Chapter 2

National Indicator Initiatives in Canada and the United States

This chapter describes four environmental or sustainable development indicator reports—two for each country—that form the basis for a first attempt to identify national-level environmental indicators that could feasibly be part of a set of candidate indicators for North America. One of the key exercises for this report was to list the indicators and parameters used in each of the reports in a spreadsheet, organizing the list by the DPSIR framework, and identifying the commonly used indicators. The results of this exercise are shown in Appendix 1: Table 2 (see page 122). To provide context for the list, the following section outlines the history of SOE reporting in each country and describes the reports according to the concepts and approaches outlined in the SOE literature described in Chapter 1.

SOE Reporting and Indicator Development in Canada

Canada has been a pioneer in state-of-the-environment reporting and indicator development. As mentioned earlier, Statistics Canada, in collaboration with the UN Statistical Office, helped develop a general framework for environmental statistics in the mid-1970s. This work led to the birth of the PSR framework that has been so widely adopted in SOE reporting worldwide (Berger and Hodge 1998). Environment Canada and Statistics Canada established an ongoing SOE reporting programme in December 1986 and collaborated on the first comprehensive national SOE report. Released the same year, the report was a two-volume document oriented mainly to a scientific audience. Two years later, the 1988 Canadian Environmental Protection Act (CEPA) required that the Government of Canada "provide information to the people of Canada on the state of the Canadian environment." Subsequent comprehensive SOE reports in 1991 and 1996 were intended for a wider, more general readership. The 1991 report had 27 chapters covering human activities, environmental components, regional case studies, and priority issues. The 1996 issue was also voluminous. It reported on the state of ecozones, put strong emphasis on sustainability, and also covered a wide range of issues (Keating 2001; NIRO 2003b).

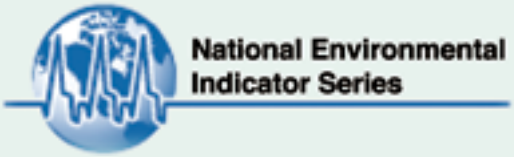
During this time, Environment Canada continued to be seen as a world leader in SOE reporting and was gaining expertise in developing environmental indicators. Canada's 1990 Green Plan had committed the government to producing a preliminary national set of environmental indicators. Environment Canada established an Indicators Task Force to identify criteria and a framework for selecting and developing national-level indicators, to survey key opinion leaders and potential users, and to define qualities with which to select indicators. Survey results showed the need for clearly communicated, flexible indicators that reveal issues of importance and that trigger action. The Task Force developed an integrated indicators system for Canada and in 1991 published *A Report on Canada's Progress Towards a National Set of Environmental Indicators*, which presented 43 preliminary indicators in 18 issue areas. These formed the basis for ongoing multi-stakeholder indicator development, and over the following 10 years, Environment Canada further developed and updated them and began the periodic release of a series of short summary indicator reports (Keating 2001; Lealess 2002; EC 2003a; UN DESA 2003a; NIRO 2003b).

Another attempt to develop a national-level set of indicators was initiated by the Canadian Council of Ministers of the Environment (CCME). In 1990, it established a State of the Environment (SOE) Reporting Task Group. Among its projects were the development of guidelines for SOE reporting and a common set of environmental indicators, but neither was adopted and the Task Group disbanded in early 1997 (NIRO 2003a).

In 1996, the SOE Directorate closed. A small Indicators and Assessment Office was retained, which continued to produce regular, concise indicator bulletins and reports on specific issues rather than the traditional large and comprehensive reports published at five-year intervals (Keating 2001; NIRO 2003b). Regular reporting through the National Environmental Indicator Series has been ongoing since 1992. In addition, during 1998–2002, seven federal SOE reports featured the federal SOE reporting symbol (see Box 14) and were placed on the online SOE Infobase (http://www.ec.gc.ca/soer-ree/English/SOER/default.cfm).

Box 14: Criteria for Canadian SOE reports

This symbol may be displayed on reports meeting specific criteria for Canada's 5NR Vision, which are thus considered part of the federal SOE Reporting Program. Reports that display the SOE reporting symbol:



- are recognized as part of a collection of federal publications that meet the SOE reporting criteria and use the widely understood SOE reporting approach;
- reach a diverse audience of people interested in the status of key environmental issues—decision-makers, educators and students, and the general public;
- are accessible through links at "The State of Canada's Environment Infobase" (www.ec.gc.ca/soer-ree/english/default.cfm), which provides an up-to-date listing of federal SOE reports and science assessments; and
- are included in the promotion of federal SOE reporting.

Source: EC 1997.

These include a short 2001 report titled *Tracking Key Environmental Issues,* illustrating the state of environmental knowledge in Canada as well as the state of the environment (EC 2001).

In 1997, Canada adopted a vision for federal state-of-the-environment reporting (called the 5NR Vision), which was developed by Canada's five natural resource departments (responsible for Environment, Agriculture and Agri-Food, Fisheries and Oceans, Health, and Natural Resources). It stipulates that each federal lead agency is responsible for preparing and producing its own SOE reports. The 5NR Vision promotes the use of SOE reporting criteria in designing policy-driven, science-based assessments (Box 14). The main components of the 5NR Vision are environmental monitoring, environmental indicators using a PSR framework, science-based assessments, reporting on critical and emerging issues, an SOE Infobase, and an Internet web site for federal SOE reports (NIRO 2003b).

Statistics Canada has also played a leading role in SOE reporting since the late 1970s, producing the *Human Activity and the Environment* series about every five years. Today, it is a smaller publication, released annually. Through the presentation and analysis of relevant statistics, it explores the relationships between population, socioeconomic activities, and the country's natural systems (air, water, soil, plants, and animals). The agency also produced *Econnections* (now discontinued), which adopted a natural-capital approach using indicators that link the environment and the economy and track progress towards environmental sustainability. It organized sets of indicators along the themes of natural resource stocks, use of land resources, consumption of materials and energy, waste production, and environmental protection expenditures (Keating 2001; NIRO 2003a; NIRO 2003b).

Developing and reporting on a national set of environmental indicators is conducted under the state-of-the-environment reporting program of the National Indicators and Reporting Office, of Environment Canada's Knowledge Integration Directorate. Apart from the indicator work by national SOE initiatives, environmental indicators are being developed and used at many other levels of government, from provincial to municipal, as well as by other bodies interested in improving their environmental performance. Thus, the process of identifying and developing indicators in and for Canada has been evolving ever since the late-1980s.

In September 2004, the Conference Board of Canada, a not-for-profit, non-governmental organization, paid particular attention to the environment in its annual publication, *Performance and Potential*. The publication benchmarks Canada's performance against that of 23 other OECD countries, using 24 environmental indicators organized according to the PSR model. In previous years, the Conference Board's analysis focussed mainly on present actions and gave brief consideration to past damage or future actions that may lessen human impact on the environment. Use of the PSR framework in the 2004 report improved Canada's relative ranking (Conference Board of Canada 2004).

Environment Canada is now developing a strategy to provide more cohesion in its own SOE work and to address the challenge of bringing together many of these indicator initiatives to contribute to an integrated picture of the state of the nation's environment (NIRO 2003a). The strategy will respond to OECD's 2004 recommendation that

Box 15: Indicator profiles in *Environmental Signals*

- Biodiversity and protected areas
- Toxic substances
- Acid rain
- Climate change
- Stratospheric ozone
- Municipal water use
- Municipal wastewater treatment
- Urban air quality
- Forestry
- Agricultural soils
- Energy consumption
- Passenger transportation
- Municipal solid waste

Source: Adapted from EC 2003a.

Canada expand its information efforts in the area of environmental indicators (OECD 2004a). To assist the strategy and in an effort to fill a gap in information about what indicators have been developed by different indicator initiatives, the National Indicators and Reporting Office is preparing an environmental indicators database (EID). It contains information on existing, preliminary, and proposed environmental indicators, organizing them into the following fields: category, organization, initiative, scope, issue, sub-issue, stage of development, name of indicator, and message (NIRO 2003b).

Two National Indicator Reports for Canada

Environment Canada's Environmental Signals series

On 2 April 2003, Environment Canada released *Environmental Signals: Canada's National Environmental Indicators Series* report, presenting its current national set of environmental indicators. It provides a picture of the state of the nation's environment and measures its performance in improving environmental conditions.

Conceptual and organizational framework

Indicator development at Environment Canada's Indicators and Reporting Office and in the Environmental Signals report is organized under four themes. The first three represent principal goals for environmental sustainability: assuring ecosystem integrity, human health and well-being, and natural resource sustainability. The fourth theme represents driving forces—termed "pervasive influencing factors"—identified as population, lifestyle, and consumption patterns. Issues are grouped under these four themes. Indicator development and reporting is based on a "stress-condition-response" model similar to the PSR approach. Each issue section contains a metered indicator, reflecting a trend over time for the indicator that best summarizes the issue. The meter shows whether the issue represented by the indicator is deteriorating, remaining stable, or improving, and to what extent. The reference section provides the method for calculating the meter, which is explained in more detail in the technical supplements. The meter calculations are generally based on percentage change over the past decade. Figure 19 shows an example (EC 2003a).

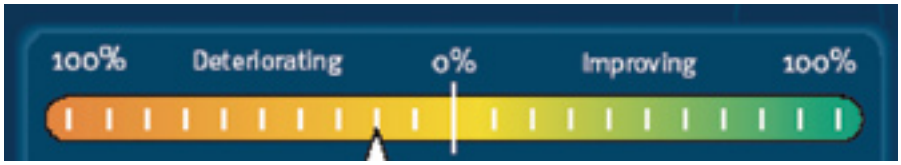
Selection process

The current key environmental issues were selected based on a series of consultations with specialists and other stakeholders; analysis of environmental stories in journals, the media, and opinion polls; and assessment of global and national concerns, Canada's Green Plan priorities, and Department of the Environment priorities. The issues were selected according to criteria that include the following: sensitive to change; supported by reliable, readily available data; understood and accepted by intended users; and of long-standing importance (EC 2004c).

Products and contents

Environmental Signals is a 78-page document, with four major chapters, organized according to the themes described above. It includes a summary at the beginning that highlights the salient indicators showing improvement or decline. The report covers 55 environmental indicators for 13 key environmental issues (Box 15). Within each theme, the report is organized under five headings: the "Context" section is a discussion about what is happening and why it is important; an "Indicators" part presents the main message as illustrated by the indicators; "Actions" discusses what the Government of Canada is doing to address the issue; "Linkages"

Figure 19: Environment Canada's meter



Source: EC 2003a

Meter Calculation

Percent change in greenhouse gas emissions between 1990 and 2000

points to other indicators relevant to the theme; and "Challenges" underscores ongoing difficulties.

A brief section looks at national and international actions dealing with each issue and a final section suggests individual actions for more sustainable living and outlines future work towards indicator development in Canada. A technical supplement presents profiles of each indicator, which include: purpose and rationale, methodology, caveats and limitations, targets and/or benchmarks, geographic coverage, units of measure, terminology/glossary, and web sites and/or references, as well as downloadable data tables including sources and metadata (EC 2003a; NIRO 2003a).

The main report was accompanied by *Environmental Signals: Headline Indicators*, a succinct overview for a more general audience. It contains a set of 12 key indicators that provide a series of snapshots with the goal of raising public awareness about progress towards environmental sustainability rather than providing a comprehensive view of the state of Canada's environment. The reports are available at the following web site: http://www.ec.gc.ca/soer-ree/English/Indicator_series/default.cfm.

Ongoing work

The development and presentation of Environment Canada's indicators is an evolving process. In addition to developing indicators that track trends in environmental issues, Environment Canada is increasingly working on showing the links among environmental, economic, and social change. Ecological monitoring efforts will eventually provide indicators on the state of ecosystems in addition to their component parts. The national set will incorporate the resulting ecosystem indicators (EC 2004c).

Environment Canada has also proposed the development of a core set of indicators—a single, recognizable set using the soundest approaches from all jurisdictions. The series supports and complements the work of Canada's National Round Table on the Environment and the Economy (NRTEE), which is also developing a core set of national indicators, as described below (NIRO 2003a).

The National Round Table on the Environment and the Economy's Environment and Sustainable Development Indicators for Canada

In its federal budget of February 2000, the Government of Canada requested that the National Round Table on the Environment and the Economy (NRTEE) prepare a recommendation for a small set of indicators linking the economy and the environment. NRTEE was established to identify and explore issues that have both environmental and economic implications and to propose actions that will help balance economic prosperity with environmental preservation. The indicators are meant to supplement and provide context for macroeconomic indicators such as the GDP. NRTEE worked closely with Environment Canada and Statistics Canada to develop realistic and useable environment and sustainable development indicators and released its report in May 2003. The report includes the recommendation that Canada use an expanded System of National Accounts and that the government support the implementation of an information system for the environment to supply "comprehensive, coherent, current and authoritative data". NRTEE does not recommend policy issues oriented to improving environmental performance as a result of needs revealed by the indicators (NRTEE 2003).

Box 16: NRTEE's proposed environmental indicators

- Air quality: population exposure to ground-level ozone
- Freshwater quality: proportion of water bodies, classified according to major objectives
- Greenhouse gas emissions: trends in aggregate emissions
- Extent of forests: map of forest crown closure
- Extent of wetlands: trends in total area

Source: Adapted from NRTEE 2003.

Conceptual and organizational frameworks

NRTEE adopted the capital model as the basis for developing a set of national indicators of economic sustainability. It focuses on tracking trends related to Canada's key capital stocks (produced, natural, and human), which requires expanding the notion of capital to include basic ecosystem services such as the provision of clean air, water, and a stable climate. According to its mandate, NRTEE's focus is on the long-term sustainability of Canada's development, so although the indicators deal mainly with the environment, they also attempt to track stocks of produced, social, and human capital.

Selection process

NRTEE set up the Environment and Sustainable Development Indicators (ESDI) Initiative, which conducted a three-year multi-stakeholder process to develop a small core set of credible and understandable indicators that could measure the environmental and social sustainability of economic activity.

It was guided by a steering committee comprising representatives from other indicator initiatives, especially from Environment Canada and Statistics Canada, and from the business, labour, government, community, NGO, academic, and research sectors of society. Criteria for selection included the need for clear, transparent, unambiguous, and scientifically credible indicators. The selection process included the participation of potential audiences and users.

Products and contents

The first part of the 76-page report describes the context for NRTEE's recommendations and describes the capital model. It then presents five indicators linked to different types of environmental capital assets that provide important ecosystem services: air quality, freshwater quality, greenhouse gas emissions, forest cover, and the extent of wetlands (Box 16). A sixth indicator relates to human capital and reports on educational attainment. The following section of the report provides the rationale for the development of each of the proposed indicators, describes them, and, where and to the extent possible, calculates and presents the indicator. Not all of NRTEE's proposed indicators are fully developed yet. It also outlines future efforts in producing and improving each indicator (NRTEE 2003). The report is available at the following web site: http://www.nrtee-trnee.ca/eng/programs/Current_Programs/SDIndicators/ESDI-Report/ESDI-Report_IntroPage_E.htm.

Ongoing work

Five of the six recommended indicators were calculated for the first report. Many are still in a preliminary form and NRTEE acknowledges that it will require years of effort to comprehensively extend the SNA and provide a robust set of data for all types of capital. Additional indicators will emerge over time. The intention is also to develop an aggregate measure of capital that can be feasibly converted to monetary values. In the short term, Statistics Canada and Environment Canada will collaborate on reporting the air, water, and climate change indicators. The federal government has declared that it would begin to incorporate key indicators on clean water and air and on emissions reductions into its decision-making (NRTEE 2003; SRP 2004).

SOE Reporting and Indicator Development in the United States

Until recently, the United States had not produced comprehensive SOE or indicator reports on the state of the nation's environment. The National Environmental Policy Act of 1969, however, mandated the President to deliver an annual

Typical deciduous forestland habitat.

Paul Fusco/UNEP/NRCS

Environmental Quality Report to Congress on the effects of federal activities on the environment. The Council on Environmental Quality (CEQ) was established and reporting began in 1970; it continued until 1997 (US CEQ 1997; Parris 2000). These reports provided information through indicators and descriptive text on environmental media, ecosystems and biodiversity, energy and transportation, and pollution prevention, among other themes. They included extensive appendices of data tables on environmental trends. Despite the lack of formal SOE reports, the Environmental Protection Agency (EPA) has always made data easily available and accessible for use and interpretation by users. A number of environmental NGOs use these data to support environmental indicators they have developed to inform the public about specific issues. For example, using publicly available data, the Natural Resources Defense Council (NRDC) publishes an annual report on the water quality of the nation's vacation beaches (Dorfman 2004).

Over the years, EPA began to develop environmental indicators, as did various other federal agencies such as the Department of Agriculture, the Fish and Wildlife Service, and the National Oceanic and Atmospheric Administration. More recently, some private companies and corporations have been trying to measure and improve their environmental performance with indicators and to put forth a "greener" image (CGER 2000). For example, a growing number of US corporations are using the Global Reporting Initiative guidelines for developing annual reports about their efforts towards achieving environmental as well as social and economic sustainability. As in Canada, other levels of government, from states to municipalities, also report on the state of the environment in their jurisdictions (ISIN 2002; US GAO 2004).

The Interagency Working Group on Sustainable Development Indicators (SDI Group) is a recent initiative that developed a set of national sustainable development indicators, including environmental indicators. It was set up in response to recommendations by the President's Council on Sustainable Development (PCSD) in a 1996 document called *Sustainable America: A New Consensus for Prosperity, Opportunity, and a Healthy Environment for the Future* (PCSD 1996). It called for a collaborative effort among the federal government and the NGO and private sectors to develop national indicators and report regularly to the public (IISD 2004a). The SDI Group includes representatives from the departments of Interior, Agriculture, and Commerce, and from the EPA. It completed its report, *Sustainable Development in the United States, an Experimental Set of Indicators,* in December 1998 (US IWG 2001). This was a study of over 40 experimental social, economic, and environmental indicators to guide the development of national sustainable development policies and to structure a long-term framework towards that goal by presenting measures of whether economic, environmental, and social endowments are diminishing or improving. In 2001, the SDI Group revised and updated the first report in preparation for the World Summit on Sustainable Development in September 2002 (ISIN 2002; UN DESA 2002).

At the end of 2002, the Council on Environmental Quality (CEQ) began a new initiative to enhance coordination among federal agencies and to develop policy guidelines for future environmental and sustainable development indicators. In part, the new orientation responds to a consensus on the need to gauge the success of environmental policy by outcomes rather than by the amount of money or number of laws and regulations devoted to environmental issues (US GAO 2004). The initiative resulted in the establishment of the Interagency Working Group on Indicator Coordination. The goal is to produce interlocking sets of environmental and human health indicators with which to inform decisions at all levels of government. The Council plans to catalyze agreement on a set of national-level environmental indicators that can be linked to regional and local conditions and to better organize statistical reporting and data collection. The Working Group, however, had no explicit responsibility or authority to catalyze involvement and resources from other federal agencies. In late 2004, the United States Government Accountability Office (GAO) stressed the need for

Runoff from this livestock yard may enter a nearby stream and degrade the water quality. *Tim McCabe/UNEP/NRCS*

Box 17: Indicator profiles in the EPA draft report

- Outdoor air quality
- Indoor air quality
- Waters and watersheds
- Drinking water
- Recreation in and on the water
- Consumption of fish and shellfish
- Land use
- Chemicals in the landscape
- Waste and contaminated lands
- Environmental pollution and disease
- Exposure to environmental pollution
- Landscape conditions
- Biotic condition
- Chemical and physical characteristics
- Ecological processes
- Hydrology and geomorphology
- Natural disturbance regimes

Source: Adapted from US EPA 2003.

the CEQ to work on a more concerted, systematic, and stable approach to the development, coordination, and integration of environmental indicator sets (GAO 2004). The CEQ will work in concert with the EPA on a long-term strategy for environmental indicators. The strategy will build on EPA's *Draft Report on the Environment*, released in 2003 as the result of its two-year process of identifying and developing national environmental indicators. The work began in 2001, with the establishment of EPA's Environmental Indicators Initiative, managed by EPA's Office of Information and Office of Research and Development (GAO 2004). In 2003, The Heinz Center, a private research body, published a comprehensive report on ecological indicators for the nation. These two reports are described below.

Two National Indicator Reports for the United States

The US Environmental Protection Agency's Draft Report on the Environment

In November 2001, the EPA launched its Environmental Indicators Initiative, with the goal of developing indicators that would enable the United States to measure and track the state of the nation's environment and support improved environmental decision making. The Indicators Initiative also identifies where additional research, data quality improvements, and information are needed. The initiative aims to be consistent with the EPA Science Advisory Board, National Research Council, and the Heinz Center indicator efforts. The *Draft Report on the Environment 2003* and the accompanying technical document were released in June 2003 (US EPA 2003).

Conceptual and organizational framework

The report's two key purposes are to describe EPA's state of knowledge about the current and changing state of the environment at a national level, and to identify and improve measures to track environmental conditions and trends. It uses a modified PSR framework, comprising a "hierarchy of indicators". It reports on those indicators that illustrate changes in the quantity of pressures or stressors; ambient conditions; exposure or body burden or uptake; and the ultimate impacts reflected by changes in human health or ecological condition. The framework does not include driving forces or responses, with the indicators focusing on outcomes rather than actions taken.

Selection process

A steering committee comprised of EPA officials guided the process, and other federal agencies and tribal and state governments assisted in reviewing drafts. EPA held a series of thematic workshops at which a series of questions about the state of environmental resources and services was formulated, focusing on outcomes. A multi-stakeholder process led to a set of recommended indicators responding to the questions, and then corresponding data sources from many federal agencies were documented. Expert reviewers evaluated the indicators guided by criteria related to data quality, scientific reliability, utility, and limitations (US EPA 2003).

Products and contents

EPA's *Draft Report on the Environment 2003* (ROE), intended for general consumption, is accompanied by a technical document. The main report has an executive summary. The first three of the report's five chapters deal with the current state of air, water, and land and the pressures that affect them. The last two chapters present indicators on human health and ecological conditions (Box 17). Each chapter addresses the issues through a series of questions and answers about what is happening, why it is happening, and what the effects are. They correspond to the framework outlined above (what are the pressures or stressors, ambient

Pawnee Buttes on Pawnee Grasslands, USA. *Gary Kramer/UNEP/NRCS*

conditions, exposure or body burden or uptake, and the ultimate impacts?) Each chapter includes a section on the indicators' limitations. Data from the work of the Heinz Center contributed to some of the indicators in this report. The *Draft Technical Document* discusses the limitations of the currently available indicators and data, as well as the gaps and challenges that must be overcome to provide better answers in the future. It also specifies that there are two categories of indicators, according to the level of adherence to a number of criteria, and it provides additional indicators to illustrate many of the trends noted in the text of the draft report (US EPA 2003). The reports are available at the following web site: http://www.epa.gov/indicators.

Ongoing work

In the report, EPA solicits suggestions and feedback from readers about the draft, future directions for its Environmental Indicators Initiative, how to measure results, and how to communicate effectively. The report represents the first step in a longer-term project to create a strategy for developing an integrated system of indicators at local, regional, and national levels. The long-term goal is to improve the indicators and data that guide EPA's strategic plans, priorities, performance reports, and decision making (US EPA 2003). The next report is scheduled for release in the summer of 2006. It will include a set of regional indicators, and work is underway to link the new report to the agency's strategic planning effort (US GAO 2004).

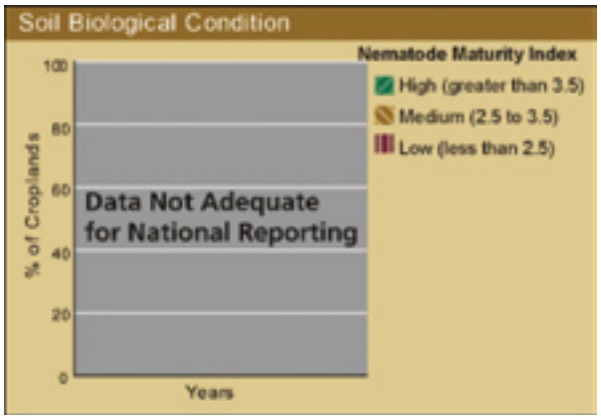
The Heinz Center's The State of the Nation's Ecosystems: Measuring the Lands, Waters, and Living Resources of the United States

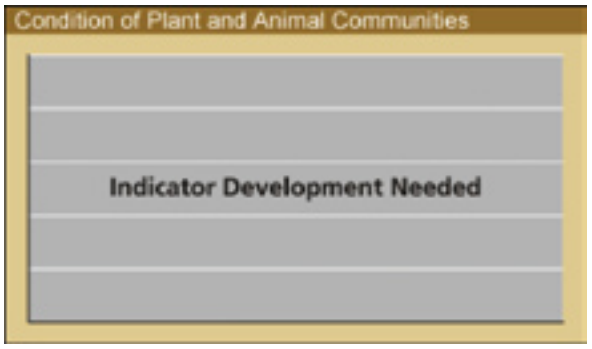
In 1995, the White House Office of Science and Technology Policy asked the H. John Heinz III Center for Science, Economics, and the Environment to compile existing data to help assess the health of the nation's ecosystems. The Heinz Center is a non- governmental organization established in December 1995 as a nonprofit, nonpartisan institution dedicated to improving the scientific and economic foundations for environmental policy through multisectoral collaboration. *The State of the Nation's Ecosystems: Measuring the Lands, Waters, and Living Resources of the United States* was published in 2002 (Heinz Center 2002). It was preceded by a preliminary study in 1999 entitled *Designing a Report on the State of the Nation's Ecosystems: Selected Measures for Farmlands, Forests, and Coasts and Oceans* (Clark, Jorling, and others 1999). The report provides policy-makers and the public with a set of key indicators on the condition and use of ecosystems in the United States, with the goal that the indicators serve as a catalyst for debate about the nation's environmental policy (Dudley 2003; O'Malley, Cavender-Bares, and Clark 2004).

Conceptual and organizational framework

The report uses the biogeophysical approach and focuses on six major ecosystem types rather than on the whole gamut of environmental systems and on the state of those ecosystems, leaving aside the pressure and response categories used in the PSR

Figure 20: Indicators showing critical gaps





Source: Heinz Center 2002, 102 and 54.

framework. It also identifies core national indicators that provide a highly aggregated view of overall conditions. Measures of ecosystem properties and ecosystem services help to evaluate each ecosystem type and the country as a whole. Ten major characteristics of ecosystem condition are used: extent; fragmentation and landscape pattern; nutrients/carbon/oxygen; chemical contaminants; physical conditions; plants and animals; biological communities; ecological productivity; food/fibre/water; and recreation and other services. The approach presents base-line spatial or productivity indicators and indices and uses about 15 indicators of specific ecosystem conditions for each major ecosystem type. It identifies critical gaps in data and monitoring programmes and indicators that have yet to be developed, rather than only using indicators for which data are already available. It presents these indicators in the issue profiles, with a view to filling in the data as they become available. Figure 20 provides an example of an indicator for which the data are still inadequate for national reporting and an indicator that has not yet been developed (Heinz Center 2002; Dudley 2003; O'Malley, Cavender-Bares, and Clark 2004).

Box 18: The Heinz Center's core national indicators

- Ecosystem extent
- Fragmentation and landscape pattern
- Movement of nitrogen
- Chemical contaminants
- At-risk native species
- Condition of plant and animal communities
- Plant growth index
- Production of food and fiber and water withdrawals
- Outdoor recreation
- Natural ecosystem services

Source: Adapted from Heinz Center 2002.

Selection process

The indicators were selected through consultations and discussions among a large number (nearly 150) and variety of experts and stakeholders who were part of several committees and working groups. Participants represented the business, environmental, academic, and government sectors. Indicator selection was based on three key standards: policy relevance, technical credibility, and political legitimacy (nonpartisan). Three criteria were used to review the data for the selected indicators: scientific credibility; adequate geographic coverage to represent the nation; and collected through an established and durable monitoring programme. The report's content was steered by a number of other guidelines: the report should be strategic, not encyclopaedic, with 18 or fewer indicators per ecosystem; it should first determine what should be reported, regardless of the availability of data; it should be understandable to non-specialists; it should include information on both the condition of ecosystems and the goods and services that people derive from them; and it should focus solely on the ecosystem's state and condition (O'Malley, Cavender-Bares, and Clark 2004; US GAO 2004).

Products and contents

Both a full 270-page report and a short, 24-page summary and highlights edition were published in 2002. The first part of the main report sets out the intent, structure, and overall focus. Part 2 summarizes the findings through the use of ten core national indicators that cut across six ecosystems (Box 18). The following chapters present the indicators that describe the state of each ecosystem: coasts and oceans, farmlands, forests, fresh waters, grasslands and shrublands, and urban and suburban areas. For each of the 103 indicators, the text answers the questions: What is this indicator and why is it

important? What do the data show? and Why can't this entire indicator be reported at this time? Part 3 is an appendix. It outlines data availability and gaps and the criteria used to select the indicator for inclusion. It also contains a technical notes section that provides definitions, metadata, and references. The first annual update was released on the organization's web site in 2003. It includes new data for 26 indicators and first-time data for one indicator for which no data were previously available (Heinz Center 2002; Heinz Center 2003; O'Malley, Cavender-Bares, and Clark 2004). The reports are available at the following web site: http://www.heinzctr.org/ecosystems/intro/updates.shtml.

Ongoing work

The Heinz Center is actively soliciting feedback and technical comments on the current version. An updated, revised edition of the report is expected to be published every five years, with the next issue planned for 2007. In the interim, the data and indicators are updated annually on the Center's web site. One of the results of the publication of the indicator set is its use to inform the design of the ecological portion of the international Global Ocean Observing System (US GAO 2004).

A Comparison of Canadian and US National Indicators

All four agencies developed the indicators through a transparent, multi-stakeholder process, and adopted a set of criteria for indicator approval. The reports each include a succinct summary and are fully accessible online, and the organizations all continue to improve upon the indicators for better reporting in the future. The technical supplements or appendices that accompany the reports provide extensive detail about the rationale, methodology, and data for each indicator. Each agency employed a conceptual framework: the EPA and Environment Canada chose modified PSR approaches; NRTEE adopted a natural capital model; and the Heinz Center restricted reporting to the condition and use of ecosystems, using biogeophysical indicators.

The EPA approached indicator selection by identifying those that could answer a series of questions posed by experts during multi-stakeholder workshops. The Heinz Center wished to develop indicators to accurately reflect ecosystem conditions, whether or not indicators, monitoring programmes, and data already existed. It identified critical gaps in these areas by identifying ideal indicators and by underscoring where they need further development and more-adequate data. NRTEE also selected a set of ideal indicators, some of which are still under development. Unlike the other agencies, Environment Canada chose to provide a performance meter for each indicator profile.

The approaches, frameworks, choice of indicators, and types of products reflect the visions and goals of their creators. All four reports are clear and understandable, making them accessible to decision-makers and the public. They present, describe, and interpret the indicators but are not prescriptive, leaving policy decisions to politicians and other decision-makers. The Heinz Center, which is not a government agency, is explicitly oriented to being politically legitimate or nonpartisan (O'Malley, Cavender-Bares, and Clark 2004), while the NRTEE's report makes recommendations to the federal government about expanding the system of national accounts to include natural and social capital.

The EPA and Environment Canada reports are the most comprehensive, addressing a wide audience and attempting to cover most aspects of each nation's environmental goods and services. The issues they include and the associated indicators resemble each other most. NRTEE explicitly reports on a very small set of indicators that link the environment and the economy and it focuses on the long-term sustainability of Canada's development, not exclusively on the environment. The focus on biological and chemical properties in the Heinz Center's report reflects its goal to exclusively report on the condition and use of US ecosystems. The Heinz Center makes a unique contribution by identifying ideal indicators and by underscoring where they need further development and more adequate data. NRTEE supports Environment Canada's indicator work, just as the Heinz Center supports that of the EPA. There is thus a great deal of correspondence between the two Canadian and the two US sets of issues and indicators.

Common issues

Table 1 presents a list of the issue areas addressed by each country in their respective reports and highlights in blue the 11 issues covered by both countries (even if the issue was found in only one of the two reports surveyed for each nation). These common issues are the following: drivers of change, the ozone layer, acid deposition, air quality, toxic substances, waste, freshwater, wetlands, forests, agricultural land, and biodiversity.

Not included in the Canadian reports are indicators for the issues of coastal and marine ecosystems, indoor air quality, national land use, fisheries, grasslands and shrublands, urban areas, and the impact of environmental change on human health. The US reports do not include indicators for climate change, protected areas, energy, and

Table 1: Comparative table of Canadian and US environmental issue areas

Issues	Canada		United States	
	NRTEE	EC	EPA	Heinz Center
Drivers (population, GDP, consumption)		X	X	
Climate change	X	X		
Ozone layer		X	X	
Air quality	X	X	X	X
Acid deposition		X	X	
Indoor air			X	
Toxic substances		X	X	X
Waste		X	X	
Land use			X	X
Freshwater	X	X	X	X
Wetlands	X		X	X
Coastal and marine			X	X
Fisheries			X	X
Forests	X	X	X	X
Agricultural land		X	X	X
Grasslands and shrublands			X	X
Biodiversity		X	X	X
Protected areas		X		
Urban areas			X	X
Energy and transportation		X		
Human health & environment			X	X

Source: Compiled by author from EC 2003a; NRTEE 2003; US EPA 2003; Heinz Center 2002.

transportation. Most gaps in issue selection reflect the different mandates and foci of the authors. The absence of indicators representing certain issues does not mean the nations do not monitor and gather data about these issues or report on them in other ways; it may be that the data are not adequate for national reporting, for example. There are many other challenges to developing suitable indicators, apart from the important issue of data, however, as discussed further in Chapter 4.

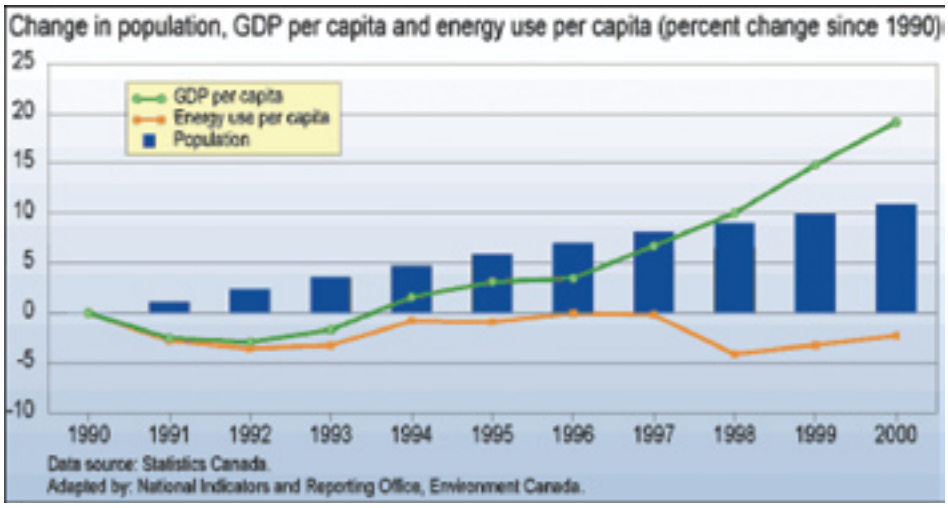
Common indicators: Notes on Table 2

Table 2 (see Appendix 1, pages 122-148) is a chart that provides details on the indicators in each of the reports, allowing for comparison and contrast among them and for the identification of common indicators. In general, the table provides a list of national-level indicators. In some places, however, it also includes ecosystem and sub-regional-level indicators to illustrate environmental trends or conditions where national data or indicators were absent or inadequate. Indicators reflecting social, institutional, and economic conditions and trends that were not explicitly linked to environmental issues (such as a number of the health indicators in the EPA report) were not included. A number of the unique aggregated indices or meters, such as Environment Canada's meters and some indices used by the Heinz Center, were also not included. Some other indicators were omitted if they were not deemed relevant to this study, such as those representing global trends, comparing trends or conditions within the country, or focusing on illustrative case studies.

The table lists the indicators as well as the data and time-coverage, even though some indicators are still being developed and some data represent what is available at present pending better and more complete national coverage. Thus, indicators that are not yet fully developed (such as a number of those suggested by the Heinz Center) are also listed. Although the PSR and DPSIR frameworks have drawbacks related to analysis, the latter is used to organize the indicators for easier cross-referencing among the tables presented in this report. Cross-referencing is also facilitated by reserving each row in Table 2 for similar or "generic" indicators.

The last column lists only the generic indicators used by both countries, regardless of the methodology and data used to develop them. These similar

Figure 21: Environment Canada's index of drivers of environmental change



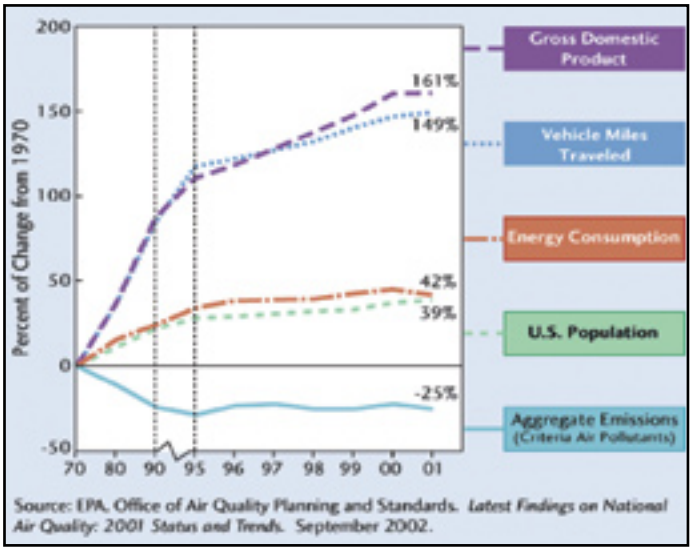
Source: EC 2003a, vi. Metadata from Statistics Canada

indicators are the most comparable and those most likely to be easily integrated. As such, they are candidates as regional indicators for North America. In Chapter 4, these common indicators will be complemented by others drawn from the reports examined in this study, to form a list of feasible environmental indicators for North America.

Analysis

Most of the indicators in Table 2 represent states and impacts, with fewer indicators expressing pressures and very few that are indicative of responses. Both Canada and the United States acknowledge three overall drivers (population, GDP, and energy use), with Canada showing the per cent change since 1990 and the United States reporting on changes since 1970 (Figures 21 and 22). The reports do not present indicators of drivers specific to each issue.

Figure 22: EPA's index of drivers of environmental change



Source: US EPA 2003, 1–2.

The Canadian reports contain a restricted number of indicators and, where possible and relevant, used internationally standard measures (such as IUCN categories for protected areas and UNFCCC methods for greenhouse gas emissions). The US reports contain large numbers of indicators and, for the most part, use methods or parameters and standards established nationally.

Table 2 shows that a total of 20 similar indicators are used by both countries and that the issues of air quality and forests are represented by the most indicators, which together form small PSIR profiles. With a few exceptions, each country has adopted different methods for calculating and presenting the data, and indicators refer to different time periods and definitions. For example, both countries report on timber harvests, but Canada uses area harvested to portray the amount produced while the United States reports on the volume harvested. Chapter Four explores such inconsistencies further.

These conclusions are based on a survey of only four reports, however, and the small number of common indicators and their variations does not suggest the impossibility of finding a way for accomplishing integrated bilateral reporting with standard indicators. Appendix 2, which provides data sources for potential indicators for North America, reveals that comparable data are available for many generic indicators not represented in these reports.

The two countries are already involved in efforts to harmonize environmental indicators in order to enable reporting on the state of several shared ecosystems. To learn more lessons about potential environmental indicators for North America, the next section looks at a number of Canada-US binational SOE reporting initiatives and the indicators they are developing.

Logging truck transporting logs to mill, Northwestern Alberta, Canada. *David P. Shorthouser/UNEP/Forestry Images*

Canada-US Bilateral Environmental and Ecosystem Indicator Initiatives

Canada and the United States cooperate in international and regional SOE reporting and indicators programmes in recognition that ecosystems, air- and watersheds, and migratory species traverse political boundaries and that both countries often share the driving forces and pressures that affect them. For example, Canada and the United States participate in the Circumpolar Council, which sponsors an Arctic state-of-the-environment report. The first such report, which focussed on pollution, was released in 1997. Two subsequent editions looked at human health and persistent organic pollutants (AMAP 2003; AMAP 2004; NIRO 2003b). Canada and the United States also cooperate to manage and produce environmental indicator reports on the Great Lakes, the Gulf of Maine, and the Georgia Basin–Puget Sound region. These three initiatives are highlighted as case studies in this section.

The Border XXI Program (1996–2000), set up to address environmental issues at the US-Mexico border, has produced a set of environmental indicators for the border region (US-Mexico Border XXI Program 1997). Based on this work, the ten-year Border 2012 Program, launched in 2002, is now developing environment and health indicators to measure progress towards its sustainability goals (US EPA 2000a).

At the trilateral level, the Commission for Environmental Cooperation (CEC) of North America, set up to oversee the NAFTA environmental accord, is mandated to produce periodic state-of-the-environment reports for the NAFTA region. In 2002, it published its first SOE report, *The North American Mosaic*. The CEC anticipates that the next SOE report will introduce a set of environmental indicators that will inform future North American regional environmental assessments (CEC 2001). The CEC also published a report on available indicators of children's health and the North American environment in 2006 (CEC 2006). In addition, the CEC's Pollutant Release and Transfer Register (PRTR) project tracks, analyzes, and publishes available data about the source, release, and transfer of toxic pollutants from industrial activity in Canada and the United States. The CEC's annual report *Taking Stock* will integrate Mexico's data for 2004, creating a North American perspective of pollutant releases for the first time. This project enhances the comparability among the separate national reporting systems and provides a unique regional picture by way of pollutant indicators and data (CEC 2004a).

The CEC is a forum for many other projects that bring scientists and experts together in international working groups to cooperate on protecting the North American environment; many of these efforts provide lessons about how to achieve consensus among different stakeholders from the three countries in taking a common region-wide ecological perspective and adopting a common language for classification systems. One example is the North American eco-region mapping initiative, which succeeded in producing a continent-wide definition and maps of three levels of nested eco-regions (see CEC 1997).

Another trinational-level effort related to producing comparable environmental data is the North American Transportation Statistics Interchange (NATS). Under this initiative, a trilateral group works on the production of transportation, energy, and environment indicators (TEEI). Canada, the United States, and Mexico cooperate to adopt a common list of indicators and are working to compile the statistical data according to a common TEEI framework. They are also working on the opportunities and limitations of the elaborated indicators in terms of their consistency, harmonization, updating, and comparability.

Governments, NGOs, and other stakeholders in Canadian provinces and territories and US states are also working together to develop and use environmental indicators to assess the state of a number of shared ecosystems.

The State of the Great Lakes

The Great Lakes lie within eight US states and the Canadian province of Ontario (Figure 23). Half the trade between the two countries crosses the region,

> The Parties to the Great Lakes Water Quality Agreement (GLWQA) want to establish a consistent, easily understood suite of indicators that will objectively represent the state of major ecosystem components across all Great Lakes basins... . This suite of indicators will also be used to assess the Parties' progress towards achievement of the purpose and general objectives of the GLWQA (Bertram and Stadler-Salt 2000, 4).

and the countries share the lakes' abundant resources and services as well as the pollution and disruption the ecosystem is experiencing (UNEP 2002a). In 1972, Canada and the United States signed the Great Lakes Water Quality Agreement (GLWQA), committing the two countries to controlling and cleaning up pollution in the Great Lakes and reporting on their progress. The amended agreement includes the goal to develop a set of comprehensive indicators on the health of the Great Lakes. To periodically assess the condition of the Lakes and to discuss further action, the US Environmen-

Figure 23: The Great Lakes

Source: GLIN 2004 http://www.great-lakes.net/gis/maps/.

tal Protection Agency and Environment Canada began hosting the biennial State of the Lakes Ecosystem Conference (SOLEC). Following the second conference in 1996, it was decided to develop a comprehensive, basin-wide set of indicators to enable reporting in a predictable, compatible, and standard format (Bertram and Stadler-Salt 2000; US GAO 2004).

At the 1998 SOLEC, a suite of easily understood indicators that objectively represent the condition of the Great Lakes ecosystem's components was proposed. This suite is used at each conference to inform the public and report on progress in achieving GLWQA goals, while work continues to broaden the suite and populate the indicators with reliable data (Bertram and Stadler-Salt 2000).

Conceptual and organizational framework

SOLEC adopted the state-pressure-human activities model, based on the PSR framework. The indicators nominated for the SOLEC list were extracted primarily from existing Great Lakes documents (Bertram and Stadler-Salt 2000). The indicators were screened using a broad set of SOLEC criteria that fell under the headings of Necessary, Sufficient, and Feasible. The SOLEC indicator framework consists of three nested levels. The first is comprised of geographic zones, issues, and cross-cutting elements; the second represents seven core groups (near-shore and open waters; coastal wetlands; near-shore terrestrial; land use; human health; societal; and unbounded); and the third level presents the PSR indicators (NIRO 2003b).

Selection process

The first step of the selection process, taken prior to the 1998 Conference, was to identify a set of indicators that reflects the state of all major Great Lakes ecosystem components. It was guided by a multi-stakeholder SOLEC indicators advisor group that coordinated seven core set advisor groups. Each of these groups identified a set and a short list of indicators for its domain. They strove to recommend indicators that could be applicable basin-wide. The short list was peer-reviewed and revised and ecosystem components needing additional indicator development were identified (Bertram and Stadler-Salt 2000). These indicators form the basis for reporting in the State of the Great Lakes reports, with each successive report building on the former as data become available, allowing the use of ever more indicators from the set. Presently, there are 79 indicators in the SOLEC list. Together, they help to assess the health of the Great Lakes' major ecosystem components. Many of the indicators are still being developed, however, and until more research is conducted and data collected, they cannot be used (Bertram and Stadler-Salt 2000).

Products and contents

The 2000 SOLEC report *Selection of Indicators for Great Lakes Basin Ecosystem Health: Version 4* provides a revised list of the indicators proposed in 1998 (Bertram and Stadler-Salt 2000). Difficulties in comparability between the two countries are identified in the short descriptions of each of the indicators. These include information about each indicator's purpose, ecosystem objective, endpoint, features, illustration, limitations, and interpretation. The *State of the Great Lakes 2001* (EC and US EPA 2001) is a 92-page report containing an assessment of the condition of each of the Great Lakes and of the region as a whole. The section devoted to indicators is organized by habitat type and kind of human impact. It includes a section titled "Implications for Managers" showing how managers can both use and contribute to indicator-based assessment (Pidot 2003). It is the first SOLEC report to use the indicator-based format and it reports on 33 of the indicators that make up the entire set. Subsequent reports are based on the suite of ecosystem health indicators developed by participants in the 2002 State of the Lakes Ecosystem Conference (SOLEC).

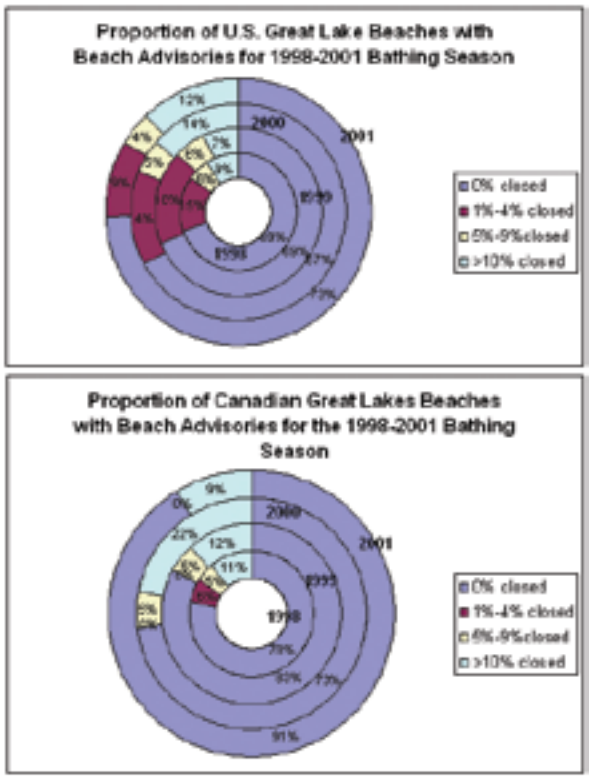
The *State of the Great Lakes 2003* is the fifth biennial report issued by the governments of Canada and the United States. It is a 102-page report,

1000 ft. Laker approaching the Blue Water Bridge at the mouth of the St. Clair River, Michigan USA. *UNEP/USACE*

which includes summaries of separate indicator reports and a status report on each of the Great Lakes and connecting channels (EC and US EPA 2003). It provides assessments of 43 of the indicators proposed by the Parties. These particular indicators were included because data were available. They are presented in the report under the headings of State, Pressure, and Response indicators (EC and US EPA 2003).

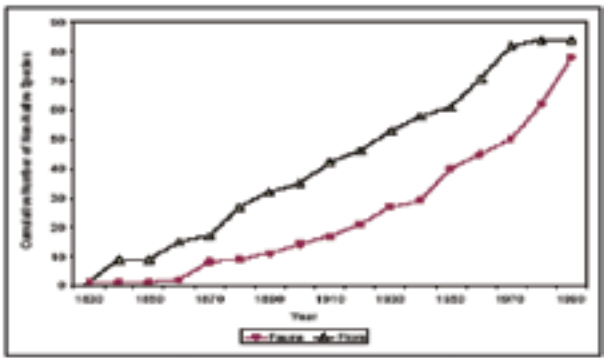
Implementing Indicators 2003 is a technical report that compiles all the indicator reports that were circulated for review at SOLEC 2002 and provides full references for the information presented in each indicator report. In some cases, the indicators represent the entire basin, while in others they highlight certain geographic locations. The compilation of a database currently comprising over 800 indicators is an ongoing part of the work. The following two figures present examples of indicators from the State of the Great Lakes 2003 report. Figure 24 is an attempt to show Great Lake beach advisories and closures in both countries in a comparable way. Figure 25 presents an ecosystem-level indicator showing the cumulative number of introduced species in the Great Lakes. The 2003 report is available from the following web site: http://binational.net/sogl2003/sogl03eng.pdf

Figure 24: Beach advisories in US and Canadian Great Lakes beaches



Source: Adapted from EC and US EPA 2003, 82.

Figure 25: Cumulative number of introduced species in the Great Lakes since the 1830s



Source: EC and US EPA 2003, 76.

Ongoing work

The suite of Great Lakes indicators is constantly evolving as modifications and refinements are made to reflect a greater understanding of the ecosystem and human interactions with and within it, and to ensure that the information is accessible and useful. Progressively more indicators are reported on at each yearly conference, a process that will continue until the whole suite is included (Bertram and Stadler-Salt 2000; EC and US EPA 2003). The two governments are planning to integrate monitoring and reporting into existing Great Lakes activities at all levels of government as well as within industry. The SOLEC indicator set helped to influence the United States Fish and Wildlife Service's decision to focus on developing an ecosystem/watershed approach to the environmental management of the Great Lakes (US GAO 2004).

Georgia Basin–Puget Sound

The Georgia Bay–Puget Sound region (Figure 26) comprises the densely populated parts of the state of Washington and the province of British Columbia surrounding an arm of the Pacific Ocean that flows between Vancouver Island and the mainland.

> An initial attempt to provide a sense of the current state and trends in this ecosystem in an integrated way across the Canada–United States boundary (GBPSEI 2002, 1).

In 2000, nearly seven million people lived in this region, with 57 per cent in the United States and 43 per cent in Canada. The area is experiencing rapid population growth: by 2020, the two core urban areas of Seattle and Vancouver are together expected to count about a million additional people. Pressures on the ecosystem have resulted in

Figure 26: Georgia Basin–Puget Sound

Source: GBPSEI 2002.

Scenic view from Port Townsend, Washington USA.
Gary Wilson /UNEP/NRCS

a need to address the environmental, social, and economic implications of that growth (GBPSEI 2002).

Government officials, scientists, and other stakeholders from both countries increasingly work closely to find cooperative solutions to shared environmental issues in the region. For example, Environment Canada and the US Environmental Protection Agency recently issued a joint report on the characterization of the Georgia Basin/Puget Sound airshed. The two countries have been working together to develop regional indicators since 2000. The Canada–United States Working Group on Environmental Indicators was formed with the view of developing and using a suite of indicators to report on sustainability in the region. It grew out of the British Columbia–Washington Environmental Cooperation Council, which began in 1992, and the Joint Statement of Cooperation by Environment Canada and the US EPA in 2000. The latter commits the two countries to work together at the federal level on transboundary issues. The Working Group is also improving the transfer of knowledge and best practices, developing shared goals and strategies, and implementing joint action programmes (GBPSEI 2002). In 2002, the Working Group released its *Georgia Bay–Puget Sound Ecosystem Indicators Report* (GBPSEI 2002), which uses six indicators to look at several aspects of the state of the environment in the transboundary region.

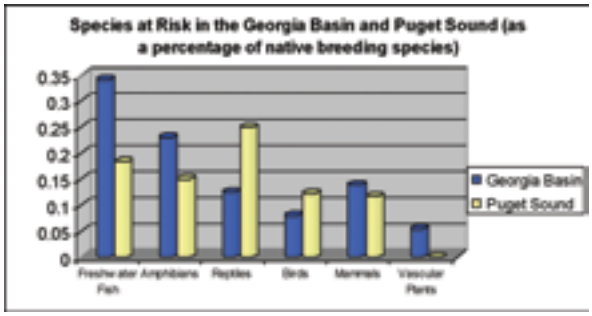
Conceptual and organizational framework

The report does not explicitly refer to the PSR or any other framework. Each indicator is presented in terms of what is happening, why it is happening, why it is important, how it compares with other regions or locations, and what is being done to address the issues of concern.

Selection process

Work began in 1999 to identify key indicators for which data were available on both sides of the boundary. Data specialists started by compiling all applicable monitoring data collected in the region to identify the best and most readily available and comparable data with which to develop a suite of indicators for the region (Pidot 2003). Only six indicators were initially selected, since differences in purpose, definition, measurement, and classification of data from different jurisdictions, as well as differences in the variety of regulatory and administrative frameworks presented challenges to developing harmonized indicators and an integrated basin-wide picture. The bilateral indicator for assessing

Figure 27: Species at risk, using a standardized assessment method



Source: Adapted from GBPSEI 2002, 14.

the conservation status of species was made possible because of a standardized method developed by the Association for Biodiversity Information, which includes a network of conservation data centres across North America (Figure 27). Except for the population indicators and a map showing the percentage of protected land, issues on each side of the border are portrayed with different indicators (GBPSEI 2002).

Products and contents

The report presents six indicators: population, air quality, solid waste, persistent organic pollutants (POPs), species at risk, and protected areas. As the key pressure on the shared ecosystem, the population indicator is the first in the report. It also portrays population distribution across the region through a series of maps. Technical backgrounders are provided for the indicators, which include data, data sources, methodology, references, contacts, and supplementary information. The organization and presentation of the technical information is not consistent across the two reporting jurisdictions. The reports are available online at: hhttp://www.env.gov.bc.ca/spd/gbpsei/index.html.

Ongoing work

The initiative is ongoing, with new indicators being developed and the original indicators modified as new data become available. For example, the PM_{10} indicator may be modified or replaced in the future by an indicator showing trends in $PM_{2.5}$ concentration (GBPSEI 2002).

Gulf of Maine

The Gulf of Maine is bordered by the states of Massachusetts, New Hampshire, and Maine and by two provinces, New Brunswick and Nova Scotia (Figure 28). This shared ecosystem is considered to be among the most biologically productive marine systems in the world: its waters and shoreline habitats host some 2,000 species of plants and animals.

Figure 28: The Gulf of Maine

Source: GMCME 2004d http://gulfofmaine.org/knowledgebase/aboutthegulf/. Map created by Richard D. Kelly, Jr., Maine State Planning Office, for the Gulf of Maine Council on the Marine Environment.

A bilateral effort is underway to maintain and enhance environmental quality in the Gulf of Maine. It is led by The Gulf of Maine Council on the Marine Environment, a US-Canadian partnership of governmental and non-governmental organizations. The Council stresses the importance of viewing the Gulf of Maine as a single ecosystem and promoting cross-boundary collaboration to help manage the region's resources and address environmental concerns. One of its long-term aims is to identify and track a set of regional environmental indicators and produce a "State of the Gulf" report (GMCME 2004a).

The Gulf of Maine is shared by Canada and the United States and is considered among the most biologically productive marine systems in the world.

Discussion about potential indicators began in December 2002 at the Atlantic Northeast Coastal Monitoring Summit, which also explored the potential for integrated regional monitoring. It was followed in January 2004 by the Northeast Coastal Indicators Workshop, where the initial selection process for regional indicators began (GMCME 2002; GMCME 2004b). Finally, the Gulf of Maine Summit was held in October 2004, bringing together and integrating the work of the many agencies, organizations, and institutions in the Gulf. The Summit was organized by the Gulf of Maine Council on the Marine Environment and

Lobster boat tied up at the Lobstermen's Co-op., Boothbay Harbor, Maine USA. *William B. Folsom/UNEP/NMFS*

the Global Programme of Action Coalition for the Gulf of Maine (GPAC). The latter is a bi-national, multi-stakeholder working group dedicated to the implementation of the United Nations Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities (Gulf of Maine Summit 2004a; GPAC n.d.). Just prior to the Summit, pre-summit drafts of *Regional Ecosystem Indicators for the Gulf of Maine* (Gulf of Maine Summit 2004b) and *Tides of Change Across the Gulf: An Environmental Report on the Gulf of Maine and Bay of Fundy* (Pesch and Wells 2004) were released to inform participants of proposed indicators and to catalyze discussion.

Conceptual and organizational framework

In 2003, the Office of Ocean and Coastal Resource Management, of the National Oceanic and Atmospheric Administration (NOAA), produced a set of nutrient indicators as a contribution to the "State of the Gulf" report. The indicators are organized around a modified PSR framework and include the following categories: environmental indicators, context indicators, stressor indicators, impact indicators, and management response indicators (Mills 2003). *Tides of Change* presents indicators in chapters that respond to questions about current conditions and trends, causes of those conditions, and actions to reverse them—similar to a PSR approach (Pesch and Wells 2004).

Selection process

A steering committee first drafted straw conceptual models, key questions, and indicators for discussion at the January 2004 workshop. Feedback on them was sought through an indicators web survey. The key goal is to achieve consensus on a list of key indicators focusing on six major issues: fisheries, eutrophication, contaminants, coastal development, aquatic habitat, and climate change. Regional work groups strived to crystallize core indicators for presentation at the Summit (GMCME 2004b). Regional watershed forums were organized and convened by local groups over two years, using a consistent but flexible format. To identify priority issues, they each used a consistent reporting mechanism that evolved into the GPAC indicator matrix, adapted from that of EPA. Each forum used "traffic light" colours to signify its level of concern with an issue, based on its knowledge and perceptions of local problems. The colours in the key correspond to a spectrum, from "definite problem" to "no problem". Matrices were drawn up for the following: changes in land use and integrity of water and riparian zones; contaminant issues; changes in species; changes in resource use; and presence of critical habitats and natural areas related to fisheries. *Tides of Change* summarizes results from the watershed forums and provides in-depth chapters on several key issues facing the Gulf: land use; contaminants and pathogens; and fisheries and aquaculture (Pesch and Wells 2004).

Rock, foam, and fog.

Captain Albert E. ThebergeUNEP/NOAA

Products and contents

The State of the Gulf Report: Nutrient Indicators was published in 2003, providing information on potential nutrient indicators for inclusion in the Gulf of Maine Council's "State of the Gulf of Maine" report. It surveys nutrient indicators used in existing reports from organizations within the US and internationally and provides a list of the most prevalent ones used. It then suggests potential indicators in the categories listed above and outlines some general principles to guide the process of selecting and developing a suite of nutrient indicators for the Gulf of Maine (Mills 2003). The *Regional Ecosystem Indicators for the Gulf of Maine: Pre-Summit Draft* (Gulf of Maine Summit 2004b) presents 12 fishery indicators, 8 coastal development indicators, and 12 contaminant indicators. Each indicator is accompanied by technical notes that describe the following: purpose, ecosystem objective, measure, outcome, illustration, features, limitations, interpretation, comments, and references. In addition, draft indicators related to aquatic habitats, nutrients (see above), and climate change were also prepared. *Tides of Change* examines how environmental, economic, and social trends are influencing land use, contaminants (including sewage, nutrients, pathogens and mercury), and fisheries and aquaculture. Indicators for these trends provide historical context, reveal current conditions, and track progress. Bilateral or regional indicators include indicators of historical change in population density and rural/urban mix in the region; species at risk; beaches with closures; average mercury concentrations; landing of all species; finfish aquaculture; and community composition of fish. The report includes an overview of recent successes in addressing regional environmental issues, and a report summary (Pesch and Wells 2004). The reports can be viewed online at: http://www.gulfofmainesummit.org/docs/index.html.

Ongoing work

The goal of the Gulf of Maine Summit is to set the stage for the preparation of a "State of the Gulf of Maine" report. The aims of the report are to provide structure for an integrated monitoring

Box 19: Issues selected by the bilateral indicator initiatives

Great Lakes	Georgia Basin–Puget Sound	Gulf of Maine
Near-shore and open waters	Population	Fisheries and aquaculture
Coastal wetlands	Air quality	Eutrophication
Near-shore terrestrial	Solid waste	Contaminants
Land use	Persistent organic pollutants	Coastal development
Human health	Species at risk	Aquatic habitat
Societal	Protected areas	Climate change

Source: Compiled by author from EC and US EPA 2003; GBPSEI 2002; Gulf of Maine Summit 2004b; Pesch and Wells 2004.

programme; identify information gaps, problem areas, and research needs; compile information on standard protocols and quality assurance; help inform and engage the public on environmental issues; and advocate for enhanced science, policy-making and management (Nedeau 2003). After the 2004 Summit, the suggested indicators were to go through a period of review and refinement, followed by work to integrate them into regional strategies (GMCME 2004c).

Analysis

The development of bilateral indicators for ecosystems shared by Canada and the United States is a fairly recent undertaking. Several initiatives, such as the CEC's indicator development work for environmental reporting in North America and the Gulf of Maine indicator initiative, are still in the initial stages of development. The three case studies presented above represent important ecosystems shared by Canada and the United States. All three indicator initiatives grew out of bilateral agreements and previous cooperative action to protect the shared ecosystems, with one of the major goals of the State of the Great Lakes work explicitly oriented to reporting on progress in achieving the purpose and general objectives of the GLWQA. Given the large extent of the Great Lakes ecosystem and the high degree of pressures upon it, it requires a larger set of indicators. Two of the case studies are focussed on shared water bodies and the important resources and ecosystem services they provide, with the majority of indicators representing their physical, chemical, and biological aspects. The indicators for Georgia Basin–Puget Sound, a densely populated region, represent a wider variety of issues. The indicator set is small and the indicators are more closely associated with the important human population and its impacts (Box 19). The latter initiative relied on indicators for which data were available, while the other two sought indicators that would answer questions about the state of the shared water bodies.

All three initiatives are based on multi-stakeholder participation for the indicator selection, attempt to develop compatible and standardized indicators, and include ongoing indicators review and refinement. The Great Lakes and the Georgia Basin–Puget Sound reports include technical documents that describe and explain each of the indicators. The Gulf of Maine project has not released its final set of indicators at the time of writing.

Given the focus on specific ecosystems and the fact that many ecosystem-level indicators may not easily serve as nation-wide indicators, lessons learned from these bilateral initiatives have more to do with the process of collaborating across borders to construct compatible environmental indicators than the actual content of the indicator sets. More information about the process of cross-border collaboration could be gleaned from a more in-depth study of these initiatives through interviews and other means.

To develop a more comprehensive list of basic indicators that could help form the basis for regional reporting for North America, the next chapter looks at indicators used or prescribed by international agencies that report on the state of the global environment. In some cases, these organizations have already harmonized or standardized data across nations.

K. Giesel/UNEP