A Minnesota and United States Index of Leading Environmental Indicators: 1999

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Good news about the environment is scarce—or is it just hard to uncover?

Center of the American Experiment and the Pacific Research Institute for Public Policy teamed up to find out. This report on the status of key environmental indicators in Minnesota and the nation is meant to bring balance to environmental policy by informing public opinion and providing unbiased scientific information on which to base decisions about trade-offs and priorities. It is adapted from a report published jointly by the two organizations in April 1999 in conjunction with Earth Day.

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For the purposes of this report, environmental indicators are divided into primary and secondary categories, each with several subsections. Primary environmental indicators—air quality, water quality, natural resources, land use and condition, and solid waste—provide direct information about environmental quality. The secondary indicators—including often-cited environmental measures such as carbon-dioxide emissions and toxic releases—provide indirect information. Together, they show considerable environmental improvement in both Minnesota and the United States.

Modern public attention to the environment dates roughly from the first Earth Day in 1970. It is clear that both Minnesotans and Americans want a clean environment. But despite a generation of concern, public opinion about environmental issues remains confused and contradictory, and consequently public policy on the environment is highly contentious and unsettled. Information showing good, clear measures of environmental quality and progress in Minnesota and the United States is not adequately collected, organized, and disseminated from raw data sources.

In part, the lack of environmental measures stems from the fact that our thinking about the environment is still in some ways in its infancy; the focus of environmental concern has often shifted. Twenty-five years ago most environmental concern centered on pollution and scarcity—the view that we were fouling our own nest and would quickly run out of natural resources. Today it is clear that anxieties about scarcity were unfounded, and concern has shifted to problems of global warming and "biodiversity," for which we lack uncontested scientific theory and objective data.

In equal part, the lack of good measures of environmental quality stems from the methodological difficulty of constructing such measures. As long ago as 1972, the President's Council on Environmental Quality (CEQ) wrote that "the process of developing dependable indices will be a long one," but the CEQ never got very far with the task. CEQ published a report on environmental trends only intermittently.

To fill this gap in public knowledge about environmental progress, to separate the facts from alarmist misinformation, and to bring balance to the environmental debate, Center of the American Experiment and the Pacific Research Institute for Public Policy of San Francisco have developed environmental indicators for Minnesota and the United States. The indicators are designed to help the public assess more accurately the state of the environment in several key areas: air quality, water quality, natural resources, land use and condition, solid wastes, energy, climate change, toxic releases, and wildlife.

This document is designed to give the reader an overview of environmental quality in Minnesota and the United States. While the indicators include many local or regional environmental issues, such as the air quality of selected cities, the goal of this study is to provide a "big picture" of general, statewide, and nationwide environmental trends. The report finds that, contrary to public opinion, objectives for protecting human health and the environment in most instances are being met, pollution and wastes are being controlled, and resources and land are being sustainably and effectively managed. Environmental quality in Minnesota and the United States is improving, not deteriorating.

Public Opinion, Prosperity, and the Environment

It is difficult to judge public sentiment about the environment accurately because the environment, taken as a whole, is a broad and all-encompassing idea. “The environment” is an evocative term, suggestive of mankind’s relationship to nature, and conveying connotations of eternity and our generation’s bequest to succeeding generations. The environment, perhaps uniquely among public issues, invites citizens to engage in metaphysical speculations. Environmental issues comprise both narrow technical concerns, often measured in parts per billion, and broad emotional concerns, such as the symbolic value of a virgin forest.

The broad and amorphous nature of environmental issues works both for and against environmentalism. When pollsters ask specifically whether the environment is a serious problem, majorities answer strongly in the affirmative, and people are generally pessimistic about environmental trends. According to the most recent Wirthlin survey on environmental issues, 79 percent think “problems regarding pollution and the environment will get worse during my lifetime.”[1] The Wirthlin survey similarly finds that 76 percent agree with the statement that “protecting the environment is so important that requirements and standards cannot be too high, and continuing environmental improvements must be made regardless of cost.”

On the other hand, if pollsters ask open-ended questions about what issue people regard as most important, the environment does very poorly, usually in the single digits. A 1995 Gallup Poll reported that only 1 percent of respondents ranked the environment as the “most important problem.” Similarly, participants in a 1994 Roper Survey that listed twenty public problems ranked the environment sixteenth, just above alcoholism.[2] This is not to suggest that public concern about the environment is overstated or misunderstood. Contradiction within public opinion is not a new or remarkable phenomenon. The environment is like many other public issues in that the public often tells pollsters that the government does not spend enough money on a specific problem while also saying that the government as a whole is too big and spends too much.

The fact that people rank the environment low on an open-ended ranking of public problems means that, while many people may have strong opinions on the environment in the abstract, it does not hold their immediate interest in the same way as, say, crime and education do. While public policy debates seldom command close public attention, citizens are more informed on issues that are likely to immediately affect them than they are on environmental issues.

Given that the public does not pay close attention to the details of environmental issues, it is not surprising that public opinion is not in harmony with the facts. Even as polls show that people think the environment is getting worse, by most measures environmental quality has dramatically improved over the last generation and is continuing to improve.

There are three ways in which the public comes to form its opinions about the environment. The first is the influence of environmental groups. Because people are not likely to spend time following environmental issues in detail and because the environment ranks low on the list of public concerns, environmental issues and policy tend to be driven by the most highly motivated interest groups, typically environmental organizations. And, since democratic government is most responsive to an atmosphere of crisis, it is often in the interest of environmental organizations to promote a sense of crisis. A New York Times feature series on environmental issues observed that environmental organizations might be "in danger of becoming the green equivalent of the military lobby, more interested in sowing fear and protecting wasteful programs than in devising a new course."[3] Other critics have described some environmentalists as "crisis entrepreneurs."

Second, the news media aggravate this problem by promoting images of environmental threats while downplaying positive news. In his magisterial book A Moment on the Earth, environmental writer Gregg Easterbrook recounts how, in 1992, he was struck by finding a good-news story, "Air Found Cleaner in U.S. Cities," in "a small box buried on page A24 of the New York Times."[4] The story went unmentioned in most other media outlets. "Surely," Easterbrook observed, "any news that air quality was in decline would have received front-page attention. The treatment suggested that the world was somehow disappointed by an inappropriately encouraging discovery."[5] This asymmetry in the way the media handle environmental issues further distorts public perception.

Third, public perception of environmental quality is powerfully driven by what economists call "the wealth effect." Several studies have shown a positive correlation between rising incomes and demand for environmental quality.[6] As people become more affluent, their tolerance for risk of all kinds diminishes. This helps explain why citizens of wealthy nations believe their environment is getting worse even as the data show it is getting better.

Incorrect public perceptions about environmental trends can have important consequences for policy: not only do they cause anxieties that may not be warranted by facts or out of proportion to the true risks involved, they can also lead to skewed policy priorities. In 1990 the U.S. Environmental Protection Agency's Science Advisory Board warned that current laws and regulations "are more reflective of public perceptions of risk than of scientific understanding of risk."[7] And a 1993 report from the Center for Resource Economics found that EPA resources were allocated in amounts inversely proportional to genuine risk. "EPA's budget and staff resources are not allocated on the basis of risk," the report concluded. "Consequently, more than 80 percent of EPA's resources are spent on pollutants considered to be relatively low risk by federal scientists."[8]

Public perception usually corrects itself as a sense of progress takes hold.

The significant improvement in several areas of environmental concern charted in this report will immediately be cited as evidence that federal environmental regulation works and, therefore, if some regulation is good, more regulation will be even better. However, the full picture is more complicated. Although economic growth in the past thirty years has improved Minnesota's and the nation's ability to protect our natural resources and has fostered a growing citizen preference for a clean environment, it is difficult to determine the precise contribution of regulatory programs, economic prosperity, and citizen preferences to environmental improvements.

It appears, for example, that environmental quality was already improving before the passage of comprehensive environmental legislation and the founding of the U.S. Environmental Protection Agency in the early 1970s. Paul Portney of Resources for the Future, using historical data, finds that the average ambient levels of airborne particulates declined by more than 20 percent during the 1960s, while ambient levels of sulfur dioxide fell by almost 50 percent. Carbon monoxide also declined by more than 20 percent in urban areas. "These data," Portney concludes, "are important because they suggest that air quality was improving as fast or faster before the Clean Air Act as it has since that time."

Similar improvements in water quality occurred before 1970. A. Myrick Freeman III, senior fellow at Resources for the Future, concluded that "attributing all of the observed improvements (or prevention of degradation) to the 1972 [Clean Water] act might overstate its true accomplishments."

There are two reasons for this seemingly counterintuitive conclusion. First, some of the reduction in pollution levels can be attributed to local environmental efforts—a significant counterpoint to the enthusiasm for uniform, one-size-fits-all regulations.

Second, much environmental improvement can be attributed to the "wealth effect" of a growing economy: the combination of increased economic efficiency through industrial modernization and the growing consumer preference for a clean environment, both of which have the effect of less air and water pollution.

The wealthier-is-healthier principle is based on the empirically valid notion that the main prerequisite for environmental improvement is economic prosperity. A wealthier society is prone to have interests in environmental amenities and has resources to devote to environmental preferences. In addition, economic growth finances the development of environmentally sensitive technologies, and market competition encourages greater efficiency in the use of materials, thereby lessening the human impact on the natural world.

Primary Environmental Indicators

Air Quality

Air quality in Minnesota and the United States shows the clearest trend of improvement among all environmental categories during the past two decades. Data are presented for ambient levels and emissions. Ambient levels are the actual concentration of a pollutant in the air. They are usually reported in parts per million (ppm), parts per billion (ppb), or micrograms per cubic meter (µg/m^3). Air-monitoring stations are maintained in most cities with populations greater than 100,000, where air pollution presents a potential problem. In the United States, 4,800 monitoring sites report air quality data for one or more of the six National Ambient Air Quality System pollutants to the Aerometric Information Retrieval System.[9]

Emissions estimates measure the amount of pollution that human activity generates; they do not include releases of the pollutant from natural sources. The U.S. Environmental Protection Agency (EPA) uses models to estimate emissions. These models are based on many factors, including the level of industrial activity, changes in technology, fuel consumption rates, vehicle miles traveled, and other activities that cause air pollution. Emissions are usually reported in kilograms, tons, or short tons. Frequent revisions in the calculation methods used to estimate emissions make comparisons between years less meaningful.

Air Quality Trends

This section examines six air pollutants—sulfur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOCs), carbon monoxide (CO), particulate matter (PM_{10}), and lead (Pb)—that regulations target, as well as a comparison of air quality in major metropolitan areas.

Sulfur dioxide is a colorless gas and a precursor to acid rain, which in sufficient concentrations can cause acidification of lakes and streams, accelerate corrosion of buildings, and impair visibility. The largest manmade contributors to SO_2 emissions are industrial and manufacturing processes, particularly generation of electrical power. After ten years of study, however, the U.S. National Acid Precipitation Assessment Program concluded that acid rain has had negligible effects on wildlife, forests, crops, or human health.[10]

Nitrogen and oxygen combine naturally through bacterial action in soil, lightning, volcanic activity, and forest fires to form a variety of compounds referred to as nitrogen oxides (NO_x). The combustion of fossil fuels by automobiles, power plants, industry, and household activities also contributes to NO_x emissions. A reddish-brown gas called nitrogen dioxide (NO_2), a member of the NO_x family, is regularly tracked by the Minnesota Pollution Control Agency and the EPA since it combines with volatile organic compounds in the presence of sunlight to form ground-level ozone. Ozone contributes to the formation of urban smog.

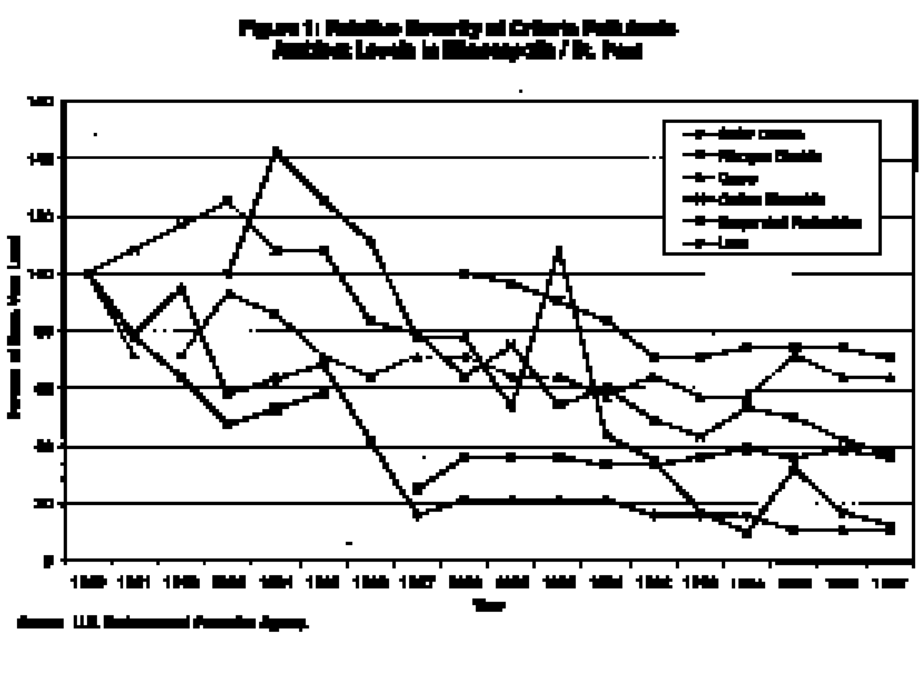
Volatile organic compounds are a subgroup of hydrocarbons; they enter the atmosphere through evaporation from auto fuel tanks, paints, coatings, solvents, and consumer products such as lighter fluid and perfume. VOCs also occur naturally because of photosynthesis. Under certain conditions, they combine with NO_2 to form ground-level ozone, which contributes to urban smog. Regulators target VOC emissions to combat the secondary pollutant, ozone.

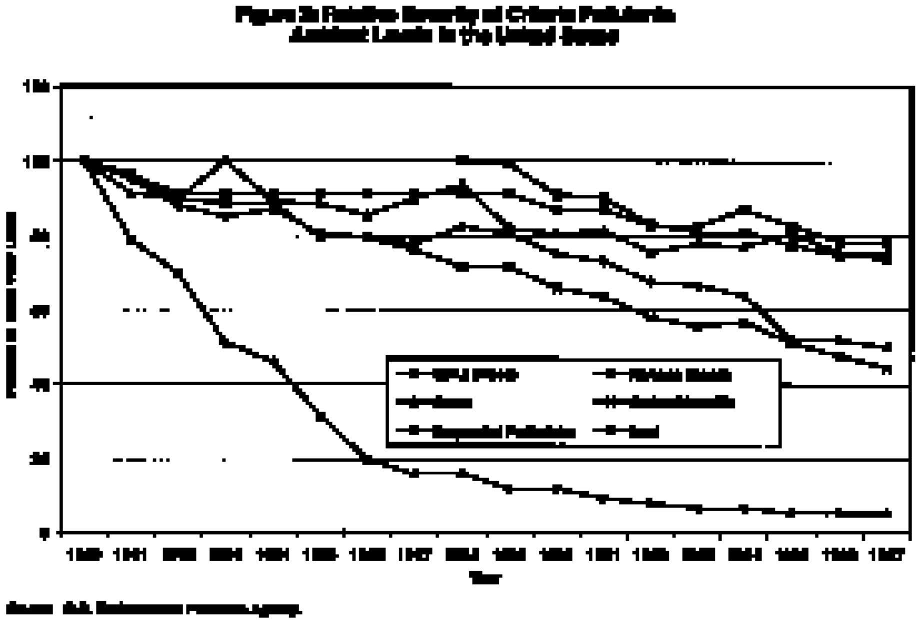
When fuel and other substances containing carbon burn without sufficient oxygen, carbon monoxide, a colorless, odorless gas, is produced. Trace amounts of carbon monoxide occur naturally in the atmosphere, but most emissions—nearly 77 percent nationally—come from automobiles and other transportation sources.[11]

Particulate matter is small pieces of dust, soot, dirt, ash, smoke, liquid vapor, and other matter in the atmosphere. Sources may include forest fires and volcanic ash as well as emissions from power plants, motor vehicles, and waste incineration and dust from mining. At high levels, particulates can be an irritant to lung tissue and may aggravate existing respiratory problems and cardiovascular diseases. In 1987 the EPA changed from measuring total particulates to measuring particulates less than 10 microns in diameter (PM_{10}).

Lead is a soft, dense, bluish-gray metal. Its high density, softness, low melting point, and resistance to corrosion make it a valuable industrial resource. It is used in the production of piping, batteries, weights, gunshot, and crystal. Until recently, automobiles were the source of most lead emissions, although small quantities of lead are naturally present in the environment. Lead is the most toxic of the main air pollutants. When it is ingested, it accumulates in the body's tissues. In high concentrations, it can cause damage to the nervous system and trigger seizures, behavioral disorders, and brain damage.

Figures 1 and 2 show how the ambient level of the six criteria pollutants for the Minneapolis/St. Paul metropol-





itan area and the United States have changed over time. The annual values for each of the pollutants are converted to a base year, which makes it possible to compare environmental quality in later years to the base year. This approach allows a comparison of relative values only; the base year values do not provide any information about the absolute level of environmental quality. This is unavoidable, as assessments about absolute environmental qualities are value judgments—social constructs that vary among societies and over time.

In Figures 1 and 2, the base year is 1980 for all pollutants except lead in 1983 (Figure 1) and particulate matter in 1988 (both figures). In addition, 1986 data for nitrogen dioxide in Figure 1 are not available. We report all of the best available information.

In Minneapolis/St. Paul, ambient concentrations of sulfur dioxide showed an 84 percent improvement between 1980 and 1997, while improving 50 percent in the United States. Between 1980 and 1997, ambient concentrations of nitrogen dioxide improved 64 percent in Minneapolis/St. Paul and 22 percent in the United States. Similarly, from 1980 to 1997, ambient concentrations in Minneapolis/St. Paul and the nation were reduced, respectively, for ozone (36 and 24 percent) and carbon monoxide (63 and 56 percent), and PM_{10} concentration improved 29 and 26 percent between 1988 and 1997. Finally, concentrations of lead improved 87 percent in Minneapolis/St. Paul between 1983 and 1997, and 95 percent in the United States between 1980 and 1997.

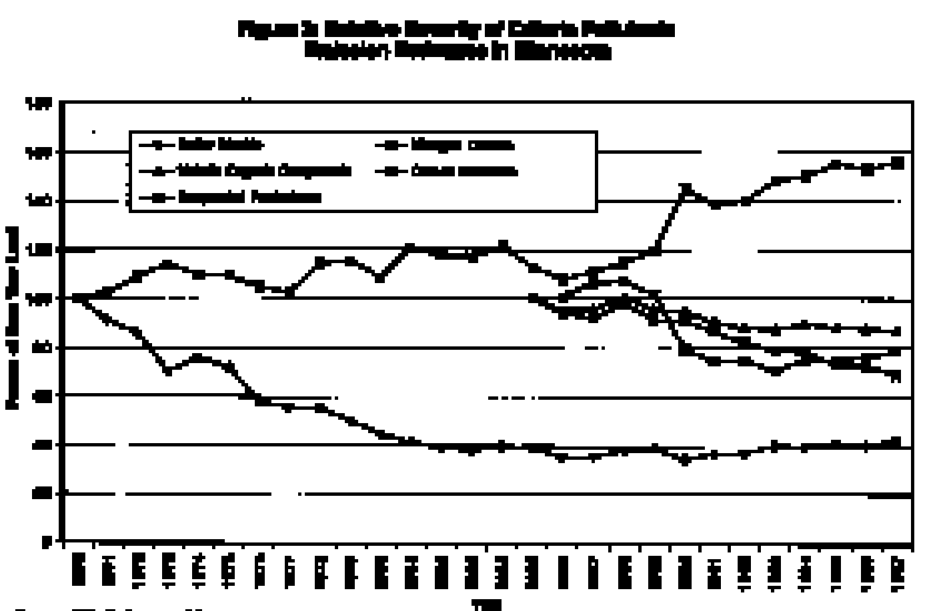
EPA trend analysis for Minneapolis/St. Paul over the 1988 through 1997 period shows a statistically significant downward trend for SO_2, CO, PM_{10}, and lead (NO_2 and ozone trends are insignificant, but 1997 readings are at or below 1988 levels).[12] The EPA addresses how these ambient air quality measures relate to human health through the Pollutant Standards Index (PSI), discussed here in the Urban Air Quality section.

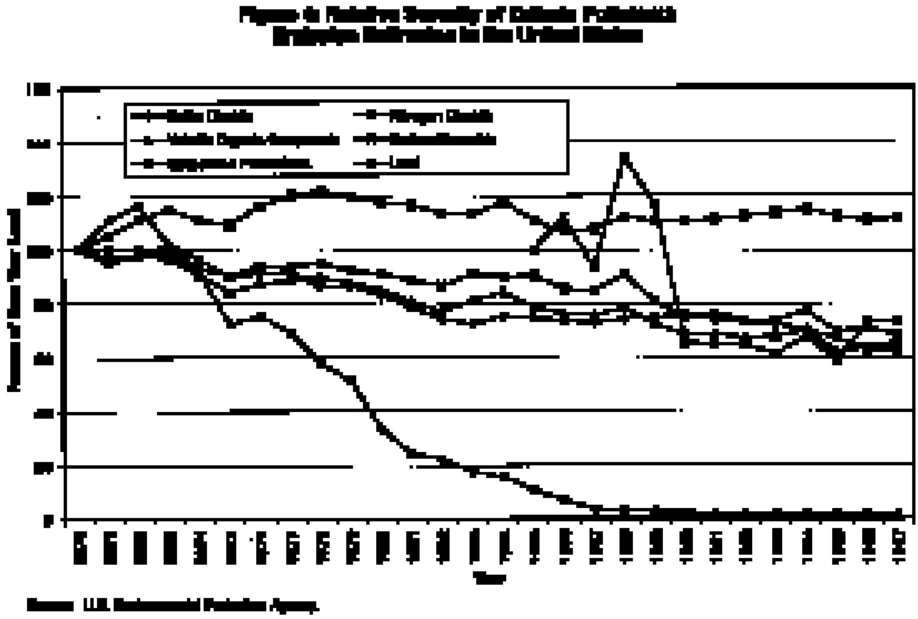
Figures 3 and 4 show how emissions have changed over time relative to a base year. For Minnesota and the nation, SO_2 emissions showed a 58 and 35 percent decrease, respectively, between 1970 and 1997, while NO_2 emissions increased 56 and 11 percent, respectively. From 1985 through 1997, emissions were reduced for VOCs (13 percent), CO (31 percent), and PM_{10} (21 percent). Similar emission reductions are observed in the U.S. data.

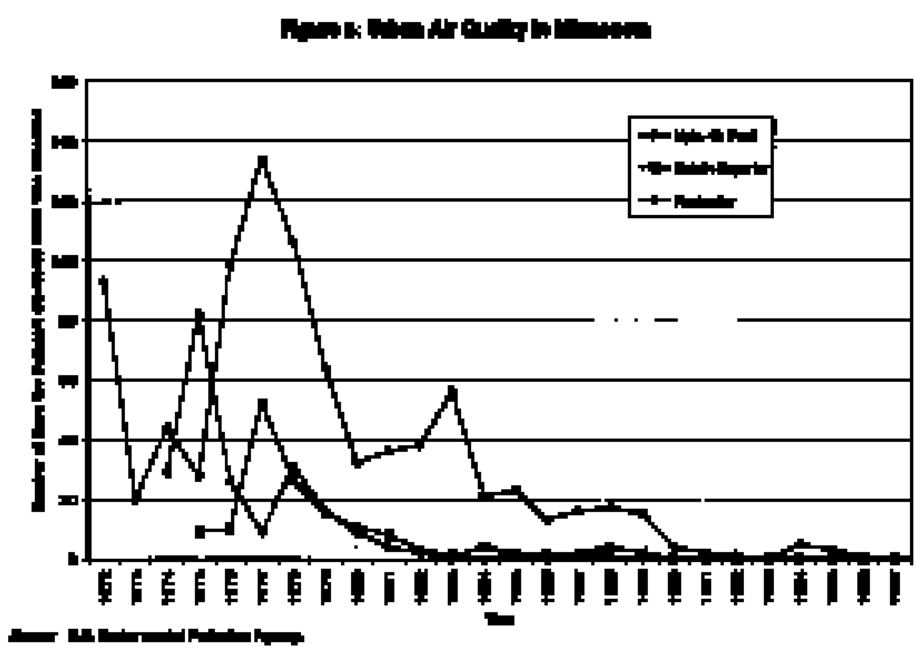
The data show that there is not a simple or predictable correlation between emissions caused by human activities and ambient air quality. For instance, while the relative severity of NO_2 emissions increased from 1980 to 1997 (Figure 3), the relative severity of ambient levels over the same period declined (Figure 1).[13]

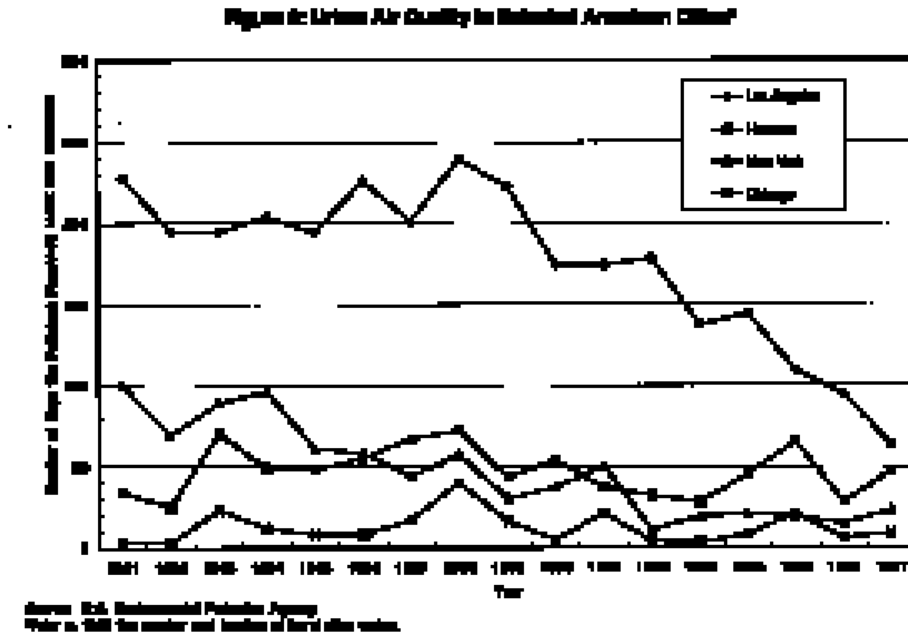
Urban Air Quality

Sulfur dioxide, nitrogen oxides, carbon monoxide, fine particulate matter, and ground-level ozone contribute to the formation of urban smog. Concentrations of these five criteria pollutants are integrated into the pollution standards index (PSI), which is a number between 0 and 500; poor air quality is represented by a high PSI. Figures 5 and 6 show the number of days when a PSI value exceeded 100; above that number, air quality is designated to be in the









unhealthy range for that day. A single monitoring station registering a single one-hour episode above the hourly standard may define a day above the standard; hence, a “violation day” does not necessarily mean that the standard was exceeded for twenty-four hours.

In terms of total days that exceed national criteria, air quality is improving in all three of the Minnesota metropolitan areas shown in Figure 5. Urban air quality in Minneapolis/St. Paul shows an improving trend over time, while the number of poor air quality days in Duluth and Rochester are few; Duluth and Rochester did not exceed national ambient air quality standards at all between 1990 and 1997.

The trends in other major metropolitan areas are also mostly improving, although in some areas, especially Los Angeles, smog remains a problem. But even in Los Angeles, the number of days exceeding the standard fell 72 percent between 1981 and 1997. New York also saw a major reduction during the same period: the number of days the PSI was exceeded fell 77 percent. Of the four metropolitan areas shown in Figure 6, Houston is the only city without a noticeable downward trend.

Water Quality

The quality of lakes, rivers, and streams is among the most difficult environmental areas to assess. The data used in this section do not represent complete ambient water quality information due to the lack of available data and the magnitude and complexity of measuring water quality. Estimates indicate that U.S. taxpayers and the private sector have spent over $500 billion on water pollution control since enactment of the federal Water Pollution Control Act in 1972. Despite this expenditure, there is still no adequate national database of water quality information with which to evaluate the results of such efforts.

The effects of both natural and manufactured contaminants on water quality vary with water conditions (source, velocity, volume, depth, temperature, and pH level) and photosynthetic activity, as well as within a day and from season to season. Water quality cannot be quantified effectively with one or two general measures because there are different parameters for different regions and watersheds. In addition, inconsistencies in data collection are apt to occur as a result of overlapping jurisdictions and budget considerations.

An unfortunate trend in water quality assessment appears to be taking hold: those in the field of data collection and analysis have begun to feel pressure to produce results that justify their expenses. Site-specific studies often are given priority over systematic and consistent monitoring, and data analysis has become very difficult without a solid database from monitoring stations. The overemphasis on crisis management can have unintended detrimental consequences, such as an inadequate water quality monitoring network.

Defining Water Pollutants

Water pollution originates in point and non-point sources. Point sources include industrial release pipes and municipal sewer outlets, which discharge pollutants directly into the aquatic ecosystem. Non-point sources are indirect sources of pollution such as runoff from agriculture, forestry, urban, and industrial activities, as well as landfill leachates and airborne matter. Water quality also varies naturally due to inherent chemical, physical, and biological characteristics.

Water pollution from human activities includes nutrients, heavy metals, persistent pesticides, and other toxins. Nutrients like phosphorus and nitrogen—found in fertilizers and livestock manure—can cause significant degradation of water quality by accelerating eutrophication (nutrient enrichment), which depletes levels of dissolved oxygen.

Heavy metals concentrate in water from the weathering of rocks; they also reach the water system directly from industrial and mining activity. High concentrations of heavy metals can affect the quality of drinking water and harm aquatic life as the metals accumulate in organs and tissues. Pesticides and toxins like polychlorinated synthetic compounds (DDT and PCBs) can also accumulate in biological organisms. The effects of these compounds on animals and birds include growth retardation, reduced reproductive capacity, diminished resistance to disease, and birth deformities.

Industrial and municipal sewage is usually treated before being released into rivers, lakes, or streams. Primary wastewater treatment removes solid waste mechanically; secondary treatment employs biological processes to break down dissolved organic material;

tertiary treatment removes additional contaminants, including heavy metals and dissolved solids.

Most industrial pollution—a form of point source—has been brought under control, significantly reducing the release of water pollutants. Non-point source pollution, however, remains an ongoing challenge to continued water quality improvements. Efforts to reduce non-point source pollution increased in 1987 when amendments were made to the Clean Water Act.

Water Quality Assessment

In 1972 the EPA instituted the National Water Quality Inventory (NWQI) under the Clean Water Act. The EPA, in conjunction with the U.S. Geological Survey, reports to Congress on criteria for water quality and pollution. Each state must meet minimum federal criteria and may set additional objectives to address particular local problems. States also must submit biennial "305(b)" reports to their regional EPA office (there are ten regions) stating whether they met or exceeded minimum federal levels. The regional EPA offices aggregate state reports to produce the biennial EPA NWQI: Report to Congress.

The NWQI assesses rivers, lakes, and estuaries based on nine designated beneficial uses: support of aquatic life, consumable fish, shellfish harvesting, supply of drinking water, primary contact (swimming), secondary contact (recreation), agriculture, recharge of groundwater supply, and wildlife habitat. According to the NWQI, 19 percent of total river miles (53 percent of continuous-flow river miles), 40 percent of lakes, ponds, and reservoirs, and 72 percent of estuaries were assessed in 1996.[14] The results in Table 1 are for 1996, the last year for which data are available.

The NWQI data provide a broad but unclear assessment of water quality. About 49 percent of Minnesota's surveyed river miles (64 percent for the United States) have good quality that fully supports aquatic life uses—suitable habitat for protection and propagation of fish, shellfish, and other aquatic organisms. About 68 percent of Minnesota's surveyed lake acres (61 percent for the United States) fully support swimming: people can swim

Table 1. 1996 National Water Quality Inventory—Minnesota and United States

	Fully supporting	Fully supporting/ threatened	Impaired
Minnesota			
Rivers (7,793 miles) [a,b]	10%	39%	52%
Lakes (2.1 million acres) [c]	61%	7%	31%
United States			
Rivers (693,879 miles) [d]	56%	8%	36%
Lakes (16.8 million acres) [d]	51%	10%	39%

Source: U.S. Environmental Protection Agency, 1997.
[a] Reported water quality for Minnesota rivers is 1994 data.
[b] Designated use is "aquatic life."
[c] Designated use is "swimming."
[d] Designated for all nine uses.

without risk of adverse health effects, such as catching waterborne diseases from raw sewage contamination. For all other bodies of water, the EPA defines impaired as "waterbodies either partially supporting uses or not supporting uses."[15] This means that an impaired body of water does not support its designated beneficial use for a partial or entire year.

The NWQI provides information to gauge the current state of water quality but fails to collect the consistent annual measurements that would be necessary to gauge water quality trends. The National Stream Quality Accounting Network (NASQAN) operated by the Geological Survey provides measurements to examine water quality trends. The NASQAN is one of two national stream water-quality networks initiated by the Geological Survey. The other network, the Hydrological Benchmark Network, measures 63 "minimally disturbed" watersheds, whereas the NASQAN measures 618 "culturally influenced" watersheds. The NASQAN provides data that are useful in tracking the progress of prominent point-source controls, especially municipal sewage treatment plants. From 1973 through 1995, Minnesota had sixteen monitoring stations representing sixteen different watersheds.

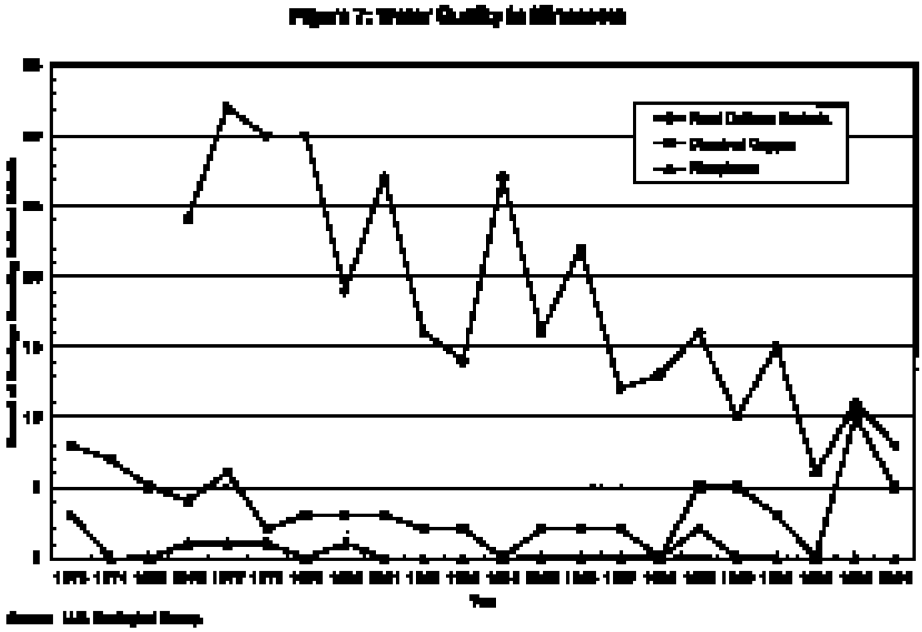
Both the NWQI and NASQAN data have several problems. Meaningful time-series analysis of the data is not possible because of annual changes in the water bodies being assessed, different methodologies and reporting techniques, and incomplete data.[16] For example, aggregating all phosphorus samples taken at NASQAN Minnesota sites generates a low of 36 samples in 1994 and a high of 157 in 1980. In addition, reported data may actually underestimate water quality, since waters where problems are most likely to be found are given priority assessment. The EPA itself notes that "it is likely that unassessed waters are not as polluted as assessed waters."

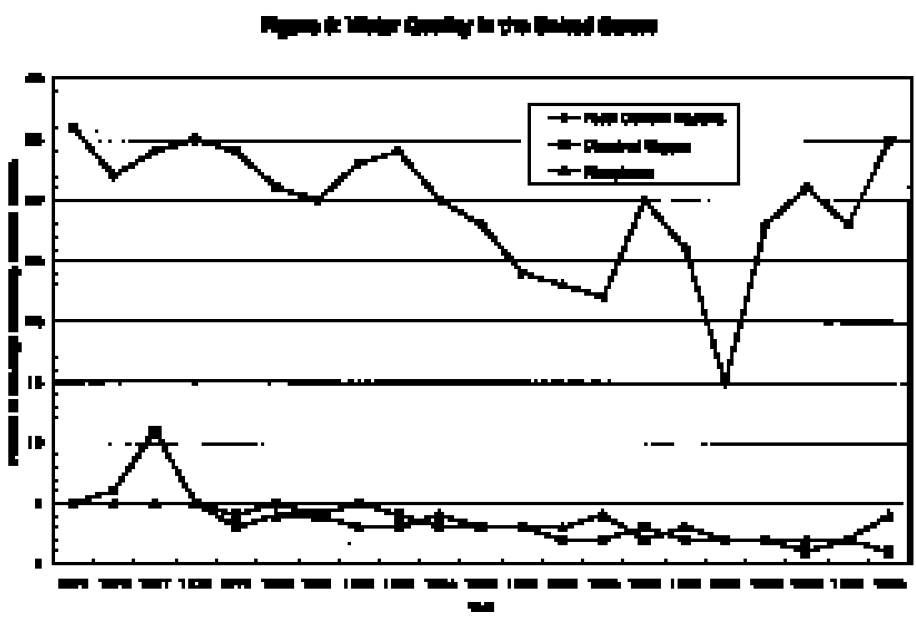
Figures 7 and 8 provide the best available look at water quality trends in Minnesota and the United States, according to the NASQAN data. Sample data are compared to the "violation level" for a pollutant. The violation level—which does not necessarily imply a legal violation—is based on EPA water quality criteria.

The figures show the violation rate—the proportion of all measurements of a specific water pollutant (fecal coliform bacteria, dissolved oxygen, and phosphorus) that exceeds the violation level for that pollutant. The data indicate a decline in fecal coliform violations and success in wastewater treatment. There has not been a significant change in dissolved oxygen or phosphorus violations. Of the 1,733 phosphorus samples taken in Minnesota between 1973 and 1994, only 7 exceeded the 1-milligram per liter (mg/l) national criteria. Similarly, only 50 out of 1,705 dissolved oxygen samples fell below the 5-mg/l national criteria.

Water Quality in Lake Superior

Lake Superior provides tremendous economic and ecological benefits to Minnesota. The lake is exposed to many sources of point and non-point pollu-





tion. Although discharges from wastewater treatment plants have increased as a result of population growth and industrial development, data reveal several encouraging trends in water quality. For example, industrial discharge of phosphorus into the lake decreased 24 percent from 1976 to 1991.

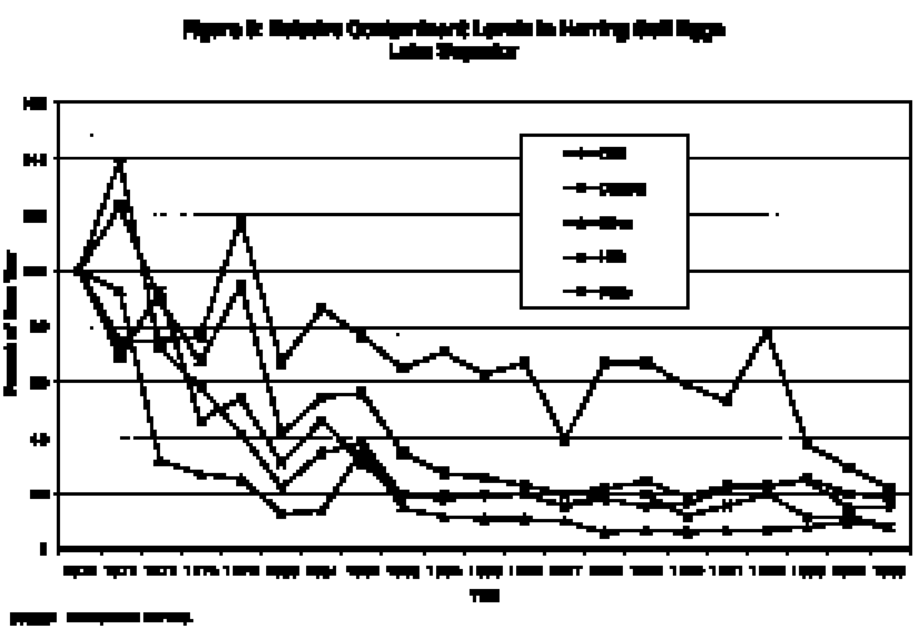
Another important indicator of water quality in Lake Superior is pesticide contamination of bird eggs. The contamination of herring gull eggs fell considerably between 1974 and 1995. Levels of dichloro-diphenyl-ethylene (DDE) fell 85 percent from the 1974 base year level (Figure 9). Available data also indicate a decrease in the already low levels of the pesticides Dieldrin (an 88 percent decrease) and Mirex (a 92 percent decrease) in herring gull eggs. Polychlorinated biphenyls (PCBs) fell 82 percent from the base year level, while the level of hexachloro-benzenes (HCBs) fell 92 percent. These favorable trends can be observed in other Great Lakes as well.

Natural Resources

Forests

North America's forests are the subject of some of the most emotionally charged environmental controversies. The fear that we will run out of trees dates back more than a century in the United States. In his address to Congress in 1905, President Theodore Roosevelt warned that "a timber famine is inevitable," and the New York Times ran headlines in 1908 proclaiming "The End of the Lumber Supply" and "Supply of Wood Nears End: Much Wasted and There's No Substitute."

North America's diverse forest resources include over 130 species of



trees and sustain a variety of plants and animals. Forests provide habitat, purify air, prevent runoff, and inhibit erosion by anchoring topsoil. Forests release water vapor into the air and play a critical role in the carbon cycle by absorbing carbon dioxide, storing the carbon, and releasing the oxygen.

Despite commercial reliance on timber products, only small portions of total forest resources are harvested each year. Roger A. Sedjo in *The True State of the Planet* states, "Although the United States has been the world's number one timber producer since World War II, U.S. forests have experienced an increase in volume in the past 50 years and have maintained roughly the same area over the past 75 years."[17]

Minnesota and the United States consistently harvest less than the amount of annual new growth. Minnesota harvested between 40 and 62 percent of new growth from 1936 to 1988, while the United States harvested 85 percent of the annual new growth in 1952, 68 percent in 1970, and 75 percent in 1991. Federal, state, and local governments control 131.5 million acres of the 489.6 million timber-producing acres—about 27 percent.[18]

For the most part, forestland historically was cleared for agricultural use. Some land, however, was proven unsuitable for farming and has been reverting to forest cover. Reforestation efforts in Maine have increased wooded areas from 74 percent to over 90 percent of the state.[19]

The serious environmental debates surrounding forests and harvesting practices tend to be local in nature; examples of such debates are those about the preservation of old-growth stands and the practice of clear-cutting. Old-growth forests are stands that are over 140 years old, have more than a specified number of trees, and have experienced minimal human disturbance. They have considerable commercial and environmental value. Today's commercial cutting cycle of fifty to eighty years means that once they are harvested, old-growth ecosystems will not be reestablished. Second-growth forests, however, also provide commercial and environmental benefits.

Even forests that have been clear-cut and replanted support diverse wildlife populations and contain trees of various ages, sizes, and species. The beautiful wilderness scenes in the popular movie *The Last of the Mohicans*, for example, were filmed in a formerly clear-cut commercial forest, not a natural forest.[20]

Clear-cutting remains a popular method of harvesting: it is economically viable, and it simplifies reforestation. Clear-cutting allows easy preparation of the site for reestablishment and tending of a new forest, and the open area provides heat and sunlight for new trees. In addition, dead stumps support an extraordinary number of species, including fungi, spiders, beetles, and centipedes. Finally, leaves and branches containing plant nutrients are often left as humus to replenish the soil. When clear-cutting is not done properly, however, it can damage sensitive watersheds and river ecosystems.

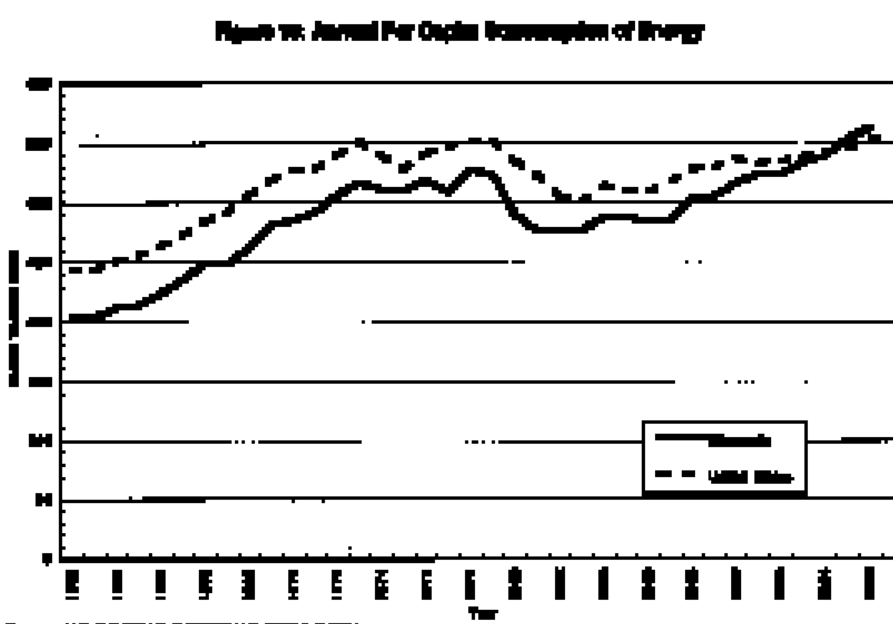
Freshwater

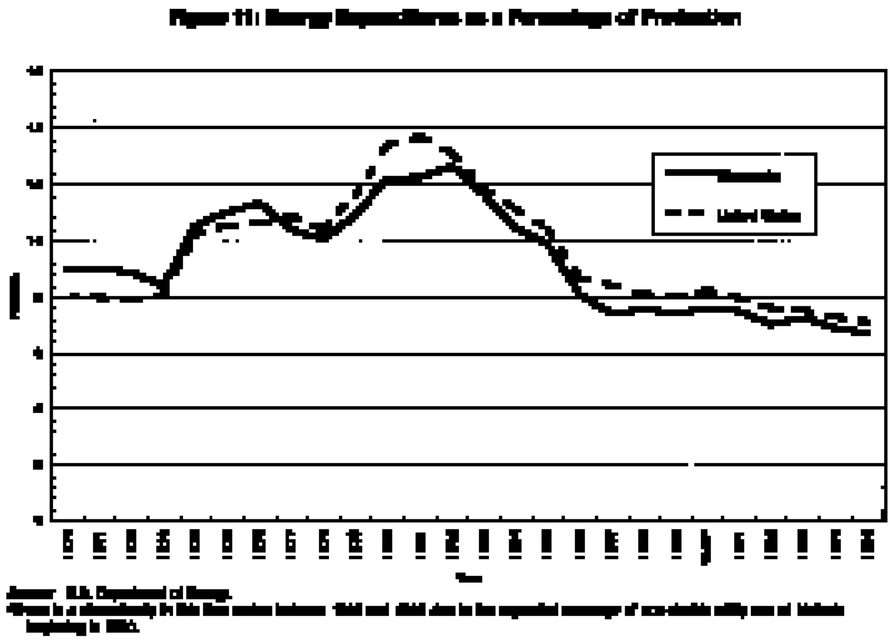
Sources of freshwater include groundwater, lakes, wetlands, streams, and rivers. The cooling of power-generating plants uses a substantial amount of freshwater, accounting for 62 percent of total withdrawals in Minnesota and 39 percent in the United States. Minnesota's total commercial and industrial use of freshwater accounts for 14.9 percent of total water use in 1995, while the public uses 16.9 percent and agriculture accounts for 6.4 percent. In the United States, industry uses of freshwater account for only 5.7 percent of total water use, the public uses 11 percent, and irrigation accounts for 40 percent.

Minnesota freshwater withdrawal data show that total water use increased from 1955 to 1975. From 1975 to 1995, however, freshwater withdrawal decreased 15 percent. Similarly, withdrawal in the United States has decreased from 1975 levels. On a per capita basis, Minnesotans in 1995 consumed only a little more than the amount they consumed in 1960—736 gallons per person per day in 1995 compared to 709 gallons per person per day in 1960.

Energy Resources

Americans use large amounts of energy resources—due to our highly industrialized economy, widely dispersed population, and large landmass—but we use energy efficiently. Today, we use less energy as a percentage of total production than in the past; however, per capita energy consumption is rising in both Minnesota and the United States (Figure 10). An alternative measure of energy use is energy per unit of income (Figure 11), which





reflects how much energy is used for each increment in economic wealth.

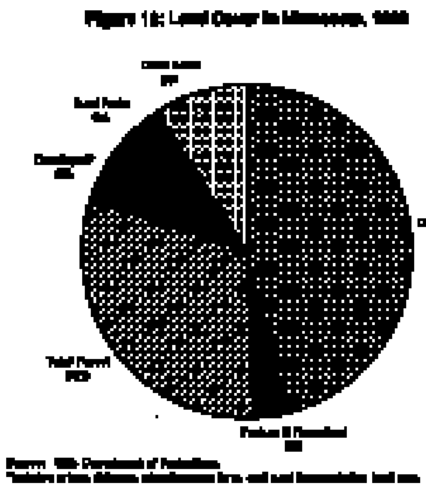
For example, in 1960, about 15 billion Btu—a unit measurement of heat or energy—were used in the United States for every million dollars of gross domestic product. Today we consume less than 12 billion Btu—a 20 percent decrease—for the same increment in economic wealth. The reduction in relative energy consumption reflects improvements in energy efficiency.

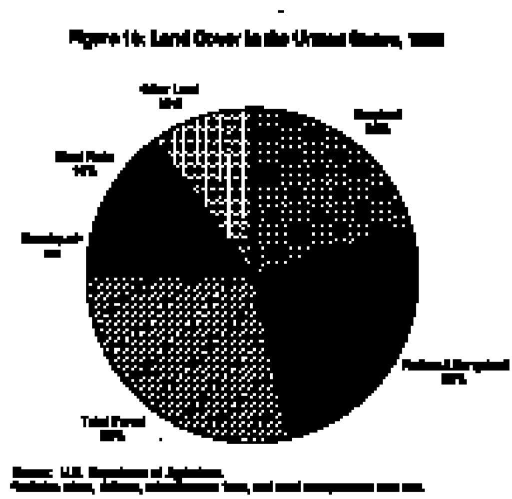
If the world were close to running out of energy, as some believe, one would expect to see a decline in production and an increase in prices in recent years. Instead, the opposite has been true. In the 1970s, the world's oil reserves were estimated at 550 billion barrels, oil prices were rising, and the energy crisis was rippling through the economy. Our so-called profligate habits threatened to end a way of life. By 1990, however, the world had consumed 600 billion barrels of oil (50 billion beyond earlier reserve estimates), the real price of oil had declined, known reserves had climbed to 900 billion barrels, and other sources of energy—natural gas, for example—flourished.

Stephen Moore in The True State of the Planet concludes, "For at least the past one hundred years, virtually every natural resource has experienced declining prices. A drop in price is a market signal of less, not more, scarcity. . . . Human ingenuity has led to the net creation over time of more resources available to us and future generations, not less."[21]

Land Use and Condition

Land cover in Minnesota and the United States is illustrated in Figures 12 and 13. This section discusses





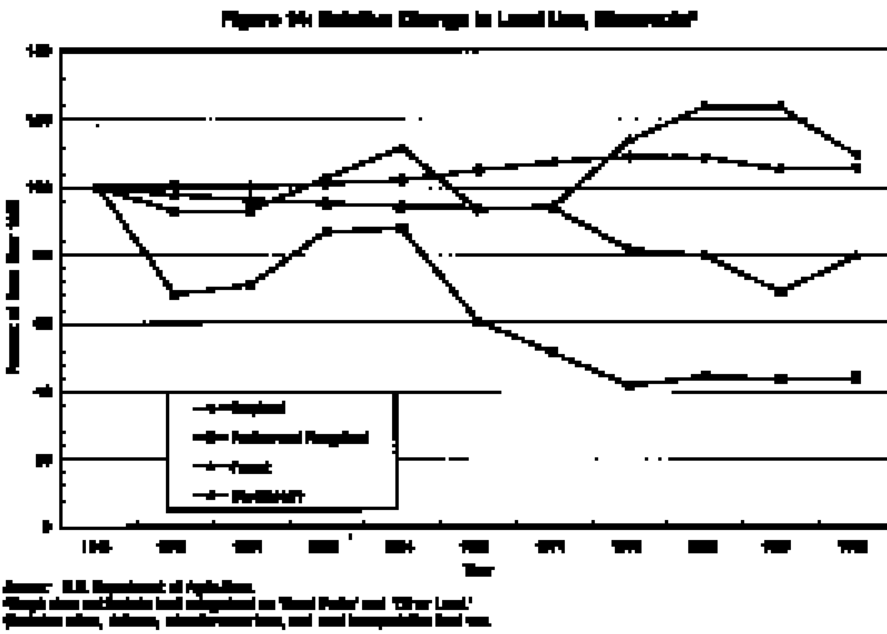
changes in land patterns with specific regard to urban growth and wetlands.

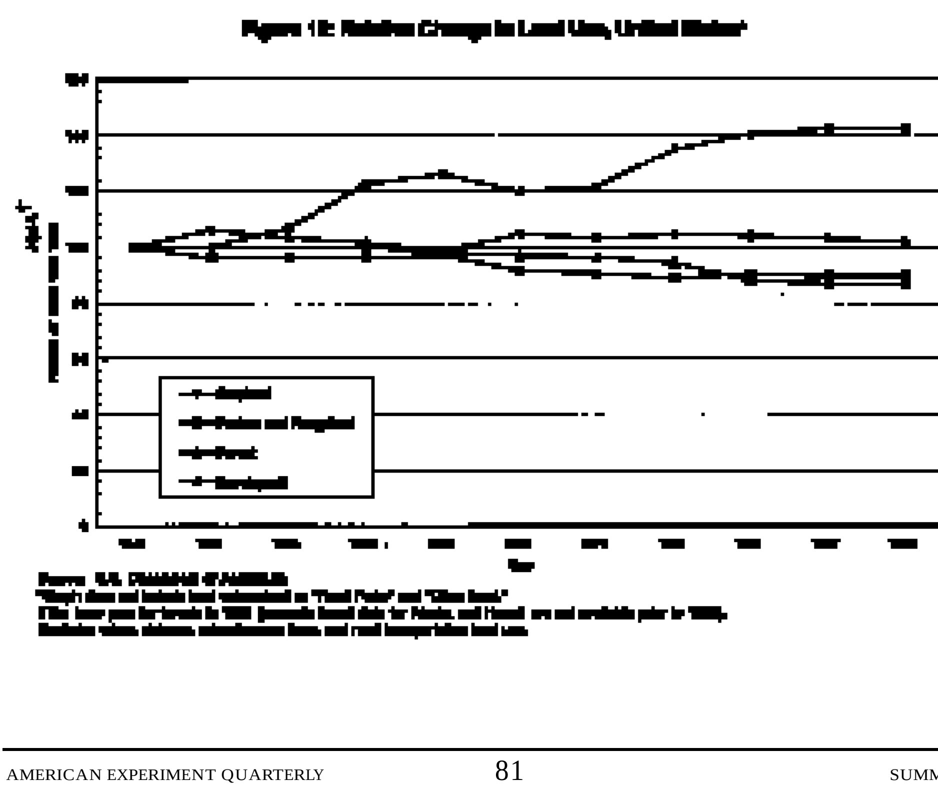
Urban Growth

Urban centers originally were established close to prime agricultural land; as populations increased, urban growth began to encroach onto farmland. Changes in land use for urban, agricultural, and protected areas in Minnesota and the United States occurred between the late 1940s and the mid-1990s (Figures 14 and 15). Urban areas expanded steadily in the United States during the decades following World War II, though the agricultural landbase remained stable. "Urban land"—a component of "Developed" in Figure 12—takes up only 2.3 percent of Minnesota's 51 million acres, and crop and rangelands represent 49 percent of Minnesota's total landmass.[22] In the United States, urban land occupies 2.6 percent of the total 2.3 billion acres. Crop, pasture, and rangelands account for 46 percent of total landmass in the United States.

Despite recent warnings of unfettered and chaotic "urban sprawl," urban growth has had a minimal effect on farming and wilderness areas. Agricultural land bases are many times the size of urban areas, and the changes in farmland acreage shown in Figures 14 and 15 do not reflect the increasing productivity of agricultural land. According to the indices of the U.S. Department of Agriculture, the American agricultural sector was 158 percent more productive at the end of the 1980s than at the beginning of the 1960s.[23] This growth in output far outweighs any threat to farmland posed by incremental urban expansion on farmland.

Similarly, wilderness areas are not in danger of disappearing. In the United States, protected areas have increased since 1959, and they have increased at a





faster rate than urban and agricultural areas. As Samuel R. Staley writes in The Sprawling of America, "Once considered a benign outgrowth of higher incomes and the search for the American Dream—homeownership, a private lot, and a car—suburbanization, or sprawl, has become a lightning rod for government activism. . . . Evidence on suburbanization and low-density development suggests suburbanization does not significantly threaten the quality of life for most people, and land development can be managed more effectively through real-estate markets than comprehensive land-use planning."[24]

Wetlands

Wetlands are land areas—marshes, swamps, and bogs—that are sufficiently saturated with water to promote aquatic processes. Wetlands provide numerous benefits, such as:

- flood control, by temporarily retaining storm water runoff;
- erosion reduction of lakeshores and stream banks;
- water quality enhancement, by capturing suspended particulates, dissolved nutrients, and contaminants such as heavy metals and agricultural pesticides; and
- essential habitat for waterfowl and other wildlife.[25]

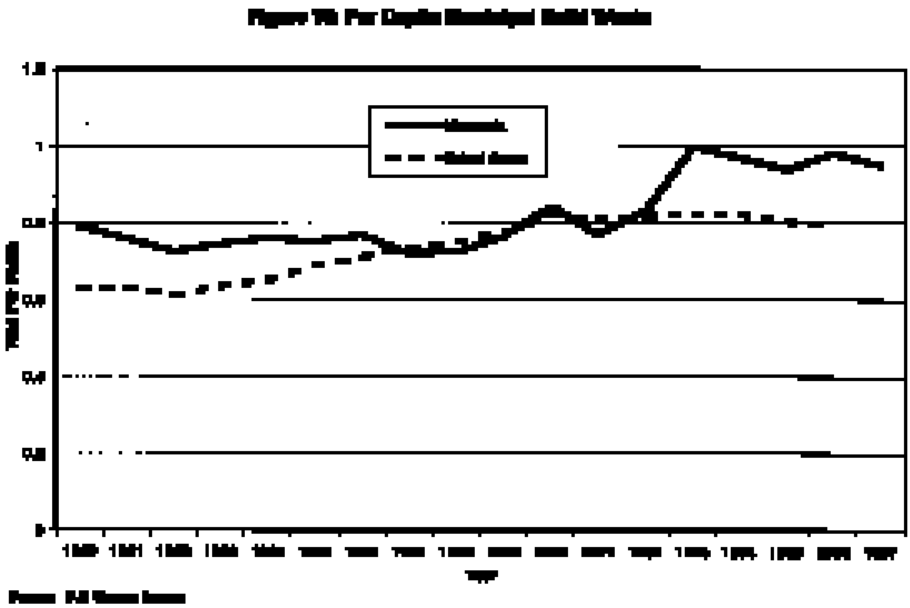
In the past, wetlands were considered waste areas to be redeemed by draining them and converting them to economically productive land. This trend is reversing, however, as recent studies show that wetland loss from agricultural conversion has dropped sharply. Nationally, wetland losses were estimated to be 141,000 acres in 1995, while wetland restorations were estimated to be 210,000, for a net gain of 69,000 acres.[26] Data indicate that less than 0.01 percent of Minnesota's wetlands were lost between 1982 and 1992.[27]

Solid Waste

Solid waste has become a leading environmental issue in recent years. Occasionally, it is even billed as a "crisis" because of the perceived lack of landfill space. Management of solid waste involves decreasing the amount that is generated ("reduce and reuse") and disposed ("recycle and recover").

Landfills

There are several reasons to expect that the generation of solid waste will increase as a country's wealth increases. The most obvious reason is that rising income leads to rising consumption. Overall, municipal waste increased 38 percent in Minnesota between 1980 and 1997, while solid waste generated per capita increased 20 percent over the same period (Figure 16). Between 1980 and 1996, the United States experienced a 47 percent increase in total solid waste generated but only a 26 percent increase in per capita waste. In 1996, Minnesota disposed of 848,000 tons of solid waste in landfill sites; an additional 392,000 tons of Minnesota waste were sent to landfills in Iowa, Wisconsin, North Dakota, and South Dakota.[28]



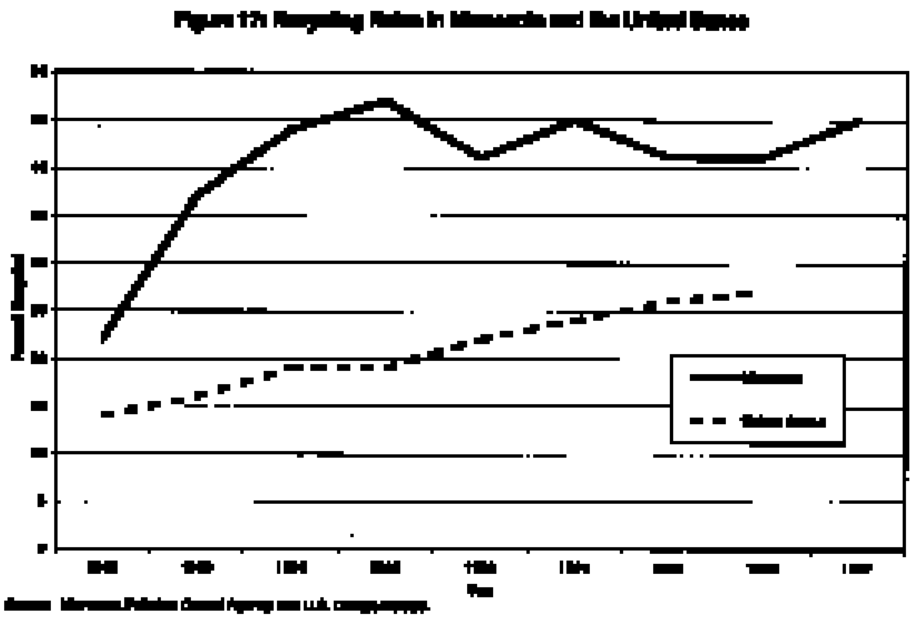
Reliance on landfills has caused fear that space for landfill is running out, but this popular belief is unfounded. Some landfills are close to capacity because they were designed to have a short life span; they are scheduled to reach capacity and close within a few years of opening. All of the solid waste generated in the United States for the next thousand years could be landfilled on less than one-tenth of 1 percent of America's land.[29]

It is not scarcity of land that inhibits the siting of landfills and incinerators but rather political pressure and the high price of land close to urban areas. When a site is chosen for garbage disposal, it becomes unavailable for other uses, and communities worry about odor, dust, litter, and scavenging animals, which traditionally have been associated with landfills in the past. New technology reduces these problems.

Recycling

Concerns about running out of space for landfills have made recycling an increasingly popular alternative to disposal (Figure 17).[30] The debate over recycling is not about whether recycling is good or bad, but about finding the optimal amount of recycling and determining the best way to achieve that amount. While recycling sometimes makes sense both ecologically and economically, it can also be wasteful and counterproductive.

In the 1970s and 1980s, most municipalities began recycling programs. Recycling, composting, and resource recovery all affect the total amount of waste disposed, but recycling is not always economically effi-



cient. In many cases, manufacturing products from recycled materials requires more resources and energy and, ironically, produces more pollution than manufacturing the same products from primary raw materials. For instance, the McDonald's decision to discontinue use of polystyrene hamburger packaging has several unfortunate resource trade-offs. Producing a polystyrene package requires 30 percent less energy than producing the paperboard alternative, which means less air and water pollution.[31]

Secondary Environmental Indicators

"Secondary" indicators provide, at best, indirect information about environmental quality. In some cases, such as carbon dioxide, it is unclear whether the indicator contributes to an environmental problem, such as global warming. In other cases—wildlife, for example—questionable data make it difficult to draw reliable conclusions.

Carbon Dioxide Emissions

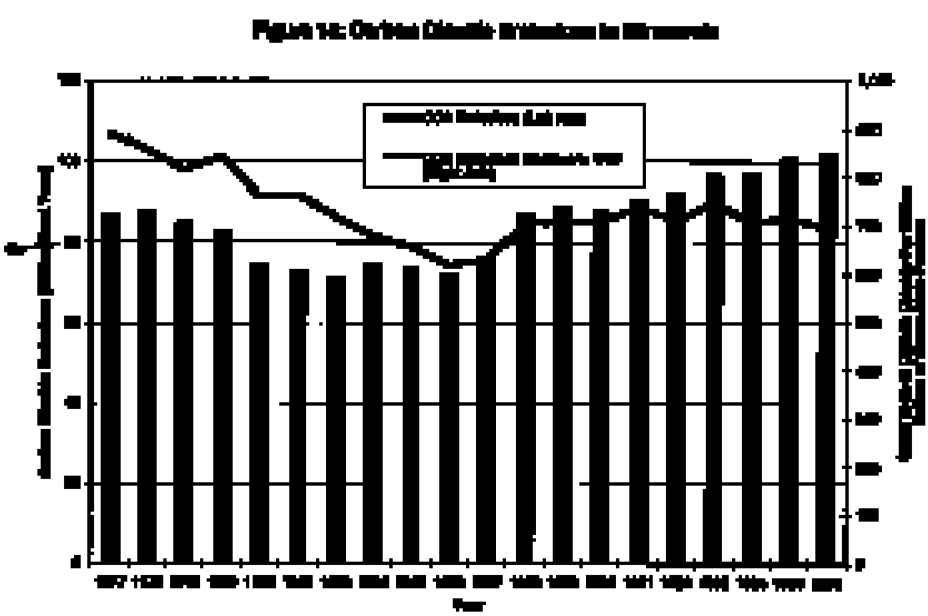
Carbon dioxide (CO_2) is a vital nutrient for plants. Oceans absorb and produce it in great quantities through a complex cycle and store about fifty times more carbon than does the atmosphere. The combustion of fossil fuels by humans also generates CO_2.

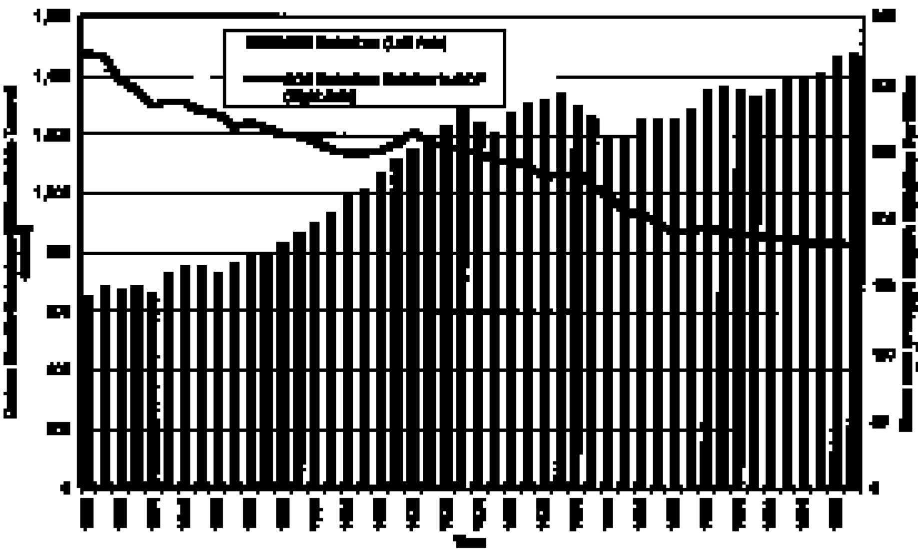
Carbon dioxide is referred to as a "greenhouse gas," and scientists agree that greenhouse gases trap heat from the sun, and this warms the earth. However, there is scientific debate about whether more greenhouse gases in the atmosphere will cause global temperature to increase. That is, there is uncertainty about whether humans, through their contributions of greenhouse gases to the atmosphere, enhance the greenhouse effect that occurs naturally and, thus, contribute to global warming.

In Minnesota, carbon dioxide emissions increased about 18 percent between 1977 and 1996 (Figure 18), while the United States experienced a 12 percent increase over the same period (Figure 19). Moreover, available data for the United States reveal a 130 percent increase in CO_2 emissions between 1950 and 1997. As the economy continues to expand, however, emissions of CO_2 decline for each step in growth. Minnesota emitted 891 short tons of CO_2 in 1977 for every million dollars of gross state product, while today emissions equal only about 694 short tons for the same increment in economic growth. The decline in emissions per unit of growth is even more striking nationally. In 1950 we produced 322 metric tons of CO_2 for every million dollars of gross domestic product, whereas today we emit only about 180 metric tons per million dollars (1 metric ton = 1.205 short tons). Arguably, as our prosperity continues, the relative significance of CO_2 emissions in our economy will diminish.

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 scientific community; there is no proven link between CO_2 and global warming.

Many scientists do not believe human activities threaten to disrupt Earth's climate. More than 16,800 American scientists have signed a petition saying, in part, that "there is no





convincing scientific evidence that human release of carbon dioxide, methane, or other greenhouse gasses is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate."[32] The Oregon Institute of Science and Medicine, an independent research organization that receives no funding from industry, circulated the petition.

Among the signers of the petition are 2,388 physicists, geophysicists, climatologists, meteorologists, and environmental scientists who are especially well qualified to evaluate the effects of CO_2 on Earth's climate. Another 4,963 of the scientists whose fields of specialization are chemistry, biochemistry, biology, and other life sciences also are well qualified to comment on CO_2's effects on plant and animal life.

Of the 16,800 petition signers, 210 are Minnesota residents, and of the Minnesota signers, 60 have Ph.D.'s, and 10 are medical doctors.

In addition, over 100 climate scientists signed, in 1995, the "Leipzig Declaration," which stated in part: "It has become increasingly clear that—contrary to conventional wisdom—there does not exist today a general scientific consensus about the importance of greenhouse warming from rising levels of carbon dioxide. On the contrary, most scientists now accept the fact that actual observations from earth satellites show no climate warming whatsoever."[33]

Explanations of atmospheric temperature change that do not rely on CO_2 emissions 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 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.[34]

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

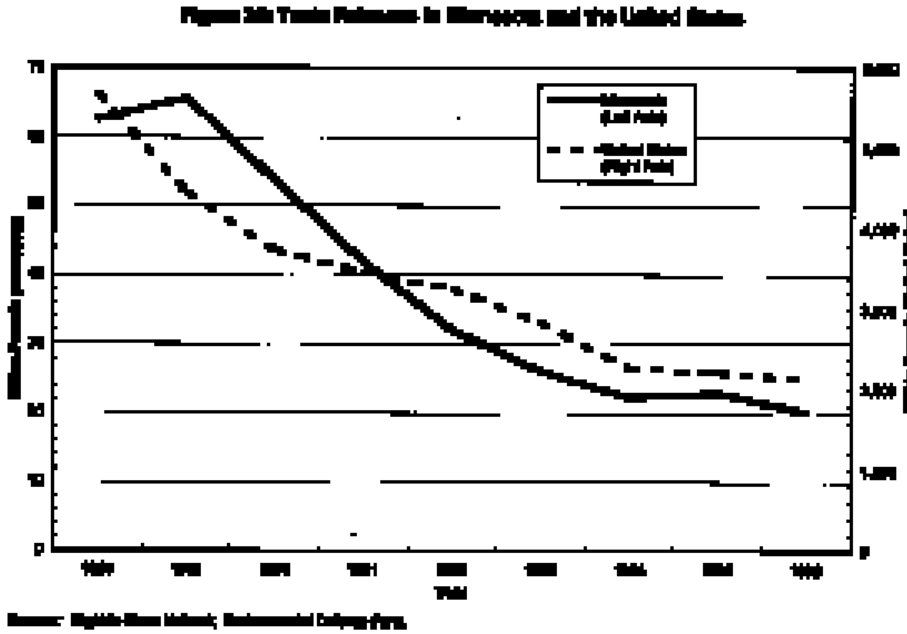
Some argue that we must take drastic regulatory action to control greenhouse gases immediately. Because of the uncertainty and the unanswered questions, however, this is a simplistic approach to policy. In fact, we cannot afford to act until we are reasonably certain that we have a problem. Taking drastic measures to control greenhouse gases will come at the expense of other social objectives.

Toxic Releases

Congress created the Toxic Release Inventory (TRI), which requires industrial facilities to report a broad range of toxic emissions, in 1986 as part of the Emergency Planning and Community Right-to-Know Act. Toxic releases declined 68 percent in Minnesota from 1988 through 1996, and 62 percent in the United States over the same period (Figure 20). Though this trend indicates an improvement in environmental quality, toxic releases are a problematic environmental indicator. Broad definitions apply to toxic wastes, and the TRI does not distinguish between releases that pose environmental problems and those that do not. As the EPA states:

> TRI data alone cannot indicate the risk that chemical releases pose to human health and the environment. . . . A determination of risk depends on many factors, including the toxicity of the chemical, the extent of exposure, the type of release, and the conditions of the environment. For example, small releases of highly toxic chemicals may present a greater risk than large releases of less toxic chemicals.[35]

Further, the TRI definition of "releases" makes no distinction between releases into the environment and instances in which toxic wastes are disposed in well-contained enclosures. For example, though some chemical wastes are stored in secure underground facilities, the TRI program counts these underground disposals as toxic releases. In light of these problems with the data, the decline in releases may be a positive sign of environmental improvement, but the magnitude of this improvement is difficult to measure.



Wildlife

Nationally, the number of wildlife species officially designated by the U.S. Fish and Wildlife Service as threatened or endangered has more than tripled, from 283 in 1980 to 960 in 1995.[36] In Minnesota, the number of endangered species increased 68 percent between 1984 and 1996, while the number of threatened species increased 106 percent over the same period. However, the definitions of "endangered" and "threatened" have changed to include more species over time. Species are listed according to a process established by the 1973 Endangered Species Act. The public originally supported the act because it would protect the bald eagle, the grizzly bear, and other animals. Today, however, much of the listed endangered or threatened designation is for plants.

Using wildlife as an indicator in assessing environmental quality presents many problems. For example, the practice of relating the number of species becoming endangered to the amount of habitat destruction is a hotly disputed topic in the scientific community.[37] In addition, there is uncertainty associated with the classification of species as endangered and with the distinction between a species and a subspecies.[38] Regardless of the answers to these scientific questions, private landowners are being forced to bear almost the entire burden of protecting listed species and habitat. In the United States, "critical" habitat is heavily regulated without compensation for landowners, a practice that has eroded political support for species and habitat protection.

Conclusion

The state of the environment in Minnesota and the United States shows that the overall trend in environmental quality continues to improve. While it is impossible to determine the magnitude of the improvement because of 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. Environmental quality in most areas is getting better, not worse.

Although we observe very clear trends in environmental quality and progress, it is difficult to determine the precise contributions of regulatory programs, economic prosperity, and citizen preferences. We do know that regulatory programs have addressed the low-hanging fruit, and what remains comes at a higher price. We also know that economic growth—which fosters a growing citizen preference for a clean environment and increases the resources available to be used for environmental protection—is the main prerequisite for environmental quality and progress. Consequently, striving for greater environmental quality and progress is an endeavor less about whether to protect the environment and more about how to improve and protect the environment.

Notes

1. Wirthlin Group, Environmentalism: No Letting Up, Wirthlin Report, August/September 1997.

2. The Gallup and Roper Surveys are included in Everett Carll Ladd and Karlyn H. Bowman, Attitudes Toward the Environment: Twenty-five Years after Earth Day (Washington, D.C.: American Enterprise Institute, 1995). Crime, the economy, and education are usually picked as the most important public problems, with 40 to 60 percent being the typical range for respondents naming them as particular problems on open-ended or multiple-choice surveys.

3. Keith Schneider, "New View Calls Environmental Policy Misguided," New York Times, March 21, 1993, p. A1.

4. Gregg Easterbrook, A Moment on the Earth: The Coming Age of Environmental Optimism (New York: Viking, 1995), p. xiii.

5. Ibid.

6. See John M. Antle and Gregg Heidebrink, "Environment and Development: Theory and International Evidence," Economic Development and Cultural Change 43, no. 3 (1995): pp. 603–25; and Gene M. Grossman and Alan B. Krueger, "Economic Growth and the Environment," Quarterly Journal of Economics 110, no. 2 (1995): pp. 353–77.

7. U.S. Environmental Protection Agency Science Advisory Board, Reducing Risk: Setting Priorities and Strategies for Environmental Protection (Washington, D.C.: U.S. Environmental Protection Agency, 1990).

8. Marc Smolonsky, David Dickson, and Elise Caplan, Annual Review of the U.S. Environmental Protection Agency (Washington, D.C.: Center for Resource Economics, 1993).

9. U.S. Environmental Protection Agency, National Air Quality and Emissions Trends Report, 1996, EPA 454/R-97-013, January 1998.

10. National Acid Precipitation Assessment Program, 1989 Annual Report to the President and Congress (Washington, D.C.:

U.S. Government Printing Office, June 1990).

11. U.S. Environmental Protection Agency, National Air Quality and Emissions Trends Report, 1996, EPA 454/R-97-013, January 1998.

12. National Air Quality and Emissions Trends Report, 1997, EPA-454/R-98-016 (Research Triangle Park, N.C.: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, January 1998), pp. 56, 133, 159.

13. A continuous time-series for NO_2 was available only for 1987 to 1997.

14. U.S. Environmental Protection Agency, National Water Quality Inventory 1996 Report to Congress (Washington, D.C.: U.S. Environmental Protection Agency, 1997).

15. U.S. Environmental Protection Agency, "The Quality of Our Nation's Water: 1996" (www.epa.gov/305b/execsum.html).

16. Problems with measuring water quality trends appear to have worsened in recent years. Between 1975 and 1995, NASQAN attempted to provide long-term water quality trends. After 1995, however, a change in the network's focus created a set of data not comparable to previous measurements. In 1996 NASQAN changed its focus from sampling a large representative geographic region to a more intensive sampling of just a few regions. Only 31 stations took samples in 1996, compared to the 1980 high of 513. Hence, from 1996 on, NASQAN data are not representative of long-term water quality trends, leaving the United States without a suitable network to monitor future trends in water quality.

17. Roger A. Sedjo, "Forests: Conflicting Signals," in Ronald Bailey, ed., The True State of the Planet (New York: Free Press, 1995), p. 178.

18. U.S. Bureau of the Census, Statistical Abstract of the United States: 1996, 116th ed. Digital document (www.census.gov/statab/www, tables 362-395, geo.pdf, Section 6, Geography & Environment). Washington, D.C.: U.S. Department of Commerce, 1996.

19. Dixie Lee Ray, Environmental Overkill (Washington, D.C.: Regnery-Gateway, 1993), p. 113; and Sedjo, "Forests: Conflicting Signals," pp. 177–210.

20. Joseph L. Bast, Peter J. Hill, and Richard C. Rue, Eco-Sanity (Lanham, Md.: Madison Books, 1994), p. 24.

21. Stephen Moore, "The Coming Age of Abundance," in Ronald Bailey, ed., The True State of the Planet (New York: Free Press, 1995), p. 111.

22. U.S. Department of Agriculture: usda.mannlib.cornell.edu.

23. U.S. Department of Agriculture, World Agriculture: Trends & Indicators, 1961–91. Digital database, 1994 (gopher://usda.mannlib.cornell.edu).

24. Samuel R. Staley, The Sprawling of America: In Defense of the Dynamic City (Los Angeles: Reason Public Policy Institute, January 1999).

25. U.S. Geological Survey, National Water Summary on Wetland Resources, Water Supply Paper 2425, pp. 237–42.

26. Jonathan Tolman, Swamped: How America Achieved "No Net Loss," Competitive Enterprise Institute, Environmental Studies Program, April 1997, p. 10.

27. U.S. Department of Agriculture, 1992 Natural Resources Inventory (http://www.mn.nrcs.usda.gov).

28. Minnesota Office of Environmental Assistance, Report on 1996 SCORE Programs: 1997 Solid Waste Report. Revised December 1997.

29. Jonathan H. Adler et al., Environmental Briefing Book for Congressional Candidates (Washington, D.C.: Competitive Enterprise Institute, August 1994).

30. Minnesota Office of Environmental Assistance, Report on 1996 SCORE Programs: 1997 Solid Waste Report.

31. Clark A. Wiseman, "Government and Recycling: Are We Promoting Waste?" CATO Journal 12, no. 2 (1992).

32. The petition can be found at http://www.oism.org.

33. The Leipzig Declaration on Global Climate Change, International Symposium on the Greenhouse Controversy, Leipzig, Germany, November 9–10, 1995.

34. Sallie Baliunas and Willie Soon, "Solar Variability and Global Climatic Change," in Laura Jones, ed., Global Warming: The Science and the Politics (Vancouver, B.C.: Fraser Institute, 1997), p. 81.

35. U.S. Environmental Protection Agency, "Executive Summary: 1993 TRI Data Release" (Washington, D.C.: U.S. Environmental Protection Agency, 1995).

36. Environmental Quality: The Twenty-fifth Anniversary Report of the Council on Environmental Quality (Washington, D.C.: Council on Environmental Quality, 1996). www.whitehouse.gov/ceq.

37. Stephen R. Edwards, "Conserving Biodiversity: Resources for Our Future," in Ronald Bailey, ed., The True State of the Planet (New York: Free Press, 1995), pp. 211–65.

38. Easterbrook argues that the number of spotted owls has been badly underestimated, that it does not differ genetically from the spotted owl populations in California, that it thrives in more kinds of habitat than is claimed, and, therefore, that it is not endangered. See Gregg Easterbrook, "The Birds," New Republic, March 28, 1994. n