ECOLOGY

The Biodiversity and Ecosystem Services Science-Policy Interface

Assessments must provide conditional predictions of the consequences of specific policy options, at well-defined spatial and temporal scales.

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In recognition of our inability to halt damaging ecosystem change (*1*–*4*), the United Nations Environment Programme (UNEP) was asked in December 2010 to convene a meeting "to determine modalities and institutional arrangements" of a new assessment body, akin to the Intergovernmental Panel on Climate Change (IPCC), to track causes and consequences of anthropogenic ecosystem change (*5*). The "blueprint" for this body, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), lies in recommendations of an intergovernmental conference held in the Republic of Korea in June 2010: the Busan outcome (*6*). But it is a blueprint for governance rather than science. Using the experience from past assessments of global biodiversity and ecosystem services change (*1*, *7*, *8*) and from the IPCC (*9*–*11*), we ask what the policy-oriented charges in the Busan outcome imply for the science of the assessment process.

The Busan Outcome

Although previous global-change assessments required policy relevance, we argue that the policy orientation and support role of IPBES goes further. For example, rather than investigating consequences of specific policies identified by a governing body, most previous assessments were constructed around scenarios devised by scientists. The Busan outcome imposes a greater obligation on the IPBES to support specific policies, with implications for both the way the governing body gives charges to scientists and the way scientists carry out their work.

We focus on four functions identified in the Busan outcome: (a) "identify and prioritize key scientific information needed for policymakers at appropriate scales," (b) "perform regular and timely assessments of knowledge on biodiversity and ecosystem services and their interlinkages, which should include comprehensive global, regional, and, as necessary, sub-regional assessments and thematic issues at appropriate scales and new topics identified by science," (c) "support policy formulation and implementation," and (d) "prioritize key capacity-building needs to improve the science-policy interface…."

Three broad implications emerge: (i) The governing body of IPBES, the plenary, should ask for assessment of consequences of specific policies and programs at well-defined geographical scales. (ii) Projections of changes in biodiversity and ecosystem services should take the form of conditional predictions of the consequences of these policies and programs. And (iii), capacity-building efforts should enhance skills needed for policy-oriented assessment within IPBES and should catalyze external funding for underpinning science and science-based policy development.

Strengthening Policy Relevance

A critical lesson from the Global Biodiversity Assessment (GBA), the Millenium Ecosystem Assessment (MA), and the IPCC is that assessments should evaluate consequences of real policy options. This requires closer integration of the different elements of the science-policy process—research, monitoring, assessment, and policy development (*12*). Research uncovers mechanisms that explain how biodiversity change impacts ecosystem services and human well-being. Monitoring records trends in indicators of change. Assessment reports scientific evidence of change and evaluates mitigation, adaptation, or stabilization options identified by policymakers. Policy selects the "best" response. Although the establishment of IPBES means that all of these elements of the process will now be in place, all need to be strengthened if the new body is to discharge its functions effectively. Assessment, however, will be its core business.

The IPBES plenary will set the scale, focus, and terms of reference of assessments, although for preliminary assessments of emerging issues, this could be delegated to the executive to make it possible to respond in a rapid and flexible manner. To connect policy and assessment more closely, the terms of reference given to working groups should include the mitigation, adaptation, and stabilization options on which future projections are to be based. Examples might be the options identified by the Convention on Biological Diversity (CBD) in its 2020 targets (*13*, *14*) or UNEP's Green Economy initiative (*15*). The plenary will also establish a rigorous review process to assure the technical content of assessments and will be expected to retain direct responsibility for evaluating policy implications.

These functions have implications for the membership of the plenary. Although core membership will be national representatives, the issues that IPBES will be asked to address include many covered by multilateral agreements between nation states. The plenary will accordingly include representatives of multilateral agreements related to biodiversity and ecosystem services. As the primary conservation agreement, the CBD will be a natural and important member. However, it is only one among many relevant multilateral agreements. IPBES should support the other conservation conventions, as well as the many agreements dealing with ecosystem services (e.g., the UN Fish Stocks Agreement) or the drivers of change (e.g., the General Agreement on Tariffs and Trade).

These functions also have implications for the balance of disciplinary expertise required. This should span the natural and social sciences and should be reflected in IPBES leadership (the plenary and working group co-chairs), working groups (the scientists invited to carry out assessments), and the secretariat (the "permanent" IPBES staff scientists supporting assessments).

Strengthening Assessment

Matching assessments to policy needs affects the type of assessments undertaken. Some impacts of biodiversity and ecosystem change are local, others are national, regional, or global. Some are extremely fast, others occur on time scales more comparable with climate change. The policy focus of IPBES suggests that something like the sub-

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sidiarity principle of European environmental policy (*16*) should apply. This principle, partially reflected in the MA global and subglobal assessments, holds that management of environmental problems should be at the scale consistent with capturing all relevant effects. We suggest that assessments should be undertaken at the smallest geographical scale consistent with capturing all relevant effects of the biophysical and social processes involved. Similarly, effects that occur on short time scales should be assessed more frequently and over a shorter time horizon than effects that occur on longer time scales.

Quantitative projections of impacts of global change on biodiversity—MA; UNEP Global Environment Outlook 4 (GEO-4); CBD Global Biodiversity Outlook 3 (GBO-3)—represent a major step forward for biodiversity assessment (*17*). In addition, assessments will need integrated models of social and environmental change that are capable of providing conditional predictions (probabilistic projections conditional on specific policy options identified by the plenary). This requires a step change in our capacity to model interactions between the socioeconomic system and the biophysical environment. Without an understanding of the feedbacks between the social and biophysical systems, it is not possible to assess the outcome of actions designed to alter the likelihood of environmental change (mitigation) relative to those designed only to alter its cost (adaptation) or to reduce stress on the uncontrolled parts of the system (stabilization).

There is also a case for strengthening monitoring activities. We anticipate that future assessments will call on the Global Earth Observing (GEO) Biodiversity Observation Network (BON), currently being designed as part of GEOSS, the Global Earth Observing System of Systems (*18*). Despite some focus on ecosystem services, however, GEO BON does not broadly integrate socioeconomic observations. Such data would be valuable to IPBES, and GEO BON has convened a working group to consider including such observations.

Strengthening Science

As with other assessments, IPBES will be charged with undertaking only synthetic and meta-analytical research, not the original research on which synthesis or meta-analysis is based. Although it is important to strengthen assessments, including the tools of synthesis, all assessments are ultimately only as strong as the supporting science. The MA, for example, was able to record physical changes in ecosystem services, but not the value of those services. Yet that is what is needed for policy. The recent assessment of the economics of ecosystems and biodiversity (TEEB) shows that understanding of the social importance of changes in biodiversity and ecosystem services is still very patchy (*19*). In part, this reflects the fact that national funding for science is both highly uneven and biased toward national issues.

The four global change programs under the auspices of the International Council for Science (ICSU)—DIVERSITAS, the International Geosphere-Biosphere Program (IGBP), the International Human Dimensions Program on Global Environmental Change (IHDP), and the World Climate Research Program (WCRP)—will be natural partners of IPBES. But these also rely on national sources for research funding, and so reflect the same unevenness as national research efforts. Broadening and deepening the funding base for the research on which assessments of biodiversity and ecosystem services are made is a basic requirement for the success of IPBES (*20*, *21*).

The Busan outcome recognized that to build capacity in basic science will require resources from elsewhere (e.g., development assistance budgets and governmental and nongovernmental research training funds). A key function of IPBES will be to catalyze such resources. One mechanism proposed in the Busan outcome is a "dialogue" between key scientific organizations, environmental policy bodies, and research funding organizations. We consider this a critical feature to address both scientific capacity and the policy relevance of research.

Conclusions

There is growing consensus that solving problems posed by global environmental change requires coordinated international research, better resourced than in the past, and paying at least as much attention to social science as it does to natural science (*22*, *23*). The establishment of IPBES provides an important link with international policy, but its effectiveness depends on the quality of the underlying science. Knowing whether the effects of biodiversity and ecosystems services change are contained within a decision-maker's jurisdiction is critical to the development of coordinated or cooperative management of the problem across jurisdictions. Knowing likely consequences of alternative policy options is critical to the choice of the best strategy.

For IPBES to provide the policy support envisaged in the Busan outcome, it needs to answer questions that are meaningful to the nations that have brought it into being. This requires an approach that differs from those adopted in previous assessments—in the functions and membership of the plenary, in assessment methodology, and in decision support. The IPBES plenary should specify the policy options to be evaluated; assessment should include quantitative conditional prediction of the consequences of those options; and reports should enable policy-makers to evaluate the relative merits of mitigation, adaptation, and stabilization strategies. This requires a much higher level of commitment to capacity-building and to engagement with the policy community. The establishment of IPBES offers a unique opportunity to build on what has been done already. It should not be wasted.

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