Chapter 2:
The Reporting Framework

This chapter describes the basic framework developed by the Design Committee to characterize the state of the nation's ecosystems. It discusses the strategic guidelines that shaped the report, defines both the major ecosystem types and the major categories of indicators described in this report, and concludes with an overview of the nature of the data included in the report.

Goals

In developing a framework for reporting on the state of the nation's ecosystems, the Design Committee reviewed a wide range of previous reporting efforts, consulted broadly with relevant stakeholders, users of environmental information, and experts, and incorporated feedback from the 1999 prototype of the present report. In addition, it built on three seminal documents: the proceedings of a National Environmental Monitoring and Research Workshop held at the Smithsonian Institution in 1996[1]; the National Science and Technology Council's *Integrating the Nation's Environmental Monitoring and Research Networks and Programs: A Proposed Framework*,[2] published in 1997; and the National Research Council's study *Ecological Indicators for the Nation*,[3] published in 2000. Recruitment of key contributors to each of these documents as members of this report's Design Committee ensured continuity and cumulative learning across the several efforts. The Design Committee developed and refined the goals for this report:

- **The report is written for decision makers and opinion leaders concerned about the "big picture" of the nation's ecosystems.** Its goal is to identify what the nation most needs to know about its ecosystems in order to conduct enlightened policy debate; we also summarize what is known—and what is not known—about those key characteristics. More generally, the report seeks to educate a broader audience by highlighting important aspects of the nation's ecosystems and by characterizing patterns of change in those conditions.
- **The report identifies a succinct set of strategic indicators to characterize the nation's ecosystems.** It does not characterize every aspect of the environment or the ecosystems of particular regions. Rather, it identifies strategic indicators that can serve as meaningful reference points for broad-ranging policy discussions.[4] In doing so, we seek to complement, not replace, existing reporting frameworks developed for particular management, regulatory, or scientific needs. Such programs provide data on many characteristics of ecosystems that we do not describe, and they can highlight changes that may not appear large at a national scale but are nonetheless quite important at a local scale.
- **The report provides scientific information on which decisions can be based, while avoiding value judgments and policy recommendations.** It thus seeks to be policy relevant while avoiding bias or advocacy. Rather than imposing our judgments of whether conditions are "good" and "bad," the report assists readers in interpreting its content by including time trends and maps from which regional comparisons can be made. When possibles, the report characterizes conditions in terms of departures from generally accepted standards (e.g., safe drinking water standards), while recognizing that there are judgments involved in setting such standards.
- **The report focuses on the *state* (or condition) of the nation's ecosystems.** It leaves to others the task of identifying the stresses (pressures) that might be changing ecosystems, and of analyzing the effects

of actions taken by governments, private individuals, or businesses to reduce those stresses. Information on pressures and societal responses is clearly important, and it has been incorporated in widely used environmental reporting frameworks.[5] For this project, however, we chose to focus on *state* for two reasons. First, there is a strong need to complement existing reporting about environmental pressures and responses with information about society's ultimate concern: the state of the nation's ecosystems. Second, the difficulties of determining "cause and effect" can influence perceptions of the scientific credibility and political neutrality of both data and reporting efforts. Experience with other national reporting efforts (particularly those concerned with the nation's economy) suggests that a broadly accepted characterization of system state can make an enormous contribution to policy development and understanding, even when disagreements persist on the causes of and appropriate policy responses to that state.

- **The indicators selected for this report reflect both key properties relating to ecosystem condition and the goods and services derived from ecosystems.** Ecosystems are incredibly complex, and reporting on them necessarily involves focusing on some characteristics and excluding many others. In addition, the values held by different people can lead them to place greater importance on some aspects of ecosystems than on others; some people place primary emphasis on the goods and services ecosystems produce, while others focus on their condition. The question is not *whether* to select, but only who does the selecting, and *how* it is done. The indicators included here were extensively discussed and negotiated by the members of our Design Committee and technical Work Groups, which included a balanced array of representatives from the private sector, environmental organizations, government, and academia. Although the selection of the indicators was inevitably a value-driven process, we took great care to make it fair and inclusive. The specific numbers assigned to those indicators were determined through a peer-reviewed scientific process, which we took great care to make transparent and credible.
- **The report identifies critical gaps in data and in monitoring programs that must be filled in order to fully, and in a balanced way, characterize the state of the nation's ecosystems.** It leaves to the future, however, any discussion of how to fill those gaps. In preparing this report, we first identified ecosystem characteristics most important for a balanced national report. We then made extensive and good faith efforts to locate sufficiently high-quality and extensive data to report on those characteristics. Where such data are not available, the report calls attention to the gaps. In implementing this strategy, we have resisted the temptation to focus only on what happens to be illuminated by the lamp-posts of existing monitoring and reporting programs. Instead, the report identifies where lamps need to be posted in order to provide the kind of illumination of ecosystems that the nation most needs.

Defining Ecosystems

At the heart of this report are a set of six ecosystem types (coasts and oceans, forests, farmlands, fresh waters, grasslands and shrublands, and urban and suburban areas) and the indicators that, taken together, describe the state of these ecosystems and of the nation as a whole. It is reasonable to think about—and to seek indicators for characterizing—the ecosystem of a small watershed, or of the planet as a whole, or of places at any scale in between. However, like the recent National Research Council study on *Ecological Indicators for the Nation*, this report focuses on indicators that can support policy debate and decision making at the national scale.[6]

Ecosystems, Land Cover, and Geography

The word "ecosystem" is used in a number of ways, and there are two common organizational approaches we might have taken—land cover and geographic. The land cover approach defines ecosystem types based on their dominant vegetation or other physical characteristics. Thus, one would speak of a "forest ecosystem," a "cropland ecosystem," or a "freshwater ecosystem." The geographic approach considers all living and nonliving things in a region to be an ecosystem[7] regardless of vegetation type. In this approach, boundaries can be defined in many ways: watersheds and ecoregions[8] are common examples.

We have chosen the land cover approach and we use the terms "land cover types," "ecosystems," and "ecosystem types" more or less interchangeably. However, we also use a more geographic approach in some cases, such as when we define a farmland landscape that includes both croplands and interspersed natural areas.

We have chosen the land cover approach in large part because many natural resource management decisions are differentiated by land type. Forests, grasslands and shrublands, farmlands, and so on produce different products, respond to different management approaches, are owned for different reasons, and are, in plain terms, different. Significant government and private activities are aligned with these land cover distinctions, and we believed that a report reflecting this structure would be most useful at this time.

Nevertheless, a growing number of "place-based" efforts are working to implement management strategies that consider all of the interactions within a watershed, ecosystem, or region. These efforts are supported by monitoring and information systems that help decision makers and the public see their region as an integrated whole, rather than as distinct elements to be managed separately.[9] We strongly support the development of such reporting and information systems, and we have had preliminary discussions on the application of the reporting framework presented in this report to smaller geographic regions.[10]

Ecosystem Types

This report uses six major ecosystem types as its basic reporting units.

- Coasts and Oceans
- Farmlands
- Forests
- Fresh Waters
- Grasslands and Shrublands
- Urban and Suburban Areas

This scheme is intended to cover all the lands and waters of the United States, including the ocean out to the limit of U.S. national jurisdiction. Obviously, these broad ecosystem or land cover types are neither homogeneous nor mutually exclusive. For example, the grasslands and shrublands ecosystem includes bare-rock desert and tundra, as well as the prairies and shrubland its name evokes. Freshwater wetlands are described along with lakes, streams, and so on, but are also tallied within the acreage of forests, farmlands, and other land covers. We describe each ecosystem type, including overlaps with other types, in greater detail in the opening section of each ecosystem chapter.

Map 4.2 (p. 40) shows where these ecosystems occur.

Coasts and Oceans. This ecosystem consists primarily of estuaries and ocean waters under U.S. jurisdiction. Estuaries are partially enclosed bodies of water (this term includes bays, sounds, lagoons, and fjords); they are generally considered to begin at the upper end of tidal or saltwater influence and end where they meet the ocean. By definition, U.S. waters extend to the boundaries of the U.S. Exclusive Economic Zone (EEZ), which extends 200 miles from the U.S. coast, but not all indicators report on this entire area. In addition, several indicators characterize shorelines along both estuaries and oceanfront areas. In these cases, we focus on the margin between land and water, not on uplands or watersheds that may influence coastal conditions.

Farmlands. We focus both on *croplands*—lands used for production of annual and perennial crops and livestock—and on a larger *farmland landscape*, which includes field borders and windbreaks, small woodlots, grassland or shrubland areas, wetlands, farmsteads, small villages and other built-up areas, and similar areas within and adjacent to croplands. Some indicators focus on croplands only, while some describe the entire farmland landscape.

Forests. We generally rely on the USDA Forest Service definition of forest: lands at least 10% covered by trees of any size, at least one acre in extent. This includes areas in which trees are intermingled with other cover, such as chaparral and pinyon–juniper areas in the Southwest, and both naturally regenerating forests and areas planted for future harvest (plantations or "tree farms").

Fresh Waters. Our freshwater ecosystems include

- Rivers and streams, including those that flow only part of the year
- Lakes, ponds, and reservoirs, from small farm ponds to the Great Lakes
- Groundwater, which is often directly connected to rivers, streams, lakes, and wetlands
- Freshwater wetlands, including forested, shrub, and emergent wetlands (marshes), and open water ponds
- Riparian areas—the usually vegetated margins of streams and rivers (although this term can also apply to lake margins)

Obviously, there are overlaps and gradations among these systems. Wetlands often occur at the margins of streams and rivers, in what is also considered the riparian area. Some ponds are shallow and thus may also be classified as wetlands. In some rivers, dams create reservoirs, and these may be classified as rivers, reservoirs, or both.

Grasslands and Shrublands. The title of this system (which many people call *rangelands*) is quite descriptive: lands in which the dominant vegetation is grasses and other nonwoody vegetation, or where shrubs (with or without scattered trees) are the norm. Bare-rock deserts, alpine meadows, and arctic tundra are included in this system as well. We also include pastures and haylands, which represent an overlap with the farmland system; less-managed pastures and haylands fit well within the grassland/shrubland system, while more heavily managed ones fit well as part of the farmlands system. Most monitoring programs do not distinguish between the levels of management for pastures, however.

Urban and Suburban Areas. This system consists of those places where the land is primarily devoted to buildings, houses, roads, concrete, grassy lawns, and other elements of human use and construction. Urban and suburban areas, in which about three-fourths of all Americans live, span a range of density, from the unmistakable city center, characterized by high-rise buildings, concrete, and relatively little green space, to the suburban fringe—where development thins to an obviously rural landscape. This definition does not include all developed lands. It includes areas that we believe are large enough and built-up enough to qualify as "urban and suburban." Many areas—small residential zones, the area of rural interstate highways, farmsteads, and the like—are "developed" but would not be considered "urban or suburban."

Indicator Categories

This report identifies ten major characteristics of ecosystem condition and use that together provide a broad, balanced description of any ecosystem type. These ten characteristics cover the physical dimensions of the systems, their chemical and physical conditions, the status of their biological components, and the amounts of goods and services people receive from them.

These ten major characteristics are described for each of the six major ecosystem types, using between fourteen and eighteen indicators to cover all ten characteristics. As a general rule, for each of the six ecosystem types, there is at least one indicator describing each of the ten major ecosystem characteristics.

We have also identified ten "core national indicators" that provide a very broad and succinct view of national ecosystem condition and use.

Table 2.1 lists the ecosystem characteristics and briefly describes the related indicators. The table on pp. 28–29 lists all indicators in the report by ecosystem type and ecosystem characteristic.

Table 2.1

Ecosystem Characteristic	Indicator Description
SYSTEM DIMENSIONS	
Extent	Area of an ecosystem or land cover type and its major components
Fragmentation and Landscape Pattern	Shapes and sizes of patches of an ecosystem type, and their relation to one another
CHEMICAL AND PHYSICAL CONDITIONS	
Nutrients, Carbon, Oxygen	Amounts and concentrations of key plant nutrients (nitrogen and phosphorus) and key ecosystem elements (oxygen and carbon)
Chemical Contaminants	Numbers of selected contaminants found in ecosystems, and how often these chemicals exceed regulatory or advisory thresholds
Physical Conditions	Condition of key aspects of the physical makeup of an ecosystem, such as erosion or water temperature
BIOLOGICAL COMPONENTS	
Plants and Animals	Status of native and non-native plant and animal species
Biological Communities	Condition of the plant and animal communities that make up an ecosystem
Ecological Productivity	Plant growth on land and in the water
HUMAN USE	
Food, Fiber, and Water	Amounts and values of key products for human use
Other Services, Including Recreation	Tangible and intangible services provided by ecosystems

Indicators of System Dimension

Extent. The extent of an ecosystem and its various components—measured either as area or as linear distance, as for rivers—is one of the most basic aspects of its condition, and provides background and context for other indicators. Indicators in this category generally describe the overall dimensions of the system—in absolute size and as a fraction of total U.S. land area. Some indicators also provide information on the composition of the system (e.g., acreage of major forest types) or on land use characteristics (e.g., area of grassland and shrublands used for livestock raising).

Fragmentation and Landscape Pattern. The size and shape of patches of forest, farmland, or other ecosystem types, and how patches of different ecosystem types are intermingled, help determine the quality and quantity of some ecosystem benefits or services. Examples of services that are believed to be strongly affected by landscape pattern include wildlife habitat, the ability to filter sediment and other contaminants from runoff, and the value for solitude and recreation.

Indicators of Chemical and Physical Condition

Nutrients, Carbon, Oxygen. These are key ecosystem building blocks. We report the amount of nitrogen and phosphorus in water, the amount of carbon in soil and other ecosystem components, and, for aquatic systems, the amount of oxygen in the water. Nitrogen and phosphorus are key plant nutrients; in excess, however, they can contribute to water quality degradation. Most animals need oxygen to survive, and carbon is a critical component of living tissue. Moreover, increased carbon storage by ecosystems can offset emissions of carbon dioxide, of concern because of climate change.

Chemical Contaminants. Chemical contaminants can harm people and impair ecosystem functioning through their effects on plants and animals. We report on two key characteristics of this phenomenon: how many chemicals are found in water, sediments, and soil, and how often their concentrations exceed standards and guidelines set to protect human health and ecosystem condition. Indicators report on selected contaminants in stream water, groundwater, stream and estuary sediments, fish tissue, and soil.

Physical Conditions. Features such as the degree of erosion of farmland soils and the timing and size of low and high flows in streams have a strong influence on the plants, animals, and microorganisms that inhabit ecosystems and on the goods and services ecosystems produce. The specific physical features that are most important differ greatly among ecosystems, so there is less consistency among these indicators than among indicators describing other major characteristics.

Indicators of Biological Condition

Plants and Animals. Plants and animals are fundamental components of ecosystems, their condition can reflect broader ecosystem conditions, and many people care deeply about their status. Indicators generally focus on the relative risk of extinction of specific groups of species, the number and extent of non-native species, and unusual mortality events.

Biological Communities. Species do not exist in isolation; rather, they occur in characteristic groupings, adapted to a particular location and climate. These communities—each with its own characteristic set of species—form the biological "neighborhood" within which individual species exist.

Indicators of the Microscopic World

A number of indicators in this report touch upon the microscopic world, which exists in all ecosystems. For many people, terms like "plants and animals" and "biological communities" may bring to mind trees, flowers, fish, mammals, birds, and the like, along with their communal groupings. However, microscopic plants—algae—capture the sun's energy and thus support much of life in the oceans; they also produce much of the oxygen necessary for animal life. Bacteria, which are neither plants nor animals, perform a host of chemical transformations in soil and water, without which these systems simply would not function. See Coastal Areas with Depleted Oxygen (p. 71); Harmful Algal Blooms (p. 78); Coastal Chlorophyll Concentrations (p. 80); Soil Biological Condition (p. 102); and Forest Disturbance: Fire, Insects, and Disease (p. 127).

Ecological Productivity: Plants, including algae, capture the sun's energy, which is the basis for almost all life on earth. The amount of plant growth in various ecosystems is a fundamental indicator of their condition.

Indicators of Human Use

Food, Fiber, and Water. The major commodity goods produced by ecosystems meet human needs and are important to the national economy. For each ecosystem, except for urban and suburban areas, we report on major commodity or commodity-like products: fish landings, timber harvest, agricultural production, fresh water withdrawals, and range-fed cattle. We report basic quantities of the commodity, often accompanied by information that relates to the long-term stability of production: factors such as agricultural yield, status of fish stocks, and the ratio between timber harvest and annual growth.

Other Services, Including Recreation. Ecosystems produce an enormous variety of "services"—from opportunities for recreation to the building of soil, reduction in flooding, and pollination of crops. This is an area of intense scientific interest, but the methods for quantifying these services are not well developed. In several instances, we highlight the importance of the underlying services but also the lack of developed indicators.

Data: Quality, Coverage, and Context

The final major element of our reporting framework involves how we selected and reported data. As noted above, we selected *indicators* on the basis of what is needed to fairly characterize the state of the nation's ecosystems rather than because the *data* happened to be available. We then had to decide on criteria for including data from particular sources, on what to do when adequate data were not available, and on how to give meaning to the measurements we report. We summarize our design decisions below.

Quality and Coverage

For each indicator, we reviewed available data sources, using both the knowledge of individuals on our various working groups and input from a large number of collaborators and reviewers. Data included in this report had to meet three key criteria:

- Data had to be of sufficiently high quality to provide a scientifically credible description of actual ecosystem conditions
- Data had to have adequate geographic coverage to represent the state of the *nation's* ecosystems
- Data had to be collected through an established monitoring program that offers a reasonable likelihood of future data availability

Data quality—meaning that the data provide a reasonably accurate representation of actual conditions and do not include any substantial known sources of bias or distortion—was the key criterion for selection of data sources. Quality was assessed using the expert knowledge of the participants in the project, supplemented by information provided by the managers of certain data sets; we also commissioned analyses of data sets specifically for this project.

A data set must also provide enough information on the resource or issue in question. This criterion is met by data sets with complete coverage (such as those based on satellite measurements) and those based on representative samples from which reasonably accurate estimates of overall conditions can be made. In practice, this led to the selection of data sets that covered most states or a significant fraction of the ecosystem in question. Obviously, there are large amounts of high-quality data that do not meet this criterion. For example, states and research institutions collect many potentially relevant data, but unless they are aggregated and reviewed to determine whether the collection methods are compatible, the data are not available in practice for national reporting, and so are not included in this report.

Third, we decided that data must be from ongoing programs, with a reasonable chance of the measurements being repeated at regular intervals in the future. Although all monitoring and reporting programs are subject to changes in funding and priorities, established programs are clearly different from one-time studies. One-time efforts can be quite valuable, since they often break new ground scientifically and may serve as baselines against which to compare future conditions. But until and unless they are performed regularly, they do not advance the goal of periodic national reporting.

Inadequate Data and Indicators Requiring Development

Applying the data selection criteria noted above, we identified a number of high-quality, nationally representative data sets with good prospects for future continuity. Inevitably, however, adequate data sets did not exist for all indicators.

Confronted with this dilemma, we tried to be pragmatic. Where small changes in the definition of an indicator would enable us to use existing data, we considered revising the indicator—provided, of course, that the modification would not compromise the indicator's basic purpose. We also avoided indicators that seemed likely to require extraordinary technical advancement beyond current monitoring methods, or extraordinary human or fiscal resources.

Nevertheless, for a substantial number of the indicators selected for this report, adequate data could not be assembled. We identify such cases in the text, to highlight where future data monitoring work is needed. (These gaps are discussed in more detail in Chapter 3, p. 17, and in the Appendix, p. 199.)

Data Not Adequate for National Reporting. There are several causes for these data shortfalls, each with a distinctly different remedy. In some cases, the data needed for reporting are available, but additional processing or analysis—requiring either more money or more time than was available for this project—was needed. For example, there are several indicators of fragmentation and landscape pattern for which the appropriate remote sensing data are available, but which would require additional processing to calculate the relevant measures (see, for example, pp. 93 and 94). These cases represent relatively simple, low-cost opportunities for filling gaps identified in this report. Table A.2 (p. 205) lists the indicators in this category; the table also lists several indicators for which data are currently being collected, thus requiring no new action to fill a gap.

Second—and by far the largest category of indicators with missing data—are those cases where many data probably exist, but they are not available in a form that we could use. Most commonly, relevant data are collected, but by different entities (e.g., states, local governments, research institutions), potentially using different methods. For example, data on groundwater levels in major aquifers are collected by a wide variety of entities to help them understand their water supply situation (see p. 151). However, no group has gathered these data and assessed whether the monitoring methods are comparable. Filling these data gaps might simply require aggregation of existing data, or it might require development and adoption of consistent methods by data collectors.

Third, there are situations where data are not widely collected, but could be if an adequately funded program were in place. The condition of microscopic animals in cropland soils (p. 102) and the contamination of bottom sediments in ocean waters (p. 72) are two examples. The challenge here is operational rather than conceptual.

Indicator Development Needed. Finally, in several cases, we could not select a specific measure, and thus could not evaluate whether data are available. For some indicators, there are multiple competing approaches to measuring a particular

What does "Data Not Adequate for National Reporting" mean?

Data selected for this report had to

- Be scientifically credible and high quality
- Cover most of the United States
- Have a reasonable likelihood of being available for future reporting

We use the phrase "data not adequate for national reporting" to indicate that we were not able to identify a data set meeting these criteria.

In many cases, some indicator data are available. However, these data may cover only a limited geographic area, may never have been assembled from the states, local governments, or research institutions that collected them, or may have been the result of one-time studies. Many of these data sets are excellent examples of the kind of monitoring necessary, and they may serve as the basis for future national reporting.

phenomenon, and progress could be made rapidly if a single method could be selected (see, for example, the stream habitat index, p. 105). Other indicators require conceptual development before data availability can be assessed (see the suburban/rural land use change indicator, p. 182).

Trends and Other Context-Setting Information

Data without context are apt to have little meaning. In order to provide context, and instead of providing "grades" for particular indicator values, we have, wherever possible, provided one or more of the following:

- Information on how the indicator value has changed over time (trends). We tried to find data for the period from 1950 through the present, although this was possible in relatively few cases. In addition, where appropriate, we also provide information on long-term historical comparisons (to presettlement conditions, for example). Presettlement comparisons are meant to give context, not to represent "ideal" conditions.
- Information on regional differences. Frequently, we display data on a regional basis to allow users of the report to compare values in one part of the country with those in another.
- Comparisons with widely accepted reference points. Where they exist, we compare data to regulatory and related standards and guidelines that have become widely used and accepted national reference points, while recognizing that there are judgments inherent in setting such benchmarks. Such standards, guidelines, and related reference points are available primarily for indicators related to nutrients and chemical contaminants. In several cases, indicators are based on comparison to relatively undisturbed "reference sites."

A Note About Regions

We have generally relied on the regional groupings used by the agency providing the data. So, for example, we report on many forest indicators using USDA Forest Service regions and on several coastal indicators using National Oceanic and Atmospheric Administration regions. In a few cases, we used a set of regions developed by The Heinz Center that considered climate, topography, and vegetation.

Since no two agencies share the same regional boundaries, the regions used in this report vary considerably. While it may be desirable to report all indicators on a common geographic basis, in practice this is not currently possible. We are certainly not the first to make this observation, and there are many efforts under way within federal agencies and elsewhere to address this issue. Ideally, data on ecosystem conditions, as reported here, should be gathered and managed so as to enable reporting on any geographic basis; this would allow comparison and aggregation of information collected by different agencies and programs.

Notes and References

1. Executive Office of the President, National Science and Technology Council, Committee on Natural Resources. 1997. National Environmental Monitoring and Research Workshop: Proceedings. February 25, 1997. http://www.epa.gov/cludygxb/Pubs/nemrwork.pdf.
2. Executive Office of the President, National Science and Technology Council, Committee on Natural Resources, Environmental Monitoring Team. 1997. Integrating The Nation's Environmental Monitoring and Research Networks and Programs: A Proposed Framework. http://www.epa.gov/cludygxb/Pubs/framewrk.pdf.
3. National Research Council (NRC), Committee to Evaluate Indicators for Monitoring Aquatic and Terrestrial Environments. 2000. Ecological Indicators for the Nation. Washington, DC: National Academy Press. http://www.nap.edu/catalog/9720.html.
4. The scientific feasibility of such a strategic approach to ecosystem characterization has recently been endorsed by the National Academy of Sciences. See NRC op. cit.

5. The Organization for Economic Cooperation and Development developed what is widely known as the "pressure-state-response" framework for reporting on environmental conditions. See Organization for Economic Cooperation and Development. 1991. The State of the Environment (Paris).
6. Local- and regional-scale ecosystem indicators clearly are needed to guide many types of public and private decisions. The need for global-scale indicators to support international environmental agreements is increasingly recognized, and has called forth large scale efforts such as the UN Environment Programme's *Global Environmental Outlook* reports and the international Millennium Ecosystem Assessment. National ecosystem indicators are nonetheless also needed, not only to support sound policymaking by nations but also to provide context for domestic regional efforts and input to global reporting efforts. NRC, op. cit.
   Millennium Ecosystem Assessment (http://www.ma-secretariat.org/en/index.htm).
   United Nations Environment Programme. 2000. *Global Environmental Outlook*—2000. http://www.unep.org/Geo2000/ov-e/index.htm.
7. For example, Odum (1971) defines an ecosystem as "Any unit that includes all of the organisms (i.e., the "community") in a given area interacting with the physical environment so that a flow of energy leads to a clearly defined trophic structure, biotic diversity, and material cycles (i.e., exchange of materials between living and nonliving parts) within the system is an ecological system or *ecosystem*." E.P. Odum. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
8. An ecoregion is "a relatively large area of land or water that contains a geographically distinct assemblage of natural communities". R.A. Abell et al. 2000. Freshwater Ecoregions of North America: A Conservation Assessment. Washington, DC: Island Press.
9. L.H. Gunderson, C. S. Holling, S. S. Light (eds.). 1994. Barriers and Bridges to the Renewal of Ecosystems and Institutions. New York: Columbia University Press.
10. In May 2000, a 1½-day meeting was held in Bozeman, Montana, under the joint sponsorship of The Heinz Center and the Department of the Interior. This meeting was with representatives of a range of public and private interests in the Greater Yellowstone area (GYA). While the meeting was not intended to be conclusive, there was general agreement that the basic framework of indicator categories used in this report was applicable in the GYA, and perhaps in other regional/ecosystem contexts as well.