Change may provide a means to enhance the quality and timeliness of the interactions between scientists and policy-makers at national scales and above. The GLOBE International Commission on Land Use Change and Ecosystems, made up of senior legislators from the G8+5 and several developing countries, provides another opportunity to bring policy-makers and scientists together. Similar initiatives will also be needed at the subnational scale.

The United Nations will convene a summit in 2010 to consider the second 5-year review of the MDGs and to catalyze action ahead of the 2015 MDG target year. We must advise policy-makers and civil society organizations on the most critical initiatives needed to achieve the MDGs while preserving biodiversity and ecosystem services.

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ECOLOGY

Tracking Progress Toward the 2010 Biodiversity Target and Beyond

Biodiversity indicators used by policy-makers are underdeveloped and underinvested.

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In response to global declines in biodiversity, some 190 countries have pledged, under the Convention on Biological Diversity (CBD), to reduce the rate of biodiversity loss by 2010 (*1*, *2*). Moreover, this target has recently been incorporated into the Millennium Development Goals in recognition of the impact of biodiversity loss on human well-being (*3*). Timely information on where and in what ways the target has or has not been met, as well as the likely direction of future trends, depends on a rigorous, relevant, and comprehensive suite of biodiversity indicators with which to track changes over time, to assess the impacts of policy and management responses, and to identify priorities for action. How far have we come in meeting these needs, and is it sufficient?

In 2006, the CBD adopted a framework of 22 cross-disciplinary headline indicators with which to measure progress toward the target at a global level (*4*, *5*). Countries are being encouraged to report progress at the national level using this framework, which is also being applied in regional initiatives such as "Streamlining European Biodiversity Indicators" (SEBI 2010). Other global multilateral environmental agreements, including the Ramsar Convention on Wetlands, the Convention on Migratory Species, and the Convention on International Trade in Endangered Species of Wild Fauna and Flora, are also adopting and adapting relevant subsets of the indicators.

However, with 2010 fast approaching, the indicator set is by no means complete. This is unsurprising given the short time since the framework was agreed upon. Of the 22 headline indicators, 5 are not being developed at a global scale, and there will be none to measure the status of access and benefit sharing, one of the three objectives of the CBD. The remainder has been subdivided into 29 actual measures, of which only 9 can be considered well-developed, with established methodologies, reasonable global coverage (all continents except Antarctica, tropical and temperate regions, and developed and developing countries), and sufficient time-series data (at least three data points spanning at least 10 years) to demonstrate changes over time [(Table 1) and supporting online material (SOM)].

Even for these well-developed global indicators, there are challenges in terms of data availability, consistency, and relevance. Some indicators are only weak proxies for biodiversity, because the urgent need for indicators has often meant relying on existing measures designed for purposes other than tracking biodiversity change. For example, forest cover may be an acceptable proxy for timber stocks, but says less about the condition of forest biodiversity. Likewise, protected area coverage signals government commitments but does not in itself measure effectiveness in reducing biodiversity loss. These subtleties are beginning to be explored but require further effort.

Patchy data are another challenge, including gaps in data submissions for indicators compiled from national reports (*6*–*9*) and incomplete taxonomic and geographic coverage of indicators compiled directly from data. The most well developed direct measures of biodiversity are species indicators, such as the IUCN Red List Index (RLI) (*10*) and the Living Planet Index (LPI) (*11*). They are being used to inform and underpin a variety of other indica-

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tors (see SOM). Nevertheless, in the RLI, only a small number of taxonomic groups have been fully assessed, whereas, in the LPI, tropical species are poorly represented (*12*). Efforts are being made to improve representation in both of these indicators, including through a sampled RLI approach (*13*).

Information on genetic- or ecosystem-level changes in biodiversity is much patchier. Despite the promise of remote sensing and the increasing quality and availability of satellite imagery, translating this into meaningful metrics of change for freshwater systems, drylands, coastal and marine habitats, and other ecosystem types has proved challenging to date. Local and regional studies are available (*14*), but they are yet to be applied globally. Likewise, indicators of genetic biodiversity are slowly being compiled for domesticated and cultivated varieties but not yet for wild relatives.

For the indicators that are under development, the race is now on to ensure adequate coverage and sufficient time-series data by 2010. Although progress has undoubtedly been made, for some, such as trends in genetic diversity and ecosystem fragmentation, a baseline and established methodology may be the most that can be expected. Some of these indicators require input from a range of disciplines not traditionally associated with biodiversity science, such as geophysics, economics, sociology, anthropology, agronomy, and health. The scientific community must be encouraged to engage in the development of these indicators and to provide case studies demonstrating how and why biodiversity losses have been reduced.

Whatever the indicators tell us, it is widely held that the target cannot and will not be achieved in its entirety (*16*). Although the current indicators will provide a partial story about both achievements and failures, there are gaps and missing linkages in the framework that mean it may not be sufficient to communicate the urgency of the message, to hold politicians to account, or to inform them of how best to act.

In October 2010, the Conference of the Parties (COP) to the CBD will review progress and agree on a new set of targets and a revised indicator framework. Whatever shape these targets take, the lessons for indicator development are clear. Indicators must be closely linked to the targets, but also to each other. We believe that a revised framework comprising a small set of headline indicators in four focal areas (pressures–threats, status–trends, benefits–services, and actions–responses) with underlying measures that are causally linked, will make it clearer to policy-makers how biodiversity loss affects people and how actions to reduce threats make a difference.

Continued investment must be made in the existing indicators to improve taxonomic, geographic, and temporal coverage, alongside support to develop measures at the finer (genetic) and broader (ecosystem) scales. Indicators of the biodiversity impacts of a wider range of threats, including climate change, should be incorporated. Critically, indicators must be developed to fill a major gap regarding the effect of biodiversity change on the provision of ecosystem services. A balance must be found between developing too large and confusing an array of individual measures versus relying on a few aggregate indices that appear compelling but that mask complexity and can be misinterpreted. Quality-control efforts are needed to ensure that indicators are sufficiently scientifically rigorous, free of bias, and sensitive enough to detect meaningful change (*16*).

Indicators cannot be developed in the absence of reliable biodiversity data. Systematic global biodiversity monitoring (*17*, *18*) would help, but this must be balanced with significant indicator capacity development at the national level. Better national indicators, developed as part of an inclusive international process, will enable better global syntheses beyond 2010. The scientific community must engage and encourage governments in this regard.

Biodiversity indicators

Components of biodiversity	
Trends in extent of selected biomes, ecosystems, habitats	
Trends in abundance of selected species	
Coverage of protected areas	
Changes in status of threatened species	
Trends in genetic diversity	
Sustainable use	
Area under sustainable management	
Proportion of products from sustainable sources	
Ecological footprint and related concepts	
Threats to biodiversity	
Nitrogen deposition	
Trends in invasive alien species	
Ecosystem integrity, goods and services	
Marine Trophic Index	
Water quality of freshwater ecosystems	
Trophic integrity of other ecosystems	
Connectivity/fragmentation of ecosystems	
Human-induced ecosystem failure	
Health and well-being of communities	
Biodiversity for food and medicine	
Status of knowledge, innovations, and practices	
Linguistic diversity	
Indigenous and traditional knowledge	
Status of access and benefits sharing	
Access and benefits sharing	
Status of resource transfers	
Official development assistance	
Technology transfer	

Table 1. Current development of the headline biodiversity indicators within the CBD framework. ■ Fully developed with well-established methodologies and global time-series data, ■ under development, and ■ not being developed. Multiple labels indicate multiple measures under each headline. See also SOM and 2010 Biodiversity Indicators Partnership, www.twentyten.net.

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