4. Data Availability

Having established a framework for assessing biodiversity conservation goals and having identified indicators, the next question is: Are the data available? Do we know what species are being monitored and have been over time? Do countries maintain timely accurate statistics on their domesticated species, nondomesticated species, communities, and protected areas? On cropping patterns, varieties grown, and seed banks? Are these data available in time series, which can be used to calculate rates of change? How accurate are the data? Have species and community data been georeferenced to ecoregion, other biogeophysical delineations, and to local, national, and regional boundaries? And, finally, are the data accessible in standard reports, data tables, and electronic form for use by policy-makers and the public?

It is beyond the scope of this paper to provide detailed answers. For a review of existing data, readers are referred to *Global Biodiversity Status of the Earth's Living Resources* (WCMC, 1992), the first comprehensive sourcebook of information on this topic. Instead a simple ranking of the data available for wild species' and genetic diversity is provided in Table 7, for community diversity in Table 8, and for domesticated species in Table 9. Using the basic indicators associated with species, communities, and *ex-situ* facilities, Tables 7-9 indicate the degree of availability in terms of the completeness of the data (particularly taxonomic coverage), country coverage, time series, and quality. In the discussion below, some of the major sources for data at the global and national levels, including a few of the more accessible reports and data bases, are given.

Wild Species

Numbers of Species (Indicator 1). It is estimated that, at most, only one of five species has been named and described. However, the percentage of vertebrates and plants described is much higher than the overall average—between 80 percent and 90 percent. Based on its existing data base, the World Conservation Monitoring Centre (WCMC) is able to compile numbers of mammalian species for about two-thirds of all countries, bird species for about three-fourths of the countries, and reptiles and amphibians for 40 percent of the countries. For vascular plants, WCMC can tabulate numbers of taxa (species and subspecies) for about 145 countries (WCMC, cited in WRI, 1988). Very few data are available on invertebrate distribution. WCMC has assembled a complete data base on swallowtail butterflies. WCMC also has data on the numbers of land mollusks and several other invertebrate taxa found in European countries. Information on species richness at subnational levels is available only for

Table 7. Data Availability and Coverage for Biodiversity Conservation Indicators: Wild Species and Genetic Diversity

Indicator	Country Coverage Rank	Country Coverage Notes	Time Series Rank	Time Series Notes	Completeness of Data Rank	Completeness of Data Notes	Quality of Data (Rank)
1. Species richness (number)	2	Mammals: available for 2/3 of countries. Birds: available for 3/4 of countries. Reptiles & amphibians: available for 40% of countries. Invertebrates: selected taxa only. Vascular plants: available for approx. 145 countries.	4	Some information on extinctions for island nations and for some megafauna and bird species.	2-3	Incomplete for invertebrates and some aquatic vertebrate taxa.	3
2. Species threatened with extinction (global) and 3. Species threatened with extirpation (national)	3	Global status: data available for all countries. National status: data available for a limited number of OECD countries only. No data for invertebrates (global or national).	3	Limited to megafauna.	3	Global status: mammals: 50% of taxa assessed birds: 100% of taxa assessed reptiles: 15% of taxa assessed amphibians: 10% of taxa assessed vascular plants: 10% of taxa assessed	3
4. Endemic species and 5. Endemics threatened with extinction	2	Vascular plants: available for about 115 countries. Some country data for mammals, birds, reptiles, amphibians, and swallowtail butterflies.	N/A		2	Incomplete for invertebrates and aquatic vertebrate taxa.	2
6. Species Risk Index		(Composite index. See rankings and notes for relevant indicators.)					
7. Species with stable and increasing populations and 8. With decreasing populations	3	Limited to selected taxa in countries dominated by grassland and temperate forest habitats.	3	Limited to a few endangered megafauna, some game and bird species.	3	Limited to a few endangered megafauna, some game and bird species.	3
9. Threatened species in protected areas	3-4	Available for a few individual protected areas.	4		4		
10. Endemic species in protected areas	3-4	Available for a few individual protected areas.	4		4		
11. Threatened species in ex-situ collections and 12. threatened species with viable ex-situ populations	2		2		2	Major zoos/botanical gardens only.	2
13. Species used by local residents	3-4	Limited to special studies.	4		4		4

Sources: World Resources Institute and World Conservation Monitoring Centre staff.
Ranking Legend: 1 = good; 2 = moderate; 3 = poor; 4 = nonexistent or unavailable.

Table 8. Data Availability and Coverage for Biodiversity Conservation Indicators: Community Diversity

Indicator	Country Coverage Rank	Country Coverage Notes	Time Series Rank	Time Series Notes	Completeness of Data Rank	Completeness of Data Notes	Quality of Data (Rank)
14. Percentage of area dominated by nondomesticated species and 15. Rate of change							
i) Bailey, Udvardy, Holdridge, Olson and Watts maps	3	Best used at regional scale.	4		2	Indicates only expected vegetation cover.	2
ii) FAO land use data	1	Available for all countries.	1	Annual from 1950s.	3	Problems in adapting FAO land-use data to a habitat indicator.	3
iii) MacKinnon-based data	3	MacKinnon data only available for Neotropical and Malayan realms.	3	Original vs. current habitat extent only.	2	Comparability problems in combining MacKinnon data with separate country studies.	2
iv) Houghton et al. data	4	Regional only.	1	Ten-year estimates from 1850.	3	Composite from above sources. Limited land-use classes.	2
v) Matthews map	3	Regional only.	3	Preagricultural era to present extent only.	2	Limited by scale.	2
vi) IUCN/WCMC tropical forest atlases	2	Asian and African atlases have been published, Latin American atlas in preparation.	3	Original vs. current habitat extent for Asia and Africa.	3	Limited to tropical forest cover.	?
16. Percentage of area dominated by nondomesticated species occurring in patches	3	Available for 6 West African countries.	4		3	Forest area only.	3
17. Percentage of area in strictly protected status	1	Good coverage for extent of national protected areas.	2		3	Incomplete for local and provincial areas.	2

Sources: World Resources Institute and World Conservation Monitoring Centre staff.
Ranking Legend: 1 = good; 2 = moderate; 3 = poor; 4 = nonexistant or unavailable.

Table 9. Data Availability and Coverage for Biodiversity Conservation Indicators: Domesticated Species

Indicator	Country Coverage Rank	Country Coverage Notes	Time Series (Rank)	Completeness of Data Rank	Completeness of Data Notes	Quality of Data (Rank)
18. Accessions of crops in ex-situ storage	1		2	1	Except for data on nongovernmental organization seedbanks.	1
19. Percentage of accessions regenerated	3		3	3		3
20. Number of crops grown	3	Indigenous use of crops not well documented.	4	4	Crops of widespread importance only.	4
21. Number of varieties grown	3	OECD countries only.	4	3-4	Some crops in OECD countries.	3-4
22. Coefficient of kinship or parentage of crop	4		4	4		4

Sources: World Resources Institute and World Conservation Monitoring Centre staff.
Ranking Legend: 1 = good; 2 = moderate; 3 = poor; 4 = nonexistent or unavailable.

certain countries and, in very few cases, such data have been georeferenced for use in a Geographic Information Systems (GIS). (The GIS, developed by the International Council for Bird Preservation in Cambridge, United Kingdom for its work on centers of avian endemism, is one notable exception.)

Habitat distribution has been defined for the known bird species of the world, which would allow a breakdown of threatened and endangered species by broad habitat type (Sibley and Munroe, 1990). Similar data for mammals are available for South America only. Mares (1992) classified mammal species by six habitat types: lowland Amazon forest, western montane forest, Atlantic rain forest, upland semideciduous forest, southern mesophytic forest, and drylands. WCMC's data fields on species generally do not include information on habitat distribution because of a lack of consensus on which habitat classification system to use.

Extinction (Indicator 2). Although more countries report on species status as compared to species numbers, these data are much less reliable. Approximately 50 percent of mammalian taxa have been surveyed for global endangered status, 100 percent of bird taxa, 15 percent of reptile taxa, 10 percent of amphibian taxa, and 10 percent of vascular plant taxa. At latest count, approximately 60 percent of countries and territories had compiled Red Data Books (lists of endangered and threatened species) for plants. These lists vary considerably in their completeness: WCMC estimates that about 45 countries have complete lists, 65 countries have completed a considerable amount of work for a number of selected families or groups, and 83 countries have preliminary data only. Species listed in Appendix 1 of CITES (an international treaty regulating trade in rare and threatened species) provide another indication of species at risk.

Extirpation (Indicator 3). Data for species threatened with extirpation within a given country are available for a number of industrialized countries, as reported in the OECD *Environmental Data Compendium* (OECD, 1991). Measures of threatened species are considered by most analysts to be very poor and usually understated because they are based on attempts by governments to identify and list threatened species that have to meet administrative as well as biological criteria. On the other hand, in a few cases naturally rare species may be included incorrectly in lists of endangered species.

Endemism and Species Risk Index (Indicators 4, 5, and 6). Data summarizing the numbers of plants endemic to specific countries are available for about 115 countries. *Global Biodiversity Status of the Earth's Living Resources* (WCMC, 1992) includes similar information for mammal, bird, reptile, and amphibian taxa. As with information on species richness, range information needed to permit the evaluation of patterns of endemism at a subnational level either does not exist or is not georeferenced adequately to specific locations within countries. Therefore, it is difficult to use at the level of ecoregions, states, or provinces. For the use of the Species Risk Index, information is needed on patterns of community coverage at a subnational level and patterns of endemism within community or ecosystem types. With the exception of the studies by MacKinnon and MacKinnon (1986a, 1986b), such data are not widely available yet.

Population Trends (Indicators 7 and 8). Data on population dynamics are available for selected species such as game, endangered megafauna (for example, rhinoceroses and whales), and data from bird counts. The data that have been compiled for industrialized countries are far more comprehensive than those available for developing countries.

Species Occurrence in Protected Areas (Indicators 9 and 10). WCMC text files on protected areas provide data (of variable quality) on species found in many national parks and reserves, including some information on endemism.

Communities

Area Dominated by Nondomesticated Species (Indicators 14, 15, and 16). This statistic is not readily available in a form comparable among countries. The Food and Agriculture Organization of the United Nations (FAO) land use data come closest to serving this need on a global scale, but a number of problems prevent their direct application, including considerable annual variation in the data and category definitions of little service for biodiversity indicators (for example, the "forest and woodland" category includes clear-cut areas, with many other habitats such as wetlands, parks, and coastal habitats classified as "other land").

Digitized vegetation maps are available for a number of countries through the WCMC map library. These maps provide information about the extent of the community, but tell nothing about the degree of degradation. WCMC is mapping the extent of tropical forest also (generally digitized at a 1:1,000,000 scale). These maps are being published in a series of regional atlases. The atlases of Asia and Africa are available. The final edition in this series, covering Latin America, should be completed by mid-1993.

Other options for calculating the area dominated by nondomesticated species include combining data on the Afrotropical and Indo-Malayan realms compiled in MacKinnon and MacKinnon (1986a, 1986b) with data reported in country environmental profiles and various natural resource inventories, such as the U.S. Agency for International Development studies of Mali, Mauritania, and Senegal. Matthews (1983) also provides regional-level information on global vegetation and land use, including agricultural and nonagricultural lands. Except in areas where land-use information is georeferenced, information on patterns of fragmentation is unavailable on a worldwide basis.

The global biogeographical maps of Bailey (1989), Holdridge (1967), Olson *et al.* (1983), and Udvardy (1975) are available in digital form through WCMC's map library. However, these data are estimates of the historical or potential coverage of nondomesticated species, rather than the current coverage. Also, they are too crude to be used at a scale finer than the regional level. A final approach uses infrastructure as a criterion. The Sierra Club and the World Bank have computed data for "wilderness" for countries based on the presence or absence of human settlements within 4,000 sq km units (McCloskey and Spalding, 1989). Conservation International, using some additional criteria, has mapped undisturbed, partially disturbed, and human-dominated areas of the world, at a base unit of 400 sq km (Hannah, unpublished manuscript).

Protected Area Coverage (Indicator 17). WCMC's Protected Area Data Unit maintains a relatively complete, country-by-country data base on protected areas. These data are organized according to several classifications, including by IUCN category. The WCMC map library contains polygon or point data for many of the IUCN category I-V protected areas over 1,000 hectares in size. The data are most complete for tropical forest countries where, in some cases, both protected areas under 1,000 hectares in size and forest reserves (generally, IUCN category VIII) have been mapped.

Information on species and habitats occurring in the protected areas is often available but not readily retrievable yet. The MacKinnons (1986a, 1986b) analyzed the percentage of each habitat type protected at the country level for the Afrotropical and the Indo-Malayan realms, using White's (1983) vegetation map of Africa and an Udvardy-based classification of Asia.

Biogeographical maps (Bailey, 1989; Udvardy, 1975; etc.) overlaid onto digitized maps can provide a surrogate measure of habitat coverage. IUCN (1990) published a regional analysis of protected area coverage by biome and province, using Udvardy's (1975) vegetation map of the world.

Domesticated Species

Gene Bank Coverage and Status (Indicators 18 and 19). Complete information on the numbers of crop accessions held by gene banks worldwide is maintained by the International Board for Plant Genetic Resources in Rome. Similar information for livestock genetic diversity is available through the Food and Agriculture Organization but is not as current or complete. Information on the extent to which accessions have been regenerated is available through each *ex-situ* facility only. In 1993, the FAO Commission on Plant Genetic Resources plans to publish a *Status Report on Genetic Resources*, which may contain data needed for some of these indicators.

In-Situ Species and Varietal Diversity (Indicators 20, 21, and 22). The numbers of species being grown in various subnational regions are available on an anecdotal basis only. The FAO does publish crop production statistics on a national basis, including many crops of solely national importance (Prescott-Allen and Prescott-Allen, 1990). Information on varietal diversity is kept for certain crops in certain countries only. For example, the United States kept close track of the varietal diversity of wheat beginning in 1919 but stopped monitoring this after 1984. Basic information on the numbers of varieties in use is available through patent offices in countries that require the registration of varieties and the issue of Plant Variety Certificates. In order to assess the coefficient of kinship or parentage, complete pedigree information is necessary for the varieties involved. Such data are held by breeders but are difficult to obtain because of proprietary considerations.

This cursory review of the availability of data suggests that a considerable amount of information is available with which to develop indicators that can be used to assess biodiversity conservation at national and global levels. There are major gaps in the data: in species, particularly marine, freshwater fish, and invertebrates; in species threatened, endangered and protected, which reflects a lack of good population data; and in communities, including baselines and rates of change. Significant limitations also prevent analysts at the local, national, regional, and global levels in getting access to and documenting the quality of data on species and habitats. Much biodiversity information is still treated as if it were of principally scientific interest, even though it has become relevant policy information and needs to be standardized and made available to policy-makers in and out of government in forms that are useful and usable.