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.

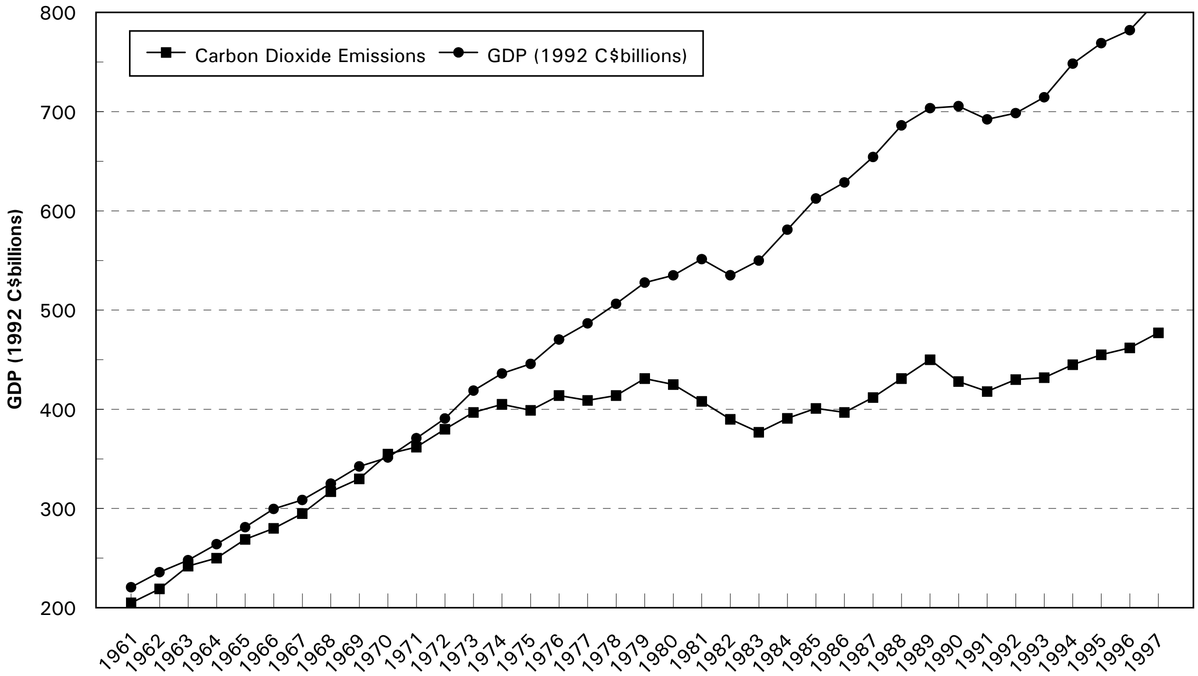
Some scientists hypothesize, for example, that much of the temperature fluctuation can be explained by changes in the brightness of the sun—something that is obviously beyond human control. Sallie Baliunas, a scientist at the Harvard Center for Astrophysics, explains:

> 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



Source: Environment Canada National Environmental Indicator Series, 1999. OECD 1999. Canadian Economic Observer 1999.

7 Oil Spills

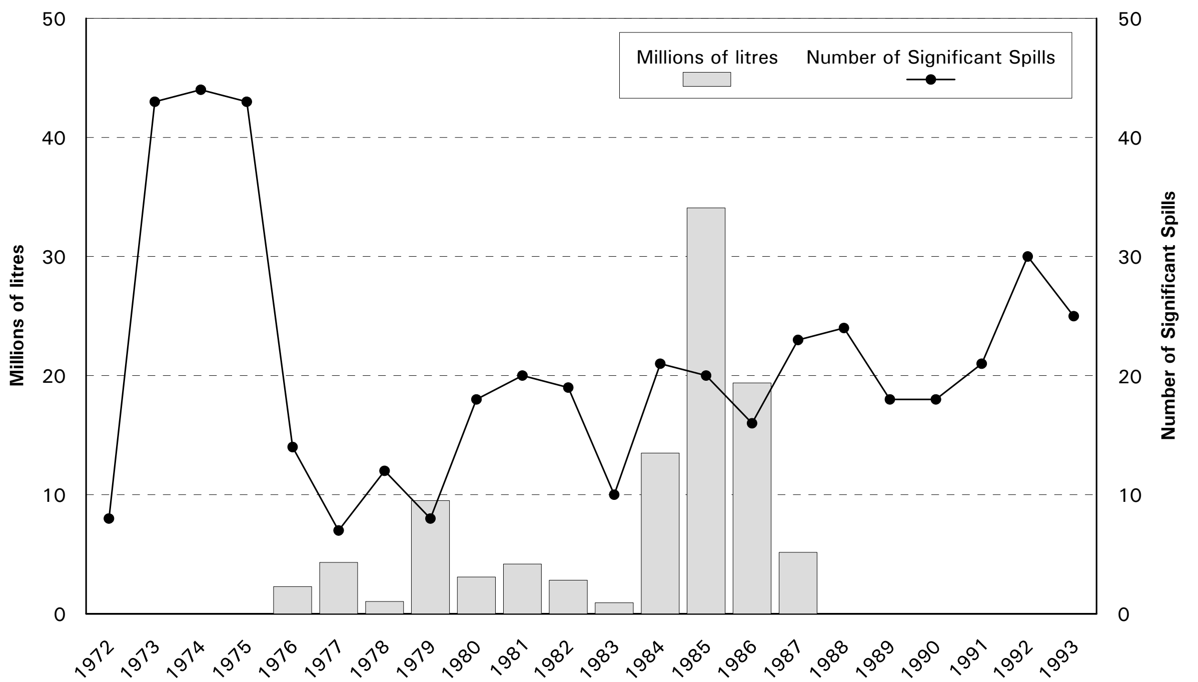
Oil spills are high-profile events. Incidents such as the Santa Barbara oil spill of 1969 and the Exxon Valdez spill in 1989 receive intense media coverage. Despite the public perception that the number of oil spills and the severity of those spills has increased, the average number of major oil spills (over 700 tonnes) dropped from 25 per year during the 1970s to about eight in the 1980s.[3] According to the United States Coast Guard, tanker accidents are a minor source of water pollution, contributing only about 5 percent 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 Exxon Valdez spilled just over 41 million litres of crude oil into Prince William Sound.

While oil spills are never desirable and the immediate damage can be alarming, in time nature will effectively deal with spilled oil. Since oil is a natural substance produced by the decomposition of micro-organisms, it degrades naturally into the environment. Within 48 hours of an accident, 40 percent of spilled oil evaporates. Bacteria and other marine species break down and consume over 90 percent of the remaining oil over time (Bast, Hill and Rue 1994: 148–53). According to *Science News*, about 50 percent of the oil from the Exxon Valdez incident was degraded naturally (Environment Canada1999d). 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 a requirement 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. Technology is developing increasingly more precise charting, radar, and navigation equipment and, in Canada, the principle that the "polluter pays" means that the party responsible for causing the pollution is responsible for paying the costs of clean-up (Environment Canada 1999d).

Canadian data track total marine spills from petroleum, industrial waste, and other chemicals by volume and significant marine spills by number. Data are available only from 1976 to 1987 (figure 7.1). Fluctuations in the number of events and volumes spilled can be attributed to differences in the numbers of vessels involved in collisions, groundings and sinkings. It is also due to changes in the number of accidents occurring during transfers of oil from one vessel to another. For more detailed information on onil spills, see Environment Canada 1998b).

Figure 7.1 Significant Spills in and around Canadian Waters



Source: Environment Canada 1991c; Environment Canada 1998b.
Note: Significant spills are those exceeding 1 tonne or affecting sensitive habitats.

8 Pesticides

Pesticides are a family of substances including herbicides, insecticides, fungicides, and fumigants. Although DDT and several other notorious pesticides have been discontinued, pesticide use remains controversial. Figure 8.1 shows the total use of pesticides in Canada. The limited data available show that in Canada, the use of pesticides decreased by 25.6 percent between 1985 and 1994. This decline illustrates that fears of greatly increased pesticide use have not materialized. (For a summary, see Easterbrook 1995: 79 ff).

Pesticides today are substantially changed from what they were when first introduced. Research has produced pesticides that have a much shorter half-life and are, therefore, less dangerous to human and animal health. 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 percent of all pesticides (Hayward 1994). They have been replaced by a new class of pesticides that are effective in lower doses, less persistent, and have fewer environmental side effects.

Although pesticides are hazardous chemicals that should be handled carefully, their use yields enormous benefits and the risk from residues is minor. Pesticides stimulate crop production so that less land is converted from wilderness to agricultural uses and food costs are lower. The Canadian Cancer Society recommends eating more plant-based foods for a healthier and potentially cancer-preventing diet and does not recognize any nutritional advantage to organic foods (Canadian Cancer Society 2000). Banning pesticides and other agricultural chemicals could increase the average household's food bill by as much as 12 percent per year (Knutson et al. 1990). The EPA's most conservative risk-assessment models attribute a maximum of about 0.00008 percent of all cancer cases per year to pesticide residues (Utt 1991). In fact, the risk from carcinogenic compounds that occur naturally in food is much greater than the risk from pesticide residues (Ames and Gold 1996).

Another major concern is that pesticides may contaminate local water supplies. Contamination of this sort, however, should be captured in measures of water quality (see section 2) and, thus, the total amount of pesticides used can be considered a secondary indicator.

Figure 8.1 Pesticide Use

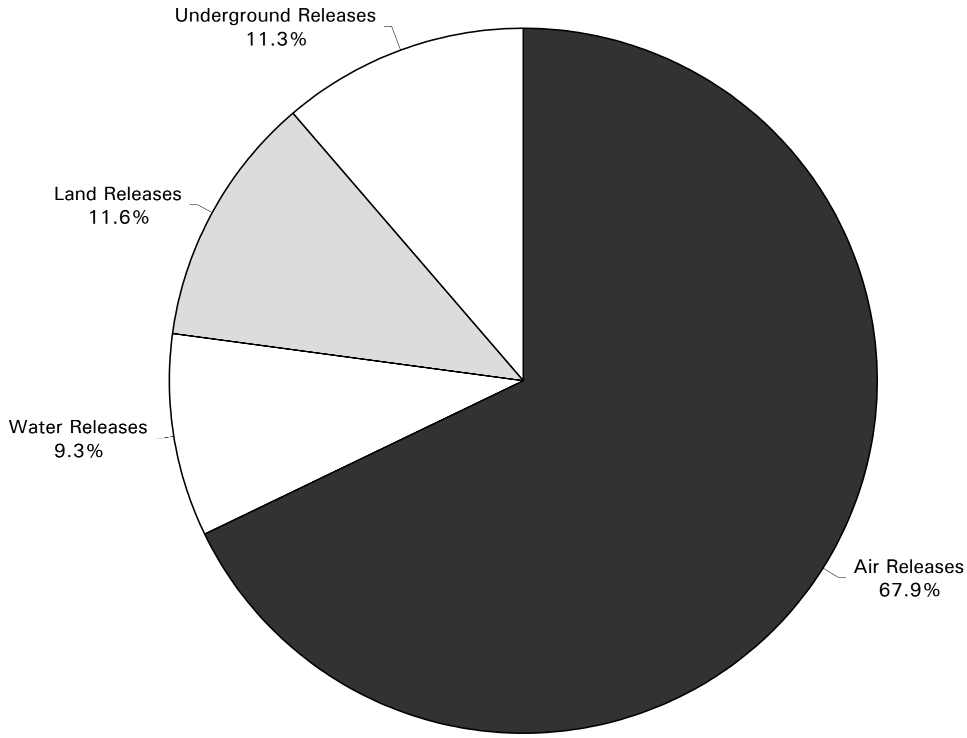
Source: OECD 1999.

9 Toxic Releases

Available data on toxic releases in Canada are relatively recent, as the National Pollutant Release Inventory (NPRI) was only established in March 1993. Its purpose 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.

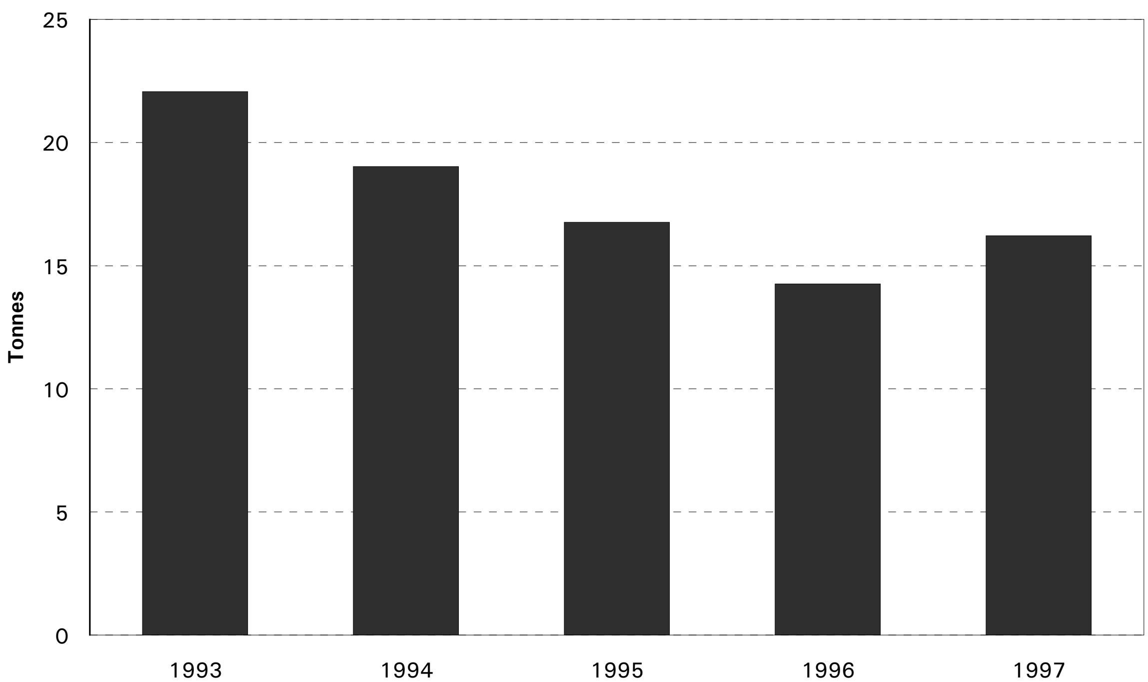
There has been a 26.5 percent decrease in toxic releases since monitoring began (See figure 9.2). This is especially significant in that the NPRI adds new facilities and substances to its list every year; 73 new substances were added for 1999 reporting. The provincial breakdown for 1997 (table 9.1) shows the marked concentration of industry in Ontario, where 963 facilities reported that year.

Figure 9.1 Nature of Toxic Releases in Canada, 1997



Source: Environment Canada 1999e.

Figure 9.2 Total Toxic Waste Releases in Canada



Source: Environment Canada 1999e.

Table 9.1 On-Site Releases in Canada (1997)

	Number of Facilities (1997)	Releases in Tonnes (1997)
Newfoundland	13	618
Prince Edward Island	5	240
Nova Scotia	38	5,364
New Brunswick	43	6,221
Quebec	434	20,374
Ontario	963	62,973
Manitoba	63	4,940
Saskatchewan	51	2,243
Alberta	226	49,743
British Columbia	128	7,597
Yukon Territory	2	1
Northwest Territories	7	1851
Canada	1,973	162,165

Source: Environment Canada 1999e.

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. To further confuse questions about biodiversity, many environmentalists make the claim that Canada's lack of federal endangered species legislation is evidence that there is a serious problem regarding protecting wildlife in this country.

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 vulnerable (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 339 in 1999.

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, almost half of the species on COSEWIC’s list are in the least serious category, “vulnerable,” while an additional 22 percent fall in the next least serious category, “threatened” (figure 10.1). Species considered “vulnerable” 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). Close to 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 and the Yukon Territories appear on the list as "vulnerable." 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 339 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 Defintions of Risk Categories

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

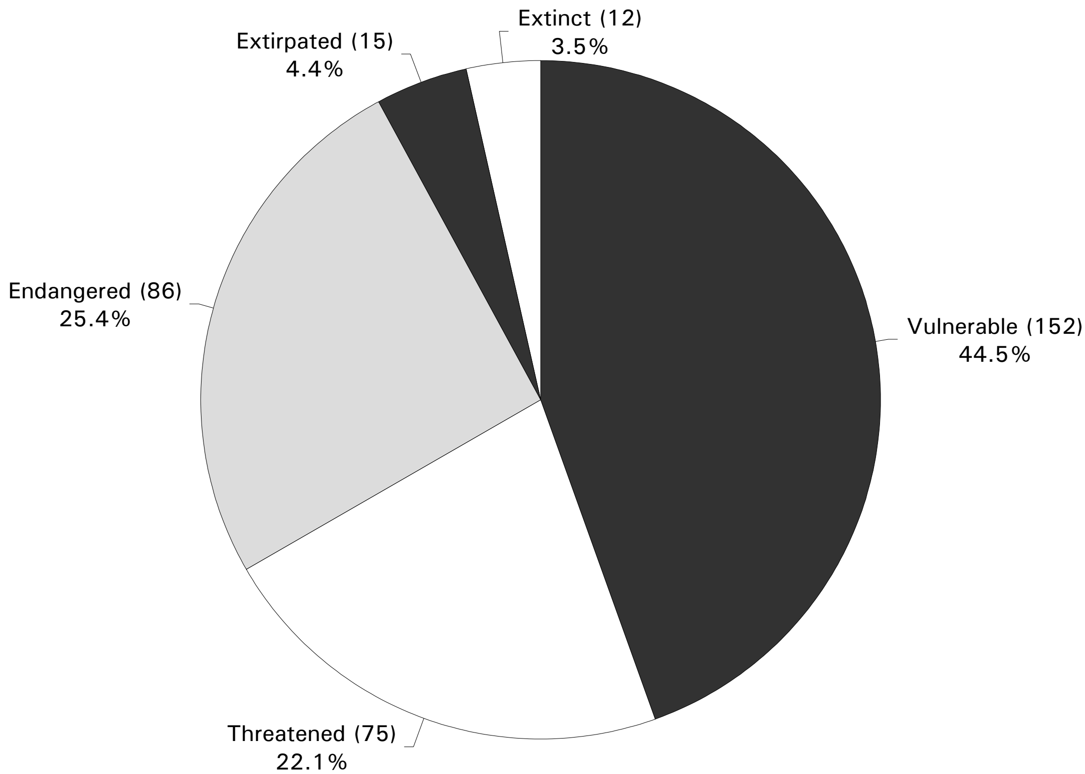
Source: COSEWIC 1998: iv.

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

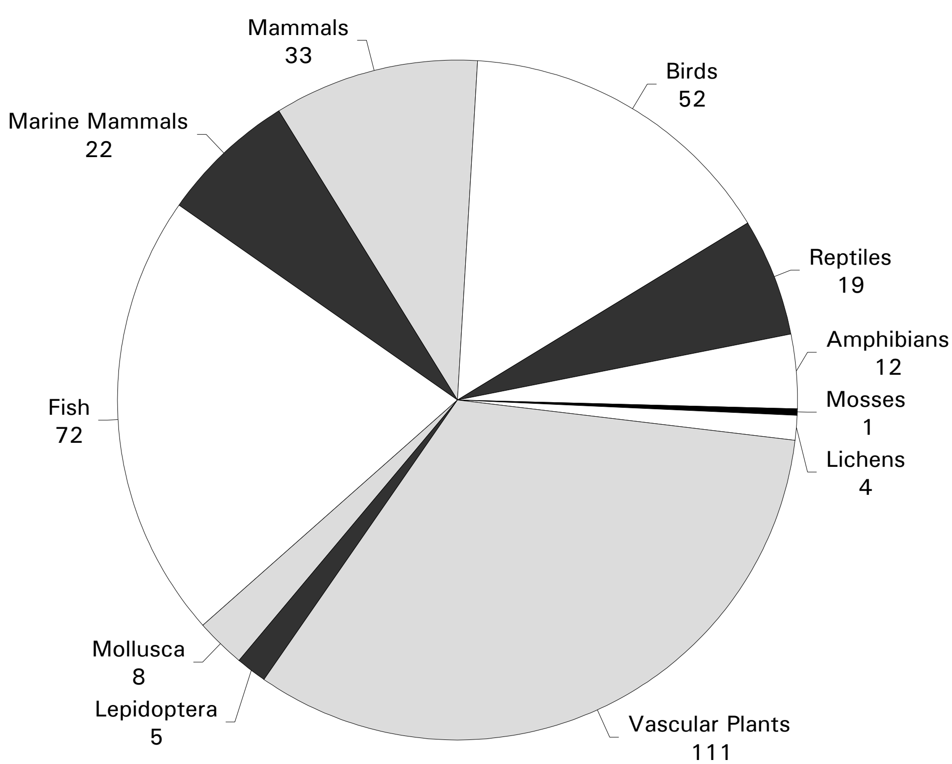
Sources: COSEWIC 1998, 1999:1–2; Environment Canada 1996h: 14–13.
*Year in which these species were added to COSEWIC's list.

Figure 10.1 Status of Species at Risk in Canada



Source: Data from COSEWIC 1999.

Figure 10.2 Species at Risk by Category



Source: Data from COSEWIC 1999.

Index of Environmental Indicators

The indicators in this report show improvements in many areas that are of environmental concern including the quality of air and water, the use of natural resources, and the management of solid wastes. This section presents an index that measures improvement or deterioration in overall environmental quality for Canada, which will be discussed in some detail, followed by an index for each of the United States, Mexico, the United Kingdom, and South Korea. The index shows that the relative severity of most environmental problems is decreasing in Canada, the United States, and the United Kingdom. Environmental quality in most categories is improving in these countries relative to the quality in 1980. Environmental quality has improved in South Korea relative to 1985, the earliest year for which data is available. Data are incomplete for Mexico before 1990. Relative to that year, however, overall environmental quality in Mexico is about the same.

Methodology

To aggregate individual environmental indicators such as lead, phosphorus, and soil erosion into a single measure of environmental quality, a common unit of measure is required. To create the index of environmental indicators, annual values within each of the four main categories (air quality, water quality, natural resources, and solid waste) are converted to the base year 1980. This makes it possible to compare environmental quality in later years to the base year. It is important to note that this approach allows a comparison of relative values only. The base-80 values do not provide any information about the absolute level of environmental quality. This is unavoidable as assessments of absolute environmental quality are value judgments, beliefs about the "state of nature" that are social constructs varying among societies and over time.[1]

Base-80 values are comparable across categories because they are measured in the same units. For the same reason, these values can be averaged. A second technical issue arises when determining the weight assigned to each indicator. For example, it is difficult to quantify the respective weights to be given to air pollution and water pollution. For this reason, no attempt is made to give relative weights to each indicator. For each year, base-80 values are averaged within each of the four environmental categories (air quality, water quality, natural resources, and solid waste). The category averages are then weighted equally to arrive at an over-all average for each year.[2] The resulting time series represents the general trend in environmental quality for each nation.

It was necessary to account for missing data in many categories because the available time-series environmental data are often incomplete. Straightforward linear regression techniques are used to estimate missing values. In cases where trends are improving, however, the law of diminishing marginal returns may begin to have a significant effect. This means that future improvements may be more difficult to achieve than past ones. In such cases, linear projections would overestimate the rate of environmental improvement. For this reason, linear projections are used only to interpolate, that is, to fill gaps between known data points and years without data. Forward projections are conservatively estimated: they use the last known data point as an estimator for later years with missing data. This technique ensures that no additional environmental improvement is assumed where data are missing. In cases where backward projections are necessary, missing data are also conservatively estimated. As a result, the index of environmental indicators likely underestimates the actual improvement in environmental quality relative to 1980.

Results

Indices 1 through 5 show the base-80 values for each environmental indicator as well as category and overall averages for Canada, the United States, Mexico, the United

Kingdom, and South Korea. The category averages are presented graphically in figures 1 and 2. The trends for Canada, the United States, the United Kingdom, and South Korea are clear: environmental problems are declining in severity in most categories relative to the base-year available. On average, overall environmental problems in Canada in these categories were 18 percent less severe in 1997 than in 1980. The United States showed a decrease of 19 percent between 1980 and 1995, the United Kingdom a decrease of over 10 percent between 1980 and 1996, and South Korea a decrease of 9 percent between 1985 and 1997. In Mexico, overall environmental quality remained the same between 1990 and 1996.

The greatest improvements in the environment in Canada were in air quality and water quality. In Canada, overall ambient air quality improved by 36 percent while water quality improved by 44 percent between 1980 and 1997. The improvement in water quality, however, should be taken with a note of caution as the available data represent only a small fraction of the number of rivers, lakes and streams in each country.

While these trends are encouraging, a few indicators showed a decrease in environmental quality. For example, ground-level ozone levels deteriorated in Canada in the 1980s and 1990s. Because ground-level ozone is the result of many factors, its reduction remains a particularly difficult regulatory problem. In addition, freshwater consumption in Canada increased relative to renewable freshwater resources. However, since Canada has abundant water resources and since consumption of freshwater could be drastically reduced if it were sold at market value, this trend may not be of great concern.

Municipal waste generation has increased substantially since 1980; recycling rates, however, have increased as well. While Canadians produced increasing amounts of refuse, fewer economically valuable resources were being sent to landfills and incinerators. In addition, using the total amount of waste generated as an indicator of environmental quality may overstate the waste problem, as there is no shortage of landfill space in Canada.

Conclusion

The index of environmental indicators for Canada, the United States, Mexico, the United Kingdom, and South Korea shows that fears about increasing environmental degradation in these countries are unfounded. In all countries, environmental quality is getting better, not worse. While it is impossible to determine the exact magnitude of the improvement in the environment due to the difficulty in determining how overall environmental quality should be measured as well as the lack of data for some important categories, the direction of the change in quality is clear. While there are still some serious environmental problems that need to be addressed, overall environmental quality continues to improve.

Index 1: Relative Severity of Environmental Problems in Canada (base year 1980)[1]

Annual values >1 represent a decline in environmental quality; annual values <1 represent an improvement

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Net Change[2]
1 Air Quality[3]																			
Sulphur Dioxide	1.00	0.92	0.83	0.70	0.73	0.63	0.63	0.54	0.68	0.69	0.70	0.51	0.54	0.58	0.52	0.46	0.53	0.58	−0.42
Nitrogen Dioxide	1.00	0.92	0.92	0.88	0.92	0.84	0.88	0.92	0.84	0.88	0.84	0.80	0.72	0.76	0.72	0.68	0.68	0.68	−0.32
Ozone	1.00	0.95	1.03	1.05	1.06	1.06	1.04	1.04	1.19	1.17	1.10	1.25	1.11	1.25	1.32	1.30	1.33	1.37	0.37
Carbon Monoxide	1.00	1.00	0.87	0.80	0.67	0.67	0.60	0.60	0.60	0.60	0.53	0.53	0.47	0.47	0.40	0.40	0.40	0.40	−0.60
Total Suspended Particulates[4]	1.00	0.88	0.78	0.71	0.70	0.64	0.64	0.70	0.66	0.66	0.58	0.57	0.53	0.54	0.52	0.52	0.53	0.55	−0.45
Lead	1.00	0.94	0.79	0.74	0.68	0.53	0.44	0.29	0.18	0.18	0.06	0.06	0.06	0.06	0.03	0.03	0.06	0.24	−0.76
Average (air quality)	1.00	0.94	0.87	0.81	0.79	0.73	0.71	0.68	0.69	0.70	0.64	0.62	0.57	0.61	0.58	0.57	0.59	0.64	−0.36
2 Water Quality																			
Exceedances[5]	1.00	1.00	1.00	1.00	1.00	1.02	1.02	1.02	0.97	0.97	0.78	0.75	0.78	0.84	0.79	0.87	0.87	0.89	−0.11
% of population without Wastewater Treatment	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.88	0.78	0.68	0.63	0.57	0.52	0.39	0.26	0.26	0.26	0.26	−0.74
DDE (British Columbia)	1.00	0.89	0.78	0.33	0.44	0.56	0.17	0.28	0.22	0.28	0.22	0.44	0.17	0.89	0.56	0.53	0.50	0.50	−0.50
PCB (British Columbia)	1.00	0.88	0.77	0.26	0.34	0.42	0.19	0.21	0.23	0.14	0.17	0.31	0.17	0.30	0.33	0.46	0.59	0.59	−0.41
Dioxins & Furans (BC)	1.00	1.00	1.00	0.19	0.18	0.17	0.15	0.15	0.11	0.27	0.11	0.07	0.02	0.06	0.05	0.05	0.05	0.05	−0.95
Average (British Columbia)[6]	1.00	0.92	0.85	0.26	0.32	0.38	0.17	0.21	0.19	0.23	0.17	0.28	0.12	0.42	0.31	0.35	0.38	0.38	−0.62
Nitrate/Nitrite (Great Lakes)	1.00	1.05	1.08	1.11	1.13	1.15	1.16	1.19	1.14	1.13	1.13	1.19	1.20	1.21	1.21	1.21	1.21	1.21	0.21
Phosphorus (Great Lakes)	1.00	0.71	0.77	0.68	0.71	0.74	0.78	0.56	0.53	0.60	0.62	0.75	0.75	0.75	0.75	0.75	0.75	0.75	−0.25
DDE (Great Lakes)	1.00	1.38	1.40	0.77	0.86	0.84	0.75	0.49	0.60	0.65	0.64	0.75	0.73	0.83	0.66	0.50	0.57	0.57	−0.43
PCBs (Great Lakes)	1.00	1.25	1.29	0.76	0.82	0.69	0.56	0.39	0.46	0.57	0.51	0.49	0.46	0.49	0.49	0.41	0.40	0.40	−0.60
HCBs (Great Lakes)	1.00	1.18	0.99	0.58	0.73	0.62	0.64	0.36	0.52	0.49	0.37	0.38	0.50	0.35	0.39	0.29	0.53	0.53	−0.47
Average (Great Lakes)[7]	1.00	1.11	1.11	0.78	0.85	0.81	0.78	0.60	0.65	0.69	0.65	0.71	0.73	0.73	0.70	0.63	0.69	0.69	−0.31
Average (water quality)[8]	1.00	1.01	0.99	0.76	0.79	0.80	0.74	0.68	0.65	0.64	0.56	0.58	0.54	0.59	0.52	0.53	0.55	0.56	−0.44
3 Solid Waste																			
Waste Generation	1.00	1.05	1.11	1.16	1.21	1.27	1.32	1.38	1.43	1.43	1.43	1.44	1.44	1.37	1.30	1.23	1.17	1.17	0.17
Recycling Rate[9]	1.00	1.00	0.99	0.99	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.91	0.89	0.89	0.89	0.89	0.89	0.89	−0.11
Average (solid waste)	1.00	1.03	1.05	1.08	1.10	1.13	1.15	1.17	1.19	1.19	1.18	1.17	1.17	1.13	1.10	1.06	1.03	1.03	0.03
4 Land																			
Developed Land[10]	1.00	0.99	1.00	1.00	1.01	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.03	1.03	1.03	0.03
Protected Areas[11]	1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.83	0.80	0.78	−0.22
Average	1.00	0.99	0.99	0.99	0.98	0.98	0.98	0.97	0.97	0.96	0.96	0.96	0.95	0.95	0.94	0.93	0.92	0.90	−0.10

(Index 1 continued)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Net Change[2]
5 Natural Resources																			
Freshwater[12]	1.00	1.05	1.08	1.10	1.13	1.16	1.19	1.20	1.22	1.24	1.25	1.27	1.28	1.30	1.31	1.33	1.33	1.33	0.33
Energy																			
Crude Oil Production[13]	1.00	0.79	0.77	0.80	0.98	1.02	0.95	0.98	0.96	0.94	0.98	1.05	1.12	1.19	1.28	1.29	1.33	1.34	0.34
Energy Efficiency[14]	1.00	0.94	0.94	0.92	0.92	0.91	0.91	0.90	0.91	0.91	0.88	0.90	0.91	0.91	0.89	0.89	0.90	0.87	−0.13
Average	1.00	0.87	0.86	0.86	0.95	0.96	0.93	0.94	0.93	0.93	0.93	0.97	1.01	1.05	1.09	1.09	1.11	1.11	0.11
Forests																			
Harvesting Levels[15]	1.00	0.92	0.81	1.09	1.20	1.21	1.15	1.20	1.19	1.22	0.94	0.93	1.00	1.11	1.16	1.19	1.15	1.15	0.15
Replanting[16]	1.00	0.96	0.92	0.89	0.88	0.85	0.82	0.75	0.73	0.69	0.56	0.55	0.63	0.67	0.64	0.68	0.68	0.68	−0.32
Average	1.00	0.94	0.86	0.99	1.04	1.03	0.98	0.97	0.96	0.96	0.75	0.74	0.82	0.89	0.90	0.94	0.92	0.92	−0.08
Average (land, freshwater, energy, and forests)	1.00	0.96	0.95	0.99	1.03	1.03	1.02	1.02	1.02	1.02	0.97	0.98	1.02	1.05	1.06	1.07	1.07	1.06	0.06
Overall Average[17]	1.00	0.98	0.96	0.91	0.93	0.92	0.90	0.89	0.89	0.89	0.84	0.84	0.82	0.84	0.81	0.81	0.81	0.82	−0.18

Note 1: Except where otherwise noted, missing data were either extrapolated backward using the earliest available data point or extrapolated forward using the last available data point. See text for explanation.

Note 2: Net change equals the 1997 base-80 value minus the 1980 base-80 value; multiply by 100 to obtain a percentage change. Any slight discrepancies between the net change column and the difference between the 1997 and 1980 columns are due to rounding-off.

Note 3: Ambient levels.

Note 4: For Canada, the TSP measure was used, which is broader than the PM-10 category monitored in the United States.

Note 5: An “exceedance” is an instance of a reported failure to comply with a standard. This line shows the percentage of readings failing to meet local standards. For Canada, this is an average of responses from British Columbia, Alberta, Saskatchewan, Manitoba, and New Brunswick.

Note 6: Average of DDE, PCB, and Dioxins and Furans in British Columbia.

Note 7: Average of Nitrate/Nitrite, Phosphorus, DDE, PCBs, and HCBs in the Great Lakes.

Note 8: Average of the lines “Exceedances,” “Average (British Columbia),” and “Average (Great Lakes).”

Note 9: Recycling rate is an average of the recycling rates for paper and cardboard and for glass; rate is inverted to express the proportion of waste not recycled.

Note 10: Total urban and agricultural area in Canada.

Note 11: The percentage of area in the Canada Land Index (CLI) that is not protected. CLI covers the southern areas of the country, including the most heavily settled portions of Canada, the most productive lands as well as areas where land-use conflicts and losses might arise (2.6 million ha).

Note 12: Ratio of withdrawals to renewable resources.

Note 13: Crude oil production as a percentage of remaining established reserves.

Note 14: Energy consumption per $ of real GDP.

Note 15: Harvest levels as a percent of Annual Allowable Cut (AAC).

Note 16: The total area replanted divided by the total area harvested each year.

Note 17: Overall average is the average of the lines “Average (air quality),” “Average (water quality),” “Average (solid waste),” and “Average (land, freshwater, energy, and forests).”

Index 2: Relative Severity of Environmental Problems in the United States (base year 1980).[1]

Annual values >1 represent an increase in environmental degradation; annual values <1 represent a decrease.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Net change[2]
Air quality[3]																	
Sulphur Dioxide	1.00	0.94	0.86	0.84	0.84	0.84	0.83	0.81	0.82	0.79	0.73	0.72	0.67	0.65	0.62	0.52	−0.477
Nitrogen Dioxide	1.00	0.98	0.96	0.94	0.95	0.94	0.95	0.94	0.95	0.92	0.88	0.88	0.83	0.81	0.86	0.83	−0.168
Ozone	1.00	0.92	0.89	1.00	0.89	0.88	0.85	0.89	0.96	0.82	0.80	0.81	0.76	0.77	0.77	0.80	−0.199
Carbon monoxide	1.00	0.97	0.88	0.88	0.87	0.79	0.76	0.72	0.69	0.68	0.63	0.60	0.56	0.53	0.54	0.48	−0.516
PM-10s[4]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.91	0.90	0.82	0.79	0.80	0.78	−0.220
Lead	1.00	0.83	0.65	0.51	0.45	0.32	0.22	0.20	0.13	0.10	0.10	0.07	0.06	0.06	0.05	0.05	−0.949
Average	1.00	0.94	0.88	0.86	0.84	0.80	0.77	0.76	0.76	0.72	0.68	0.66	0.62	0.60	0.61	0.58	−0.421
Water quality																	
"Exceedances"[5]	1.00	0.92	0.94	0.88	0.77	0.75	0.71	0.55	0.70	0.69	0.66	0.46	0.60	0.57	0.68	0.68	−0.322
Phosphorus (Gr. Lakes)	1.00	0.96	0.91	0.87	0.83	0.78	0.78	0.87	0.80	0.74	0.78	0.74	0.74	0.78	0.61	0.61	−0.391
Nitrogen (Gr. Lakes)	1.00	1.03	1.06	1.08	1.11	1.14	1.15	1.18	1.13	1.12	1.13	1.18	1.19	1.19	1.19	1.19	0.194
DDE (Gr. Lakes)	1.00	1.32	1.36	0.67	0.78	0.75	0.68	0.42	0.54	0.58	0.62	0.75	0.67	0.77	0.69	0.48	−0.523
PCB (Gr. Lakes)	1.00	1.24	1.23	0.73	0.80	0.67	0.55	0.37	0.45	0.57	0.50	0.48	0.44	0.34	0.48	0.39	−0.610
HCB (Gr. Lakes)	1.00	1.22	0.98	0.56	0.72	0.58	0.60	0.34	0.50	0.48	0.34	0.34	0.46	0.33	0.36	0.26	−0.740
Average (Great Lakes)[6]	1.00	1.15	1.11	0.78	0.85	0.78	0.75	0.64	0.69	0.70	0.67	0.70	0.70	0.68	0.67	0.59	−0.414
Average[7]	1.00	1.04	1.02	0.83	0.81	0.77	0.73	0.59	0.69	0.69	0.70	0.58	0.65	0.63	0.67	0.63	−0.368
Natural resources																	
Forests[8]	1.00	1.01	1.02	1.02	1.03	1.04	1.05	1.05	1.06	1.06	1.07	1.07	1.07	1.07	1.07	1.07	0.071
Water[9]	1.00	0.98	0.96	0.94	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	−0.100
Energy[10]	1.00	1.00	0.96	0.99	0.97	0.97	0.98	0.99	1.02	1.00	0.96	0.94	0.95	1.00	0.98	1.00	0.000
Developed Land[11]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.004
Soil erosion	1.00	1.00	1.00	0.99	0.97	0.96	0.95	0.93	0.90	0.86	0.83	0.79	0.76	0.76	0.76	0.76	−0.243
Average	1.00	1.00	0.99	0.99	0.98	0.97	0.97	0.98	0.97	0.97	0.95	0.94	0.93	0.94	0.94	0.94	−0.056
Solid waste																	
Waste generation	1.00	1.02	1.03	1.05	1.07	1.09	1.13	1.17	1.21	1.25	1.29	1.32	1.34	1.36	1.38	1.38	0.381
Recycling rate[12]	1.00	1.00	0.99	0.99	0.99	0.97	0.95	0.93	0.91	0.89	0.87	0.86	0.85	0.83	0.82	0.82	−0.179
Average	1.00	1.01	1.01	1.02	1.03	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.09	1.10	1.10	1.10	0.101
Overall average[13]	1.00	1.00	0.98	0.93	0.91	0.89	0.88	0.84	0.87	0.86	0.85	0.82	0.82	0.82	0.83	0.81	−0.186

Note 1: Except where otherwise noted, missing data were either extrapolated backward using the earliest available data point or extrapolated forward using the last available data point. See text for explanation.

Note 2: Net change equals the 1995 base-80 value minus the 1980 base-80 value; multiply by 100 to obtain a percentage change. Any slight discrepancies between the net change column and the difference between the 1995 and 1980 columns are due to rounding-off.

Notes continued on next page.

Note 3: Ambient levels.
Note 4: For Canada the TSP measure was used; for the United States, the narrower category of PM-10 is monitored and has thus been included in the study.
Note 5: An “exceedance” is an instance of a reported failure to comply with a standard. This line shows the percentage of readings failing to meet local standards.
Note 6: Average of phosphorus, nitrogen, DDE, PCB, and HCB.
Note 7: Average of the line “Exceedances” and the line “Average (Great Lakes).”
Note 8: In index 2, this is the ratio of harvest to growth; in Index 1 this is the ratio of annual allowable cut (AAC) to growth.
Note 9: Ratio of withdrawals to renewable resources.
Note 10: Ratio of consumption to production.
Note 11: Developed Land (urban + agricultural) as a proportion of total land base.
Note 12: Recycling rate is an average of the recycling rate for paper and cardboard and the recycling rate for glass; rate is inverted to express the proportion of waste not recycled.
Note 13: Overall average is the average of the lines “Average (air quality),” “Average (water quality),” “Average (natural resources),” and “Average (solid waste).”

Index 3: Relative Severity of Environmental Problems in Mexico (base year 1990).[1]

Annual values >1 represent an increase in environmental degradation; annual values <1 represent a decrease.

	1990	1991	1992	1993	1994	1995	1996	Net Change[2]
Air Quality[3]								
Sulphur Dioxide								
Mexico City	1.00	1.07	0.89	0.56	0.41	0.56	0.56	−0.444
Guadalajara	1.00	1.00	1.00	1.00	1.00	0.77	0.70	−0.300
Monterrey	1.00	1.00	1.00	1.00	1.06	0.94	1.18	0.176
Average[4]	1.00	1.02	0.96	0.85	0.82	0.75	0.81	−0.189
Nitrogen Dioxide								
Mexico City	1.00	0.93	0.87	1.00	1.03	0.95	1.15	0.148
Guadalajara	1.00	1.00	1.00	1.00	1.00	1.09	1.11	0.114
Monterrey	1.00	1.00	1.00	1.00	1.00	0.89	0.96	−0.036
Average[5]	1.00	0.98	0.96	1.00	1.01	0.98	1.08	0.075
Ozone								
Mexico City	1.00	1.12	1.06	0.96	1.02	1.00	0.95	−0.047
Toluca	1.00	1.00	1.00	1.00	1.00	0.97	1.43	0.434
Monterrey	1.00	1.00	1.00	1.00	0.82	0.79	0.91	−0.091
Average[6]	1.00	1.04	1.02	0.99	0.95	0.92	1.10	0.099
Carbon Monoxide								
Mexico City	1.00	1.11	0.86	0.54	0.53	0.76	0.78	−0.224
Guadalajara	1.00	1.00	1.00	1.00	1.00	0.88	0.90	−0.098
Monterrey	1.00	1.00	1.00	1.00	0.96	0.80	0.84	−0.160
Average[7]	1.00	1.04	0.95	0.85	0.83	0.82	0.84	−0.161
Total Suspended Particulates								
Mexico City	1.00	0.73	0.69	0.89	0.81	1.10	1.25	0.250
Guadalajara	1.00	1.00	1.00	1.00	1.00	1.05	0.83	−0.175
Monterrey	1.00	1.00	1.00	1.00	1.17	0.84	0.88	−0.116
Average[8]	1.00	0.91	0.90	0.96	1.00	1.00	0.99	−0.014
Lead (Mexico national)	1.00	0.67	0.38	0.24	0.20	0.17	0.18	−0.825
Average[9]	1.00	0.94	0.86	0.81	0.80	0.77	0.83	−0.169
Water Quality								
Nitrates in Rivers								
Bravo	1.00	2.02	1.34	0.93	1.11	0.89	0.89	−0.107
Lema	1.00	1.25	2.66	3.86	1.11	1.11	1.11	0.114
Panuco	1.00	1.20	2.70	1.70	2.60	1.50	1.50	0.500
Grijalva	1.00	2.21	0.58	0.43	0.21	0.32	0.32	−0.683

(Index 3 continued)	1990	1991	1992	1993	1994	1995	1996	Net Change[2]
Average[10]	1.00	1.67	1.82	1.73	1.26	0.96	0.96	−0.044
Phosphorus in Rivers								
Lema	1.00	0.50	0.60	0.70	2.12	2.12	2.12	1.125
Panuco	1.00	0.93	0.39	0.67	0.83	0.87	0.87	−0.130
Grijalva	1.00	0.10	0.09	0.32	0.07	0.21	0.21	−0.789
Balsas	1.00	1.05	0.94	1.02	1.72	1.72	1.72	0.719
Average[11]	1.00	0.65	0.51	0.68	1.18	1.23	1.23	0.231
Ammonium in Rivers								
Bravo	1.00	2.60	0.72	1.08	1.24	0.12	0.12	−0.884
Lema	1.00	0.83	1.25	2.75	7.06	7.06	7.06	6.057
Panuco	1.00	0.80	0.60	0.40	0.50	0.30	0.30	−0.700
Grijalva	1.00	0.20	0.10	0.05	0.05	0.10	0.10	−0.900
Average[12]	1.00	1.11	0.67	1.07	2.21	1.89	1.89	0.893
Copper in Rivers								
Panuco	1.00	0.75	0.50	0.50	0.50	0.50	0.50	−0.500
Biochemical Oxygen Demand in Rivers								
Bravo	1.00	0.89	0.86	1.00	1.22	0.86	0.86	−0.139
Lema	1.00	0.21	1.13	1.19	0.71	0.71	0.71	−0.289
Panuco	1.00	1.04	1.08	1.12	0.92	0.86	0.86	−0.145
Grijalva	1.00	1.05	1.36	1.68	1.73	0.91	0.91	−0.091
Average[13]	1.00	0.80	1.11	1.25	1.15	0.83	0.83	−0.166
Phosphorus in Lakes								
Chapala	1.00	1.17	1.13	1.23	1.33	1.33	1.33	0.333
Patzcuaro	1.00	1.33	1.66	0.84	0.01	0.01	0.01	−0.989
Catemaco	1.00	0.56	0.11	0.08	0.06	0.04	0.04	−0.956
Average[14]	1.00	1.02	0.97	0.72	0.47	0.46	0.46	−0.537
Nitrogen in Lakes								
Chapala	1.00	2.40	1.20	1.37	1.53	1.53	1.53	0.533
Catemaco	1.00	1.13	0.63	1.06	1.50	0.50	0.50	−0.500
Average[15]	1.00	1.76	0.91	1.21	1.52	1.02	1.02	0.017
Average[16]	1.00	1.11	0.93	1.02	1.18	0.98	0.98	−0.015
Natural Resources								
Forests[17]	1.00	0.94	0.88	0.82	0.76	0.70	0.70	−0.298
Water[18]	1.00	1.02	1.03	1.05	1.07	1.09	1.09	0.088
Energy[19]	1.00	1.00	1.02	1.01	1.04	1.04	1.04	0.043
Developed Land[20]	1.00	1.01	1.02	1.02	1.02	1.02	1.02	0.020
Average	1.00	0.99	0.99	0.98	0.97	0.96	0.96	−0.037

(Index 3 continued)	1990	1991	1992	1993	1994	1995	1996	Net Change[2]
Solid Waste								
Waste Generation	1.00	1.00	1.04	1.33	1.40	1.45	1.45	0.449
Recycling Rate[21]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.000
Average	1.00	1.00	1.02	1.17	1.20	1.22	1.22	0.224
Overall Average[22]	1.00	1.01	0.95	1.00	1.04	0.99	1.00	0.001

Note 1: Except where otherwise noted, missing data were either extrapolated backward using the earliest available data point or extrapolated forward using the last available data point. See text for explanation.

Note 2: Net change equals the 1996 base-90 value minus the 1990 base-90 value; multiply by 100 to obtain a percentage change. Any slight discrepancies between the net change column and the difference between and the 1996 and 1990 columns are due to rounding off.

Note 3: Ambient levels.

Note 4: Average of sulphur dioxide levels in Mexico City, Guadalajara, and Monterrey.

Note 5: Average of nitrogen dioxide levels in Mexico City, Guadalajara, and Monterrey.

Note 6: Average of ozone levels in Mexico City, Toluca, and Monterrey.

Note 7: Average of carbon monoxide levels in Mexico City, Guadalajara, and Monterrey.

Note 8: Average of total suspended particulate levels in Mexico City, Guadalajara, and Monterrey.

Note 9: Average of the "Average" lines for sulphur dioxide, nitrogen dioxide, ozone, carbon monoxide, and TSP, and line for Pb (Mexico national).

Note 10: Average of nitrates in the Bravo, Lema, Panuco, and Grijalva Rivers.

Note 11: Average of phosphorus in the Lema, Panuco, Grijalva, and Balsas Rivers.

Note 12: Average of ammonium in the Bravo, Lema, Panuco, and Grijalva Rivers.

Note 13: Average of biochemical oxygen demand in the Bravo, Lema, Panuco, and Grijalva Rivers.

Note 14: Average of phosphorus in the Chapala, Patzcuaro, and Catemaco Lakes.

Note 15: Average of nitrogen in the Chapala and Catemaco Lakes.

Note 16: Average of the "Average" lines for nitrates, phosphorus, ammonium, B.O.D., and the Copper line in rivers, and the "Average" lines for phosphorus and nitrogen in lakes.

Note 17: This is the ratio of harvest to growth.

Note 18: Ratio of withdrawals to renewable resources.

Note 19: Ratio of consumption to production.

Note 20: Developed land (urban + agricultural) as a proportion of total land base.

Note 21: Recycling rate is an average of the recycling rate for paper and cardboard and the recycling rate for glass; rate is inverted to express the proportion of waste not recycled.

Note 22: Overall average is the average of the lines "Average (air quality)," "Average (water quality)," "Average (natural resources)," and "Average (solid waste)."

Index 4: Relative Severity of Environmental Problems in the United Kingdom (base year 1980).[1]

Annual values >1 represent an increase in environmental degradation; annual values <1 represent a decrease.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Net Change[2]
Air quality[3]																		
Sulphur Dioxide	1.00	0.78	0.70	0.63	0.59	0.59	0.70	0.52	0.37	0.63	0.52	0.52	0.41	0.37	0.30	0.26	0.22	−0.778
Nitrogen Dioxide[4]	1.00	1.07	1.23	1.40	1.30	1.17	1.07	1.03	0.97	1.07	1.00	0.80	0.80	0.80	0.80	0.77	0.77	−0.233
Ozone	1.00	1.17	1.50	1.92	1.67	1.75	1.75	1.75	2.00	2.00	2.08	2.00	1.92	1.75	1.83	1.83	1.58	0.583
Carbon Monoxide	1.00	1.29	1.35	0.87	0.80	0.51	0.51	0.65	0.80	1.29	1.02	1.07	0.72	0.56	0.50	0.46	0.50	−0.499
Total Suspended Particulates	1.00	1.19	1.10	1.14	1.00	1.00	1.00	0.95	0.90	0.81	0.81	0.76	0.67	0.62	0.52	0.52	0.52	−0.480
Lead	1.00	0.95	0.90	0.85	0.80	0.75	0.42	0.44	0.47	0.34	0.27	0.19	0.15	0.12	0.13	0.09	0.09	−0.906
Average	1.00	1.07	1.13	1.13	1.03	0.96	0.91	0.89	0.92	1.02	0.95	0.89	0.78	0.70	0.68	0.66	0.61	−0.385
Water quality																		
Heavy Metals in Rivers–Cadmium																		
Thames	1.00	0.96	0.92	0.88	0.84	0.80	0.50	0.50	0.40	0.20	0.10	0.30	0.50	0.50	0.20	0.10	0.10	−0.900
Severn	1.00	0.80	0.61	0.41	0.22	0.02	0.03	0.02	0.02	0.04	0.05	0.04	0.02	0.01	0.02	0.01	0.01	−0.990
Clyde	1.00	0.95	0.89	0.84	0.78	0.73	0.55	0.45	0.45	0.45	0.18	0.18	0.36	0.27	0.27	1.09	1.09	0.091
Mersey	1.00	0.85	0.70	0.55	0.40	0.25	0.38	0.25	0.25	0.25	0.38	0.38	0.38	0.13	0.13	0.13	0.13	−0.875
Average[5]	1.00	0.89	0.78	0.67	0.56	0.45	0.36	0.31	0.28	0.24	0.18	0.22	0.31	0.23	0.15	0.33	0.33	−0.669
Heavy Metals in Rivers–Chromium																		
Thames	1.00	0.99	0.97	0.96	0.95	0.93	0.84	0.93	0.78	0.47	0.47	0.79	0.93	0.93	0.16	0.15	0.15	−0.850
Severn	1.00	0.87	0.75	0.62	0.50	0.37	0.35	0.21	0.10	0.07	0.07	0.07	0.04	0.05	0.06	0.05	0.05	−0.947
Clyde	1.00	0.97	0.94	0.91	0.88	0.85	1.28	1.21	0.97	1.26	1.06	0.89	0.78	0.83	0.69	0.68	0.68	−0.316
Mersey	1.00	0.92	0.85	0.77	0.70	0.62	0.72	0.60	0.48	0.55	0.53	0.43	0.28	0.30	0.24	0.25	0.25	−0.750
Average[6]	1.00	0.94	0.88	0.82	0.75	0.69	0.80	0.74	0.58	0.59	0.53	0.55	0.51	0.53	0.29	0.28	0.28	−0.716
Heavy Metals in Rivers–Copper																		
Thames	1.00	1.01	1.02	1.03	1.04	1.05	1.12	1.10	0.83	0.54	0.84	0.79	0.67	0.62	0.51	0.68	0.68	−0.320
Severn	1.00	0.92	0.83	0.75	0.66	0.58	0.54	0.41	0.28	0.29	0.46	0.26	0.23	0.25	0.25	0.25	0.25	−0.755
Clyde	1.00	0.91	0.83	0.74	0.65	0.57	0.55	0.41	0.41	0.26	0.53	0.30	0.34	0.55	0.40	0.90	0.90	−0.098
Mersey	1.00	0.90	0.80	0.69	0.59	0.49	0.54	0.51	0.49	0.58	0.41	0.44	0.46	0.44	0.37	0.36	0.36	−0.640
Average[7]	1.00	0.93	0.87	0.80	0.74	0.67	0.69	0.61	0.50	0.42	0.56	0.45	0.43	0.47	0.38	0.55	0.55	−0.453
Metal Average[8]	1.00	0.92	0.84	0.76	0.68	0.60	0.62	0.55	0.46	0.41	0.42	0.41	0.42	0.41	0.28	0.39	0.39	−0.612
Nutrients in Lakes–Phosphorus																		
Neagh	1.00	1.01	1.03	1.04	1.06	1.06	1.00	0.87	0.83	0.98	0.89	0.93	0.93	1.04	0.62	1.11	1.11	0.111
Lomond	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.56	0.33	1.67	2.11	2.11	2.56	1.67	1.00	1.00	1.00	0.000
Bewl Water	1.00	1.00	1.00	1.00	1.00	1.00	3.26	3.37	3.48	3.52	3.65	3.78	3.91	5.78	10.43	1.30	1.30	0.304
Average[9]	1.00	1.00	1.01	1.01	1.02	1.02	1.72	1.60	1.55	2.06	2.22	2.27	2.46	2.83	4.02	1.14	1.14	0.138

(Index 4 continued)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Net Change[2]
Nutrients in Lakes–Nitrogen																		
Neagh	1.00	1.00	1.00	1.00	1.00	1.00	0.71	0.63	1.31	0.54	1.60	1.21	0.79	0.85	0.85	0.88	0.88	−0.125
Lomond	1.00	1.00	1.00	0.97	0.97	0.97	0.90	0.77	0.70	0.53	0.43	0.67	1.20	0.50	0.73	1.30	1.30	0.300
Bewl Water	1.00	0.97	0.93	0.91	0.88	0.85	1.07	1.46	0.86	0.88	1.23	1.99	1.60	1.54	0.67	0.62	0.62	−0.385
Average[10]	1.00	0.99	0.98	0.96	0.95	0.94	0.89	0.95	0.96	0.65	1.09	1.29	1.20	0.96	0.75	0.93	0.93	−0.070
Nutrient Average[11]	1.00	1.00	0.99	0.99	0.98	0.98	1.30	1.27	1.25	1.35	1.65	1.78	1.83	1.90	2.39	1.03	1.03	0.034
Biological Quality of Rivers and Canals[12]																		
England and Wales	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.82	0.72	0.63	0.54	0.54	−0.462
Scotland	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.87	0.80	0.73	0.67	0.67	−0.333
Northern Ireland	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.000
Average[13]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.89	0.84	0.79	0.74	0.74	−0.265
Chemical Quality of Rivers and Canals[14]																		
England and Wales	1.00	1.00	1.00	1.00	1.00	1.00	1.04	1.08	1.12	1.16	1.20	1.14	1.08	1.02	0.96	0.90	0.90	−0.100
Scotland	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.000
Northern Ireland	1.00	1.20	1.40	1.60	1.80	2.00	1.93	1.87	1.80	1.73	1.67	2.13	2.60	3.07	3.53	4.00	4.00	3.000
Average[15]	1.00	1.07	1.13	1.20	1.27	1.33	1.32	1.32	1.31	1.30	1.29	1.42	1.56	1.70	1.83	1.97	1.97	0.967
Contaminants in Fish in the Irish Sea–Whiting																		
Mercury	1.00	1.00	1.00	1.21	0.86	0.93	0.93	0.86	0.86	0.93	0.93	0.79	0.86	0.93	0.93	0.93	0.93	−0.071
PCBs	1.00	1.00	1.00	1.05	1.11	1.21	1.04	0.87	1.16	0.92	0.66	0.74	0.62	0.50	0.50	0.50	0.50	−0.500
DDT	1.00	1.00	1.00	0.83	0.67	0.44	0.61	0.78	0.78	0.44	0.33	0.44	0.44	0.44	0.44	0.44	0.44	−0.556
Contaminants in Fish in the Irish Sea–Plaice																		
Mercury	1.00	1.00	1.00	1.17	0.92	0.75	0.92	0.92	1.00	0.83	0.83	0.83	0.83	0.75	0.75	0.75	0.75	−0.250
PCBs	1.00	1.00	1.00	1.00	1.75	1.00	0.75	1.00	1.25	1.25	1.08	0.92	0.75	1.00	0.88	0.75	0.75	−0.250
DDT	1.00	1.00	1.00	1.00	1.18	0.27	0.64	0.64	0.55	0.55	0.48	0.42	0.36	0.64	0.50	0.36	0.36	−0.636
Average[16]	1.00	1.00	1.00	1.04	1.08	0.77	0.81	0.84	0.93	0.82	0.72	0.69	0.64	0.71	0.67	0.62	0.62	−0.377
Contaminants in Fish in the North Sea–Cod																		
Mercury	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	1.11	1.00	0.67	0.72	0.78	0.78	0.78	0.78	−0.222
PCBs	1.00	1.00	1.00	0.86	0.62	0.38	0.32	0.35	0.44	0.33	0.32	0.32	0.27	0.21	0.35	0.30	0.24	−0.758
DDT	1.00	1.00	1.00	0.40	0.35	0.30	0.30	0.20	0.40	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	−0.800
Contaminants in Fish in the North Sea–Plaice																		
Mercury	1.00	1.00	1.00	1.14	0.86	0.71	0.57	0.71	0.86	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	−0.286
PCBs	1.00	1.00	1.00	1.00	1.20	0.20	0.20	0.20	0.60	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	−0.800
DDT	1.00	1.00	1.00	1.00	1.67	0.67	1.00	1.00	1.67	0.67	0.33	0.33	0.33	0.33	0.33	0.33	0.33	−0.667
Average[17]	1.00	1.00	1.00	0.90	0.93	0.52	0.55	0.56	0.81	0.54	0.46	0.41	0.41	0.41	0.43	0.42	0.41	−0.589
Water quality average[18]	1.00	1.00	0.99	0.98	0.99	0.87	0.93	0.92	0.96	0.90	0.92	0.94	0.96	0.99	1.06	0.86	0.86	−0.140
Natural Resources																		
Forests[19]	1.00	1.01	1.03	1.04	1.05	1.06	1.14	1.22	1.30	1.38	1.46	1.49	1.52	1.55	1.58	1.60	1.60	0.605

(Index 4 continued)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Net Change[2]
Water[20]	1.00	0.97	0.94	0.91	0.88	0.85	0.86	0.87	0.88	0.89	0.89	0.85	0.81	0.77	0.73	0.69	0.69	−0.308
Energy[21]	1.00	0.98	0.87	0.82	0.94	0.85	0.84	0.87	0.92	1.02	1.03	1.04	1.03	1.01	0.93	0.88	0.88	−0.117
Developed Land[22]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	−0.010
Average	1.00	0.99	0.96	0.94	0.97	0.94	0.96	0.99	1.02	1.07	1.09	1.09	1.09	1.08	1.06	1.04	1.04	0.042
Solid Waste																		
Waste Generation	1.00	1.02	1.04	1.06	1.08	1.10	1.14	1.17	1.21	1.25	1.29	1.29	1.29	1.29	1.29	1.29	1.29	0.290
Recycling Rate[23]	1.00	1.02	1.02	1.01	1.01	0.98	0.98	0.98	0.98	0.95	0.88	0.88	0.85	0.85	0.83	0.85	0.85	−0.153
Average	1.00	1.02	1.03	1.04	1.04	1.04	1.06	1.07	1.10	1.10	1.09	1.08	1.07	1.07	1.06	1.07	1.07	0.068
Overall Average[24]	1.00	1.02	1.03	1.02	1.01	0.95	0.97	0.97	1.00	1.02	1.01	1.00	0.97	0.96	0.97	0.91	0.90	−0.104

Note 1: Except where otherwise noted, missing data were either extrapolated backward using the earliest available data point or extrapolated forward using the last available data point. See text for explanation.

Note 2: Net change equals the 1996 base-80 value minus the 1980 base-80 value; multiply by 100 to obtain a percentage change. Any slight discrepancies between the net change column and the difference between the 1996 and 1980 columns are due to rounding off.

Note 3: Ambient levels.

Note 4: NO2 was measured at Central London, Cromwell Rd, and Stevenage sites only until 1987. In 1987, more sites were measured.

Note 5: Average of cadmium in the Thames, Severn, Clyde, and Mersey Rivers.

Note 6: Average of chromium in the Thames, Severn, Clyde, and Mersey Rivers.

Note 7: Average of copper in the Thames, Severn, Clyde, and Mersey Rivers.

Note 8: Average of the “Average” lines for cadmium, chromium, and copper.

Note 9: Average of phosphorus in the Neagh, Lomond, and Bewl Water.

Note 10: Average of nitrogen in the Neagh, Lomond, and Bewl Water.

Note 11: Average of the “Average” lines for phosphorus and nitrogen.

Note 12: This expresses the percent of rivers and canals not considered Fair or Good.

Note 13: Average of the biological quality of rivers and canals in England and Wales, Scotland, and Northern Ireland.

Note 14: This expresses the percent of rivers and canals not considered Fair or Good.

Note 15: Average of the chemical quality of rivers and canals in England and Wales, Scotland, and Northern Ireland.

Note 16: Average of the levels of mercury, PCBs, and DDT found in whiting and plaice in the Irish Sea.

Note 17: Average of the levels of mercury, PCBs, and DDT found in cod and plaice in the Irish Sea.

Note 18: Average of the lines “Metal Average” and “Nutrient Average,” and the Averages for “Biological Quality of Rivers and Canals,” “Chemical Quality of Rivers and Canals,” “Contaminants in Fish in the Irish Sea,” and “Contaminants in Fish in the North Sea.

Note 19: This is the ratio of harvest to growth.

Note 20: Ratio of withdrawals to renewable resources.

Note 21: Ratio of consumption to production.

Note 22: Developed land (urban + agricultural) as a proportion of total land base.

Note 23: Recycling rate is an average of the recycling rate for paper and cardboard and the recycling rate for glass; rate is inverted to express the proportion of waste not recycled.

Note 24: Overall average is the average of the lines “Average (air quality),” “Average (water quality),” “Average (natural resources),” and “Average (solid waste).

Index 5: Relative Severity of Environmental Problems in South Korea (base year 1985)[1]

Annual values >1 represent an increase in environmental degradation; annual values < 1 represent a decrease

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Net change[2]
Air quality[3]														
Sulphur Dioxide	1.00	0.86	1.00	1.08	1.04	0.96	0.83	0.71	0.52	0.46	0.42	0.33	0.27	−0.73
Nitrogen Dioxide	1.00	1.00	1.00	0.93	0.83	0.86	0.97	0.97	0.97	0.86	1.00	1.03	1.00	0.00
Ozone	1.00	0.72	0.61	0.56	0.50	0.61	0.67	0.78	0.72	0.78	0.78	0.89	0.94	−0.06
Carbon Monoxide	1.00	1.06	1.17	1.06	1.11	0.92	0.83	0.70	0.60	0.61	0.50	0.50	0.43	−0.57
Total Suspended Particulates[4]	1.00	0.88	0.86	0.90	0.76	0.73	0.61	0.52	0.46	0.41	0.42	0.43	0.38	−0.62
Lead (measured since 1993)[5]									1.00	0.89	0.75	0.69	0.52	−0.48
Average (air quality)	1.00	0.92	0.94	0.92	0.87	0.85	0.82	0.78	0.71	0.67	0.65	0.65	0.59	−0.41
Water quality[6]														
Biological Oxygen Demand	1.00	1.14	0.93	1.07	1.34	0.78	0.43	0.47	0.54	0.47	0.82	0.76	1.01	0.01
Chemical Oxygen Demand	1.00	0.81	0.71	0.76	0.68	0.53	0.55	0.72	0.87	1.29	1.22	1.06	1.40	0.40
Phosphorus	1.00	1.00	1.00	1.00	1.00	1.00	1.05	0.63	0.43	0.52	0.21	0.45	0.57	−0.43
Nitrogen	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.18	1.45	1.54	1.68	1.76	0.76
Average (water quality)	1.00	0.99	0.91	0.96	1.01	0.83	0.76	0.69	0.76	0.93	0.95	0.99	1.19	0.19
Solid waste														
Waste generation	1.00	1.00	1.04	1.19	1.29	1.37	1.47	1.33	1.29	1.33	1.32	1.60	1.71	0.71
Recycling rate[7]	1.00	1.00	0.97	0.96	0.91	0.90	1.00	0.85	0.73	0.69	0.59	0.66	0.67	−0.33
Average (solid waste)	1.00	1.00	1.01	1.06	1.10	1.14	1.24	1.09	1.01	1.01	0.96	1.13	1.19	0.19
Natural Resources														
Forest[8]	1.00	0.57	1.00	0.53	0.46	0.52	0.70	0.37	0.55	0.52	0.10	0.46	0.43	−0.57
Energy[9]	1.00	0.95	0.86	0.83	0.76	0.69	0.63	0.6	0.6	0.57	0.55	0.59	0.60	−0.40
Developed Land[10]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	1.00	0.99	0.99	0.98	−0.02
Average (natural resources)	1.00	0.84	0.95	0.79	0.74	0.74	0.78	0.65	0.71	0.7	0.55	0.68	0.67	−0.33
Overall Average[11]	1.00	0.94	0.95	0.93	0.93	0.89	0.90	0.80	0.80	0.83	0.78	0.86	0.91	−0.09

Note 1: Except where otherwise noted, missing data were either extrapolated backward using the earliest available data point or extrapolated forward using the last available data point. See text for explanation.

Note 2: Net change equals the 1997 base-85 value minus the 1985 base-85 value; multiply by 100 to obtain a percentage change. Any slight discrepancies between the net change column and the difference between the 1997 and 1985 columns are due to rounding-off.

Note 3: Ambient levels.

Note 4: For Korea, the TSP measure was used, which is broader than the PM-10 category monitored in the United States.

Note 5: Lead has been measured since 1993.

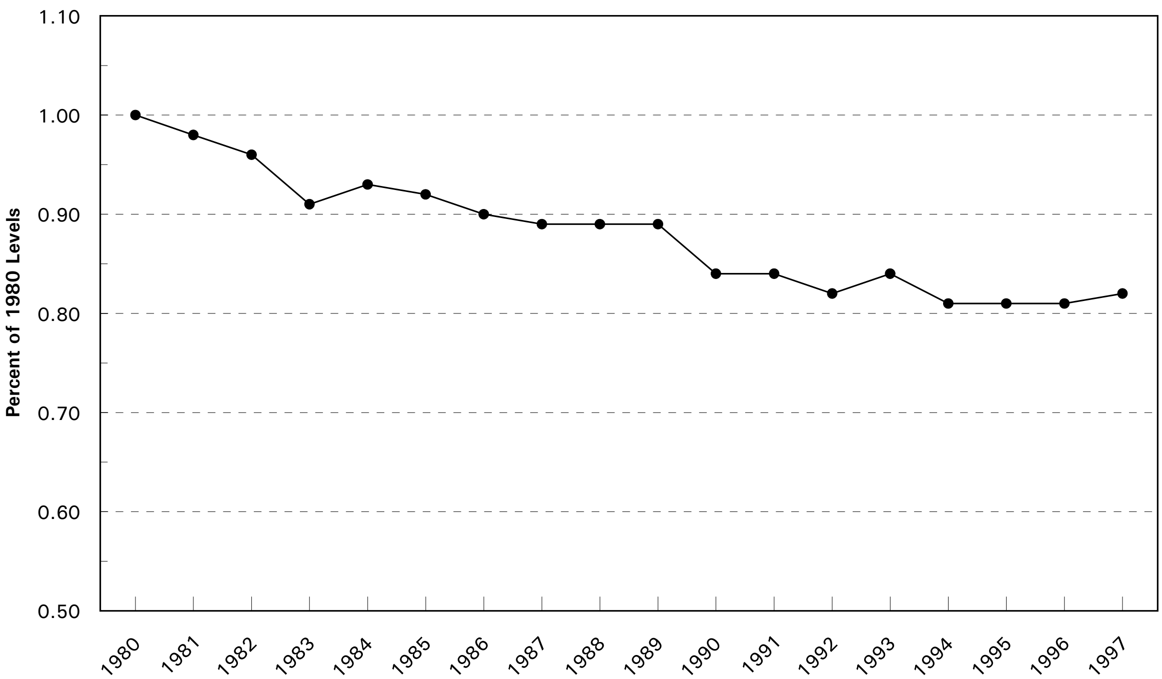
Note 6: Measurements taken from the major rivers (Han, Naktong, Kum, Yongsan) in South Korea.

Note 7: Recycling rate is an average of the recycling rate for paper and cardboard and the recycling rate for glass; rate is inverted to express the proportion of waste not recycled.

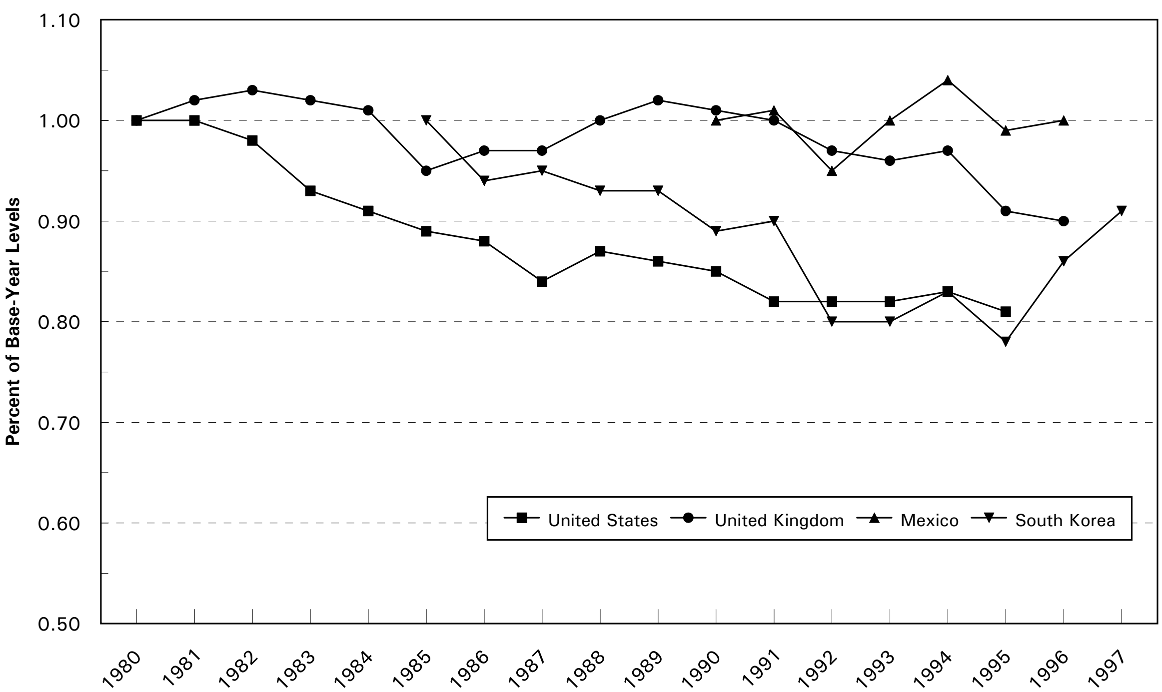
Notes continued on next page.

Note 8: Ratio of Annual Allowable Cut to growth.
Note 9: Ratio of consumption to production.
Note 10: Developed land (urban and agricultural) expressed as a proportion of total land base.
Note 11: Overall average is the average of the lines "Average (air quality)," "Average (water quality)," "Average (natural resources)," and "Average (solid waste)."

Index Figure 1 Severity of Environmental Problems in Canada



Index Figure 2 Relative Severity of Environmental Problems in the United States, the United Kingdom, Mexico, and South Korea



Note: Base year for the United States and the United Kingdom is 1980, for South Korea is 1985, and for Mexico is 1990.

Notes

Primary Indicators

1 Canada also has standards for hydrogen fluoride and is proposing standards for hydrogen sulphide.
2 Air monitoring stations operate in most Canadian cities with populations over 50,000; they are located in residential, industrial and commercial areas.
3 Standards are more stringent for longer time periods. For example, the 1-hour desirable level for sulphur dioxide is 172 ppb, whereas the annual desirable level is 11 ppb.
4 The stations exceeding the 1-hour acceptable level in 1997 were located in Rouyn QC, Shawinigan QC, Sorel QC, Windsor ON, Sudbury ON and Yellowknife, NT. Readings that exceeded standards were less then 0.1 percent of the total readings for each of the stations.
5 The three stations with no readings exceeding the I-hour desirable level in 1997 were located in Saint John NB, Regina SK and Saskatoon, SK.
6 Stations with more than 8 percent of their total readings above the 1-hour desirable level are located in Long Point ON, Simcoe ON, Grand Bend ON, Algoma ON, Merlin ON, Stouffville ON and Vegreville AB.
7 The stations with readings above the 1-hour desirable level in 1997 were located in Edmonton AB and Montreal QC. For both stations, less than 0.08 percent of their readings were above the standard.
8 The stations with readings above the 24-hour maximum acceptable level were located in Sorel QC and Yellowknife NW, with 5.6 and 1.8 percent of their readings exceeding the standard respectively.
9 Point versus non-point sources of water pollution could be compared to stationary versus mobile sources of air pollution.
10 Eutrophication, or nutrient enrichment, is the oversupply of inorganic nutrients that cause algae and plants to multiply rapidly; when they die and decompose, the water's dissolved oxygen content is depleted. Dissolved oxygen, which is derived from photosynthesis by aquatic plants and atmospheric exchange, is essential to ensure the maintenance of aquatic life and self-purification processes in natural water systems.
11 Bioaccumulation in aquatic organisms occurs when a persistent, fat-soluble, contaminant enters the organism's body through the skin or by ingestion. If consumption exceeds the organism's ability to metabolize or eliminate the contaminant, over time it accumulates in the tissues.
12 Contaminant levels in herring-gull eggs are a good water quality indicator since these pollutants are bio-accumulative; as fish-eaters, herring gulls will have the highest concentration of these pollutants in their systems.
13 DDT (dichloro-diphenyl-trichloro-ethane) is a persis-tent, bioaccumulative, synthetic insecticide. Its use was heavily restricted in the 1970s and prohibited after 1990. The breakdown product, DDE (dichloro- diphenyl-dichloro-ethylene), is most easily measured in the fat of animals or in the eggs of birds. Most other pesticides in use today are not as persistent and hence are not transported to the same degree as DDT.
14 Data are unavailable before 1977.
15 PCBs were once used extensively in many parts of the electrical and transmission industry, in flame retardants, water-proofing agents, printing inks, adhesives; they were also spread on roads to prevent airborne dust. In the 1980s, tight restrictions allowed PCBs to be used only in closed electrical equipment and safe incineration technologies now are used to destroy those currently in storage. They have been associated with declining fish populations in some locations.

16 HCBs are used in fungicides, dye manufacturing, and wood preservatives; they are also produced as a waste by-product of chemical manufacturing. The Great Lakes region is at risk from HCB contamination since numerous chlorine plants are located near the Lakes on both sides of the border.

17 These declines have not been without cost. In 1982, for example, more than 450,000 kg of PCB contaminated sediments were dredged from the Weukegan harbour at a cost of 24 million dollars (Environment Canada & USEPA 1997a).

18 While summarizing research into the toxic effects of pollution in the Great Lakes in 1997, the United States Agency for Toxic Substances and Disease Registry concluded that both wildlife and human populations are being affected by exposure to toxic substances (IJC 1997). The background paper on toxic contaminants from the State of the Lakes Ecosystem Conferences (SOLEC) reports that water-quality objectives for the protection of human health are exceeded at current levels. It also recommends further reductions in pollutant concentrations (Environment Canada & USEPA 1995b: 1).

19 Target loads for phosphorous are defined in the 1978 Great Lakes Water Quality Agreements (in metric tonnes per year) as: Lake Superior 3400, Lake Michigan 5600, Lake Huron 4300, Lake Erie 11000, and Lake Ontario 7000.

20 Phosphorous concentrations are measured in the spring since they largely influence the amount of summer phytoplankton biomass (Environment Canada & USEPA 1995a: 4)

21 For this report, the near-shore ecosystem includes land that is directly affected by the lakes and areas with warm shallow water. This area encompasses 25 percent of each of lakes Michigan, Huron and Ontario, 90 percent of Lake Erie, 5 percent of Lake Superior, all connecting channels, and land 16 km from the shoreline of all lakes except Lake Superior.

22 Lake Erie, for example, was previously considered dead but now supports a commercial fishery. In Lake Superior, Lake Trout are now self-sustaining (Environment Canada & USEPA: 1997a).

23 Do you re-call the famous Mobro garbage-barge episode in the mid-1980s, in which the wandering barge appeared night after night on the news, became the icon of the trash debate in the United States. What happened to the Mobro garbage barge? After wandering up and down the Atlantic seaboard for several weeks, the trash it carried was placed in a landfill in New York, just a few miles from where it had started its journey.

24 In Canada, municipal waste is all waste that is not construction and demolition debris. See OECD 1999: 165.

25 Data are based on apparent consumption (a proxy for waste generated) using figures from domestic consumption of the respective product + imports – exports (OECD 1999: 172).

26 This figure for glass recycling includes packaging glass only (OECD 1999:174).

27 Estimates for urban space range from 0.2 percent to 1 percent depending on the definition.

28 Cropland is the amount of land used to grow field crops, fruit, vegetables, nursery products, and sod.

29 Soil quality has been defined by Agriculture and Agri-Food Canada as the "soil's fitness to support crop growth without becoming degraded or otherwise harming the environment" (Acton & Gregorich 1995: xi).

30 These practices were initially promoted by the National Soil Conservation Program (NSCP) in 1989. From this program came other programs addressing erosion such as the Permanent Cover Program in the Prairies, the Soil and Water Environmental Enhancement Program in Ontario, and the programs of the Eastern Canada Soil and Water Conservation Centre in Atlantic Canada (Acton & Gregorich 1995: 75).

31 Data on the risk of erosion is used instead of the actual amount of soil erosion since erosion levels vary between years largely due to natural conditions. There is also more data available on the risk of erosion.

32 Roundwood refers to round sections of tree stems such as logs or bolts.

33 For this inventory, old-growth was defined as the following: for coastal British Columbia, 251+ years for all forest types; for interior British Columbia, 141+ years for most forest types, and 121+ years for stands dominated by lodgepole pine or deciduous species. This inventory examined 94 percent of British Columbia's land base. The remaining land is largely privately owned.

34 The amount of old-growth forest that is protected ranges by biogeoclimatic zones. For example, 16 percent of old growth in the Coastal Western Hemlock and Engelmann Spruce-Subalpine Fir zones is protected. In the Ponderosa Pine and Sub-boreal Spruce biogeoclimatic zones only 5 percent is protected.

35 In future reports, *Environmental Indicators* will try to examine data for old-growth forests in other provinces.

36 Primary energy is the total energy available for all uses. It includes energy used by final consumers as well as energy needed to make other forms of energy.

37 Total domestic energy is defined here as the sum of total residential, commercial, industrial, transportation, and non-energy uses as well as the energy needed to produce electricity and producer consumption and loses. This calculation is a good approximation of total primary energy.

38 Non-energy uses includes petrochemical feedstock, asphalt, lubricants, etc.

39 Gross additions exceeded net production in 1989 and 1995.

40 These estimates vary depending on assumption for price and advancements on technology.

41 The oil and natural-gas industry is divided into the “upstream” sector—production—and the “downstream” sector—refining and marketing. The upstream sector includes exploration and production companies as well as seismic and drilling contractors, and technical, service, and supply companies. The downstream sector includes pipeline systems, refineries, gas-distribution utilities, wholesalers of oil products, service stations, and petrochemical companies.

Secondary Indicators

1 The atmosphere contains 750 billion tonnes of carbon dioxide; living plants contain 560 billion tonnes, soils 1,400 billion tonnes, ocean sediments 11,000 billion tonnes and the oceans themselves 38,000 billion tonnes. See Environment Canada 1991c: (22) 7.

2 Scientists do not dispute that the increase in equivalent CO_2 has occurred. Since the Industrial Revolution, equivalent CO_2 levels have risen from approximately 290 ppm to nearly 440 ppm in 1994 (Bailey 1995: 87). Humans do not, however, contribute to the main absorbers of infrared light in the atmosphere. Water vapour and clouds are responsible for over 98 percent of the current greenhouse effect (Lindzen 1992: 2).

3 As recorded by the International Tanker Owners Pollution Federation Ltd. (Environment Canada 1999d).

Index

1 For a comprehensive discussion of the wide variety of beliefs about nature in this century alone, see Bramwell 1989.

2 This two-stage averaging process is necessary to avoid giving exaggerated weight to categories that include a larger number of sub-categories.

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