sales of pesticides are calculated regularly in Quebec and have been published in its annual report, *Bilan des ventes de pesticides au Quebec*, since 1992. The most recent available data show that 3,381,942 kg of active ingredients were sold in Quebec in 1997, a decrease of 10% since 1992 (table 8.3).

In all, 283 active ingredients are found in 1,136 different formulations sold in Quebec. Herbicides are the largest group of pesticides sold, making up almost 60% of sales. Insecticides come second (18%) and fungicides, third (14%). Agriculture is the most important sector, accounting for 81% of sales (Ministère de l'Environnement du Québec 1997).

Nova Scotia

Nova Scotia collects raw sales data but has not analyzed or organized it in a useful way. The biggest user of pesticides in the province is agriculture, followed by forestry. The total usage has probably been steady over time (Skinner 2001).

Northwest Territories

A survey, *Pesticide Use in the Northwest Territories,* covering 1994 and 1995, was published in 1996 for the territorial government. In 1995, 8,955 kg of active ingredients were used in the Northwest Territories in 20 different products containing 18 different active ingredients. Between 1994 and 1995, the amount of pesticide sold and stored in the territory declined by 23% and 14%, respectively.

The patterns of use have changed substantially over time. Previously, pesticides were used to control mosquitoes and blackflies. Currently they are used primarily for pest control in buildings and other structures with a small number of users applying them as mosquito repellent or for protection against weeds (Department of Resources, Wildlife and Economic Development, Government of the Northwest Territories 1996).

Table 8.1: Use of agricultural pesticides, by country

	Total use (tonnes of active ingredients)	Intensity of use (kg/ha)
Canada	41,684	0.9
United States	341,669	1.8
West Germany	85,386	4.2
France	31,487	4.4
United Kingdom	40,774	5.8
Japan	82,553	7.7

Source: Alberta Environment 1998.

Table 8.2: Use of pesticides in Ontario, 1983 to 1998

	Total pesticide use (kg of active ingredient)	Pesticide use per hectare
1983	8,719,240	2.1
1988	7,201,470	1.85
1993	6,246,442	1.66
1998	5,167,475	1.35

Source: Ontario Ministry of Agriculture, Food and Rural Affairs 1999.

Table 8.3: Sales of pesticides in Quebec (kg of active ingredient)

	Amount of active ingredient sold (kg)	Percent change over previous year
1992	3,753,509	0
1993	3,536,392	−5.8%
1994	3,236,172	−8%
1995	3,320,462	2.3%
1996	3,765,635	9.5%
1997	3,381,942	−10.2%

Source: Quebec Ministry of Environment 1997. Note that the data for 1992 and 1996 contained unusually high numbers in the industrial sector; this increased the annual total considerably.

9 Pollutant Releases

The National Pollutant Release Inventory (NPRI) was developed in the early 1990s in response to public demand for greater access to information about the hazardous materials being used, produced, and released in their communities (Jackson 2000). The purpose of the NPRI is to provide information on the type and quantity of pollutants being released in Canada (Environment Canada 1996g). The data can be analyzed by type of release (see figure 9.1), by province, or even on a facility-by-facility basis. The NPRI's monitoring of toxic releases supports a number of environmental initiatives. It encourages industry to reduce releases of toxic substances voluntarily, tracks the progress, and helps legislators identify priorities for action. NPRI data are also useful in identifying some of the point sources of pollutants that are hazardous to human health.

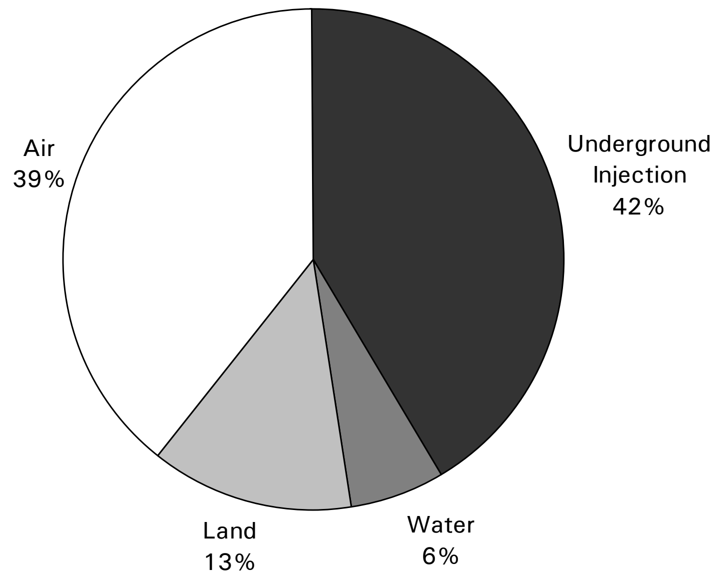
There has been a 34.4% decrease in toxic releases since monitoring began (see figure 9.2) and when using matched data. The NPRI adds new facilities and substances to its list every year; 73 substances were added for 1999 reporting, and another 4 were added in 2000, bringing the total of reportable substances to 248 for that year. Because of the difficulties this poses in comparing data, figure 9.2 shows matched data released by the NPRI that present the number of facilities reporting releases of the originally reported substances. The provincial breakdown for 1998 (table 9.1) shows the marked concentration of industry in Ontario, where 982 facilities reported that year.

Table 9.1 On-site releases in Canada, 1998

	Number of Facilities Reporting	Releases in Tonnes
Newfoundland	13	695
Prince Edward Island	5	221
Nova Scotia	38	4,762
New Brunswick	43	6,401
Quebec	445	18,639
Ontario	982	63,960
Manitoba	69	6,408
Saskatchewan	55	2,140
Alberta	252	46,644
British Columbia	129	7,968
Yukon Territory	0	0
Northwest Territories	6	1,782
Canada	2,037	159,620

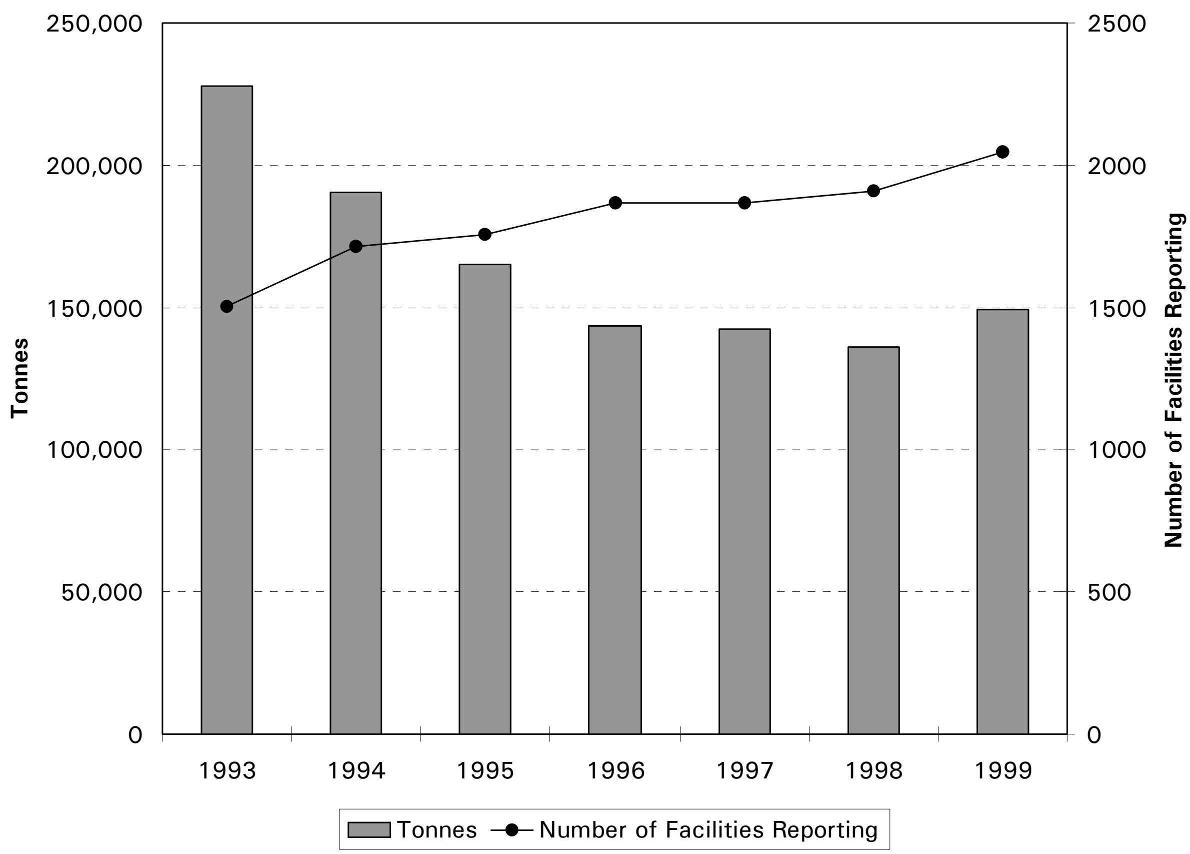
Source: National Pollutant Release Inventory 1999, 2000.

Figure 9.1 Distribution of on-site releases in Canada, 1999



Source: National Pollutant Release Inventory 1999.

Figure 9.2 Total pollutants released in Canada



Source: National Pollutant Release Inventory 1999.

10 Wildlife

Concern about preserving global biodiversity is growing among environmentalists, governments, and the public. This concern, however, has also led to some confusion about the status of wildlife and plants within Canada's borders. The confusion occurs because often no clear distinction is made between the number of endangered species in Canada and anxieties about global biodiversity.

In order to assess the state of Canada's wildlife, Environment Canada established the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1978. The committee comprises representatives from government wildlife agencies in each province and territory as well as representatives from the Canadian Wildlife Service, Parks Canada, Fisheries and Oceans, the Canadian Nature Federation, the Canadian Wildlife Federation, and World Wildlife Fund Canada. Each year, COSEWIC publishes *Canadian Species at Risk*, which lists species that fall within one of the following five categories: "extinct," "extirpated," "endangered," "threatened," and "special concern" (see table 10.1). In Canada, the number of species designated by the Committee on the Status of Wildlife (COSEWIC) as "at risk" in these categories has increased from a total of 17 species in 1978 to 387 in 2001.

The growth in the number of species on COSEWIC's list appears to indicate a serious environmental problem. But, it is important to understand that much of the growth in the list simply reflects the increasing number of species that COSEWIC has studied. In addition, more than one-third of the species on COSEWIC's list are in the least serious category, "special concern," while an additional 24% fall in the next least serious category, "threatened" (figure 10.1). Species noted as of "special concern" are not endangered or threatened but are considered particularly sensitive to human activities or natural events. It is also interesting to note the composition of the species considered at risk (figure 10.2). One-third of the species on the list are plants, and one-fifth of the species are fish.

An examination of COSEWIC's list of species at risk reveals that many of the "species" are not actually species at all but populations of a species that exist in a particular geographical location. For example, the grizzly bear appears twice on the list of 339 species. The prairie population of grizzly bears appear in the "extirpated" category, while other populations in Alberta, British Columbia, the Northwest Territories, Nunavut, and the Yukon Territories appear on the list as being of "special concern." In addition to this double counting, the COSEWIC list also includes many species that are naturally rare in Canada because the border between Canada and the United States is the northernmost part of the species' range. Therefore, the COSEWIC list cannot be considered a reliable indicator of the number of species at risk of extinction in Canada.

While the number of species considered "at risk" is growing quickly, the number in the most serious category, "extinct," are not. Only 12 of the 387 species on the list represent actual extinctions (since 1844) and only two of these are mammals—the Sea Mink and the Queen Charlotte Island Woodland Caribou. Table 10.2 shows the species that have gone extinct in Canada, the date of extinction, and the probable cause of extinction. It is important to remember that extinctions have occurred throughout history and prehistory as part of natural dynamics. Most of the extinctions on the Canadian list, however, were a result of human over-exploitation—hunting, trapping, and fishing. As unfortunate as these extinctions were, there is no reason to expect that they will continue. The problem of over-hunting, with the exception of the fisheries, has been largely solved. According to Environment Canada, "extinctions and extirpations from harvesting of wildlife have declined because of improved knowledge of the threats to species and because of changing policies and legislation, combined with better management and enforcement" (Environment Canada 1996h: 14–12).

Table 10.1 COSEWIC's definitions of risk categories

Extinct	a species that no longer exists
Extirpated	a species no longer existing in the wild in Canada, but occurring elsewhere
Endangered	a species facing imminent extirpation or extinction
Threatened	a species likely to become endangered if limiting factors are not reversed
Special Concern	a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events
Not at Risk	a species that has been evaluated and found to be not at risk
Data Deficient	a species for which there is insufficient scientific information to support status designation

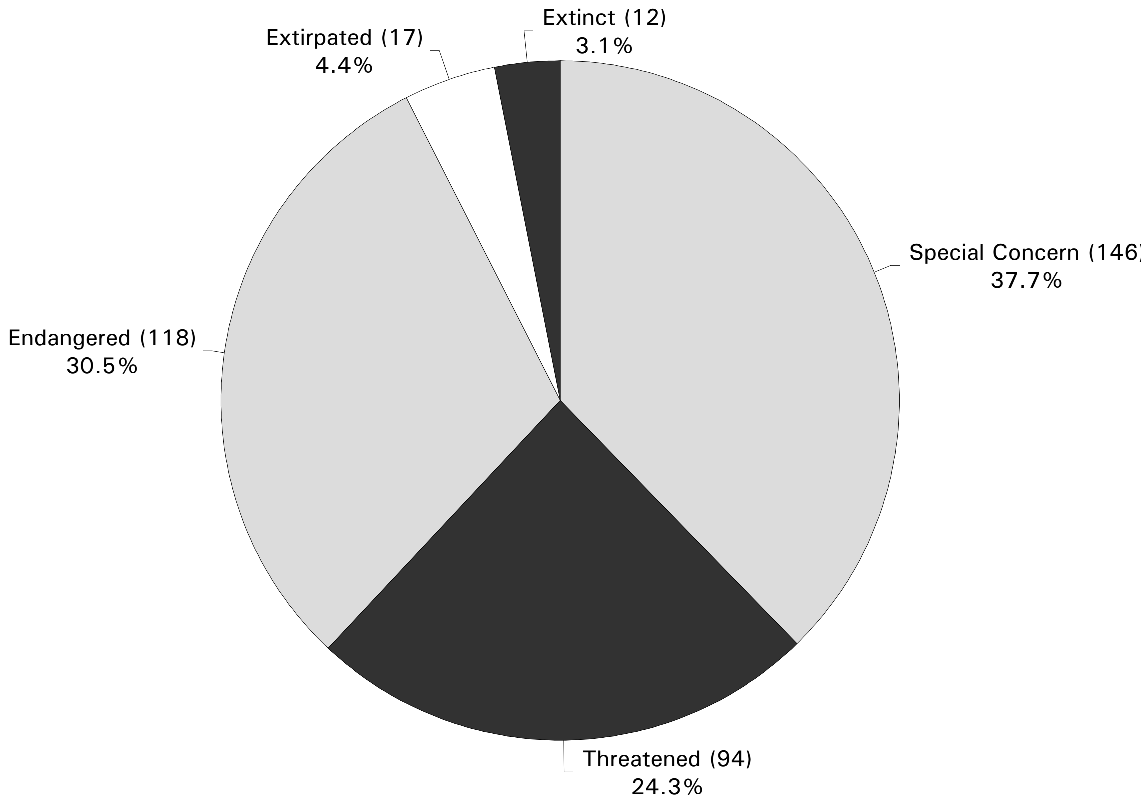
Source: COSEWIC 2001: 1.

Table 10.2 Extinctions in Canada

Species	Category	Date of Extinction	Probable Cause of Extinction
Caribou, Woodland (Queen Charlotte Islands Population) (*Rangifer tarandus dawsoni*)	Mammal	1920	Past unregulated hunting
Mink, Sea (*Mustela macrodon*)	Mammal	1894	Past unregulated trapping
Auk, Great (*Pinguinus impennis*)	Bird	1844	Past unregulated hunting
Duck, Labrador (*Camptorhynchus labradorius*)	Bird	1875	Past unregulated hunting, habitat alteration
Pigeon, Passenger (*Ectopistes migratorius*)	Bird	1914	Past unregulated hunting, habitat alteration
Cisco, Deepwater (*Coregonus johannae*)	Fish	1952	Commercial Fishing, predation by introduced species
Cisco, Longjaw (*Coregonus alpenae*)	Fish	1975	Commercial Fishing, predation by introduced species
Dace, Banff Longnose (*Rhinichthys cataractae smithi*)	Fish	1986	Predation by introduced species
Stickleback, Hadley Lake (benthic) (Gasterosteus spp)	Fish	*1999	Predation by introduced species
Stickleback, Hadley Lake (limnetic) (Gasterosteus spp)	Fish	*1999	Predation by introduced species
Walleye, Blue (*Stizostedion vitreum glaucum*)	Fish	1965	Commercial Fishing, habitat alteration
Limpet, Eelgrass (*Lottia alveus*)	Mollusca	1929	Natural Causes

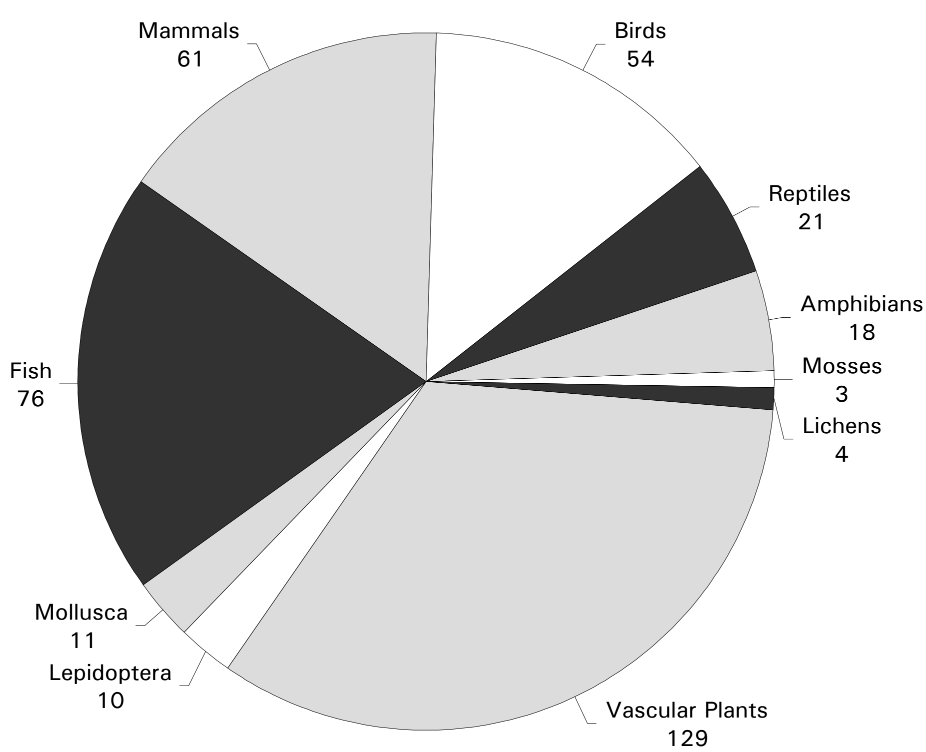
Sources: COSEWIC 2001: 5; Environment Canada 1996h: 14–13. *Year in which these species were added to COSEWIC's list.

Figure 10.1 Status of species at risk in Canada



Source: Data from COSEWIC 2001.

Figure 10.2 Species at risk by category



Source: Data from COSEWIC 2001.