Rev. sci. tech. Off. int. Epiz., 2010, **29** (1), 65-72

Biodiversity: an international perspective

S. Morand

Institut des Sciences de l'évolution, CNRS-UM2, CC065, Université de Montpellier 2, 34095 Montpellier, France & Unité de recherche Animal et Gestion Intégrée des Risques (UR AGIRs), CIRAD, France

Summary

This paper examines the way in which biodiversity has been incorporated into the agenda of many international organisations, including non-governmental organisations, and international programmes. Biodiversity has been defined by the Convention on Biological Diversity but is also widely discussed in relation to genetic resources, biodiversity hotspots and ecosystem services. The author identifies the principal institutions, organisations, conventions and international programmes that specifically refer to biodiversity, the environment or ecosystem services. This more recent 'ecosystem approach' has radically changed the perspective on biodiversity by focusing on the services that biodiversity provides. Finally, this paper stresses the urgent need to develop indicators of the ecosystem services that people and societies gain from biodiversity.

Keywords

Access – Benefit-sharing – Biodiversity – Biodiversity hotspots – Ecosystem services – Genetic resources – Hotspots – Indicators.

Introduction

Since the United Nations Conference on the Environment and Development, or the 'Rio Summit', held in 1992, the diversity of all living things, identified by the term 'biodiversity', has become of global concern. The definition of biodiversity, as given by the Convention on Biological Diversity (CBD) (Box 1), is: 'the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems' (Article 2). The preservation of biodiversity has been clearly identified as an international goal. Indeed, biodiversity is the source of many ecosystem goods, such as food, shelter and genetic resources. Any international strategy for sustainable development refers to the principle of sustainable and equitable use of biodiversity. However, the definition of biodiversity given by the CBD is so general that it can be interpreted and used in different ways. In this paper, the author aims to present the various ways in which biodiversity is discussed, from genetic resources to ecosystem services, as well as examining how international organisations and programmes have incorporated biodiversity into their agendas (Box 2).

Aspects of the biodiversity discussion

The main points in the biodiversity debate are:

– the loss of wildlife species

– the loss of agricultural diversity and erosion of genetic resources

– increasing interest in issues of ownership and control.

The loss of species is the concern of several major non-governmental organisations (NGOs), which have adopted the concept of 'hot spots of biodiversity' (5, 6). A second issue is the manipulation, commercialisation and patenting of living organisms, leading to the need for legal protection of gene banks and local expertise, while acting ethically towards indigenous peoples and recognising their local expertise as valuable knowledge. This issue has culminated in two fundamental objectives of the CBD, as laid out in article 8J of the Convention:

– access and benefit-sharing

– the recognition of cultural diversity as an element in biodiversity.

Box 1
Institutions, organisations, conventions and programmes that specifically refer to biodiversity, environment or ecosystem services
This is not an exhaustive list

International organisations
- Food and Agriculture Organization of the United Nations (FAO) www.fao.org
- United Nations Development Programme www.undp.org
- United Nations Educational, Scientific and Cultural Organization www.unesco.org
- United Nations Environment Programme www.unep.org
- United Nations Foundation www.unfoundation.org
- World Bank www.worldbank.org
- World Health Organization www.who.org

International institutions
- Consultative Group on International Agricultural Research www.cgiar.org
- Global Environment Facility www.gefweb.org
- Intergovernmental Panel on Climate Change www.ipcc.ch
- International Council for Science www.icsu.org
- International Union for Conservation of Nature www.iucn.org

Conventions and agreements
- Convention on Biodiversity www.biodiv.org
- Convention on Biological Diversity Adaptation Website http://adaptation.cbd.int/
- Convention on International Trade in Endangered Species www.cites.org
- Convention on the Conservation of European Wildlife and Natural Habitats www.coe.int
- Convention on the Conservation of Migratory Species of Wild Animals www.cms.int
- FAO Commission on Genetic Resources for Food and Agriculture www.fao.org/nr/cgrfa
- Like-Minded Megadiverse Countries www.lmmc.nic.in/index.php
- Ramsar Convention on Wetlands www.ramsar.org
- Trade-Related Aspects of Intellectual Property Rights Agreement (World Trade Organization) www.wto.org
- United Nations Convention to Combat Desertification www.unccd.int
- United Nations Framework Convention on Climate Change www.unfccc.int
- World Heritage Convention http://whc.unesco.org/

International programmes and non-governmental organisations
- BirdLife International www.birdlife.net
- Conservation International www.conservation.org
- Diversitas, an international programme of biodiversity science www.diversitas-international.org
- Environmental Research Web http://environmentalresearchweb.org/cws/home
- Global Ballast Water Management Programme http://globallast.imo.org
- Global Invasive Species Programme www.gisp.org
- International Council for Game and Wildlife Conservation www.cic-wildlife.org
- International Geosphere – Biosphere Programme www.igbp.net
- Wetlands International www.wetlands.org
- World Conservation Society www.wcs.org
- World Wide Fund for Nature www.panda.org

More recently, the accepted view on biodiversity has been challenged by the concept of ecosystem services. This perspective emerged from the 'ecosystem approach', and is defined by the CBD, as follows:

'The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Thus, the application of the ecosystem approach will help to reach a balance of the three objectives of the Convention: conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. An ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential structure, processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems.'

The Millennium Ecosystem Assessment (Box 2) defines 'ecosystem services' as the benefits people obtain from ecosystems, which include:

- provisioning services (food, water)
- regulating services (flood, disease control)

Box 2
Examples of conferences and reports that stress the themes of biodiversity, sustainable development and the ecosystem approach

Conferences

– United Nations Conference on the Human Environment (Stockholm, 1972), with adoption of: Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

– United Nations Conference on Environment and Development, or 'Earth Summit' (Rio de Janeiro, 1992), with adoption of:

a) the Convention on Biological Diversity (CBD)

b) the United Nations Framework Convention on Climate Change

– United Nations Convention to Combat Desertification

– The Forest Principles

– International Conference on Population and Development (Cairo, 1994)

– World Food Summit (Rome, 1996)

– United Nations Millennium Summit (New York, 2000)

– Cartagena Protocol on Biosafety, adopted by Parties to the CBD (2000)

– World Summit on Sustainable Development (Johannesburg, 2002)

– World Summit: 'Biodiversity, Science and Governance' (Paris, 2005)

Reports and statements

– World Conservation Strategy (IUCN *et al.*, 1980)

– Brundtland report: 'Our Common Future' (WCED, 1987)

– Caring for the Earth (IUCN *et al.*, 1991)

– Our Common Journey: A Transition Toward Sustainability (NRC, 1999)

– United Nations Millennium Declaration (2000)

– Transition to Sustainability in the 21st Century: The Contribution of Science and Technology (2000)

– International Panel on Climate Change

– Millennium Ecosystems Assessment

IUCN: International Union for Conservation of Nature
WCED: World Commission on Environment and Development
NRC: National Research Council

– cultural services (spiritual, recreational and cultural benefits)

– supporting services (nutrient cycling).

Assuming that all changes in biodiversity can influence the supply of ecosystem services, the preservation of biodiversity is then recognised as crucial for human development and the reduction of poverty.

Access and benefit-sharing: a focus on genetic resources

The CBD recognises the sovereign rights of States over their natural resources within their jurisdiction, which guide their authority to determine conditions of access to genetic resources. Parties to the Convention have, however, the obligation to take appropriate measures to favour the sharing of benefits derived from the use of genetic resources. This is one of the three fundamental objectives of the CBD. However, two other international forums overlap this scope by addressing the use of genetic resources from their own institutional perspectives:

– the Food and Agriculture Organization of the United Nations Commission on Genetic Resources for Food and Agriculture

– the Trade-Related Aspects of Intellectual Property Rights Agreement (the 'TRIPS Agreement') (Box 1).

The countries that provide the genetic/biological resources, mostly countries of the South, have a major interest in ensuring their national sovereignty over their own genetic/biological resources. The concept of access and benefit-sharing recognises and protects the genetic resources of indigenous peoples and particularly their knowledge, in the context of international business (for example, from pharmaceutical or agro-chemical companies). These countries are now protected by international law under the CBD. However, the patenting of living matter (which may differ from country to country, according to national jurisdiction) demanded by the TRIPS Agreement can run counter to the access and benefit-sharing mechanisms of the CBD. Moreover, focusing on genetic resources may have prevented significant advances in other areas of the CBD. This may explain why some conservation biologists try to find other solutions and approaches when confronting the rapid and continuing erosion of biodiversity.

Biodiversity hotspots: the territorialisation of biodiversity

Norman Myers proposed the concept of the 'biodiversity hotspot' in 1988 (5), as a means of identifying which areas are of immediate priority in conserving biodiversity. A biodiversity hotspot is defined as a region that must contain at least 1,500 species of endemic vascular plants. Moreover, this region should have lost at least 70% of its original habitat. Thus, more than 50% of the total plant

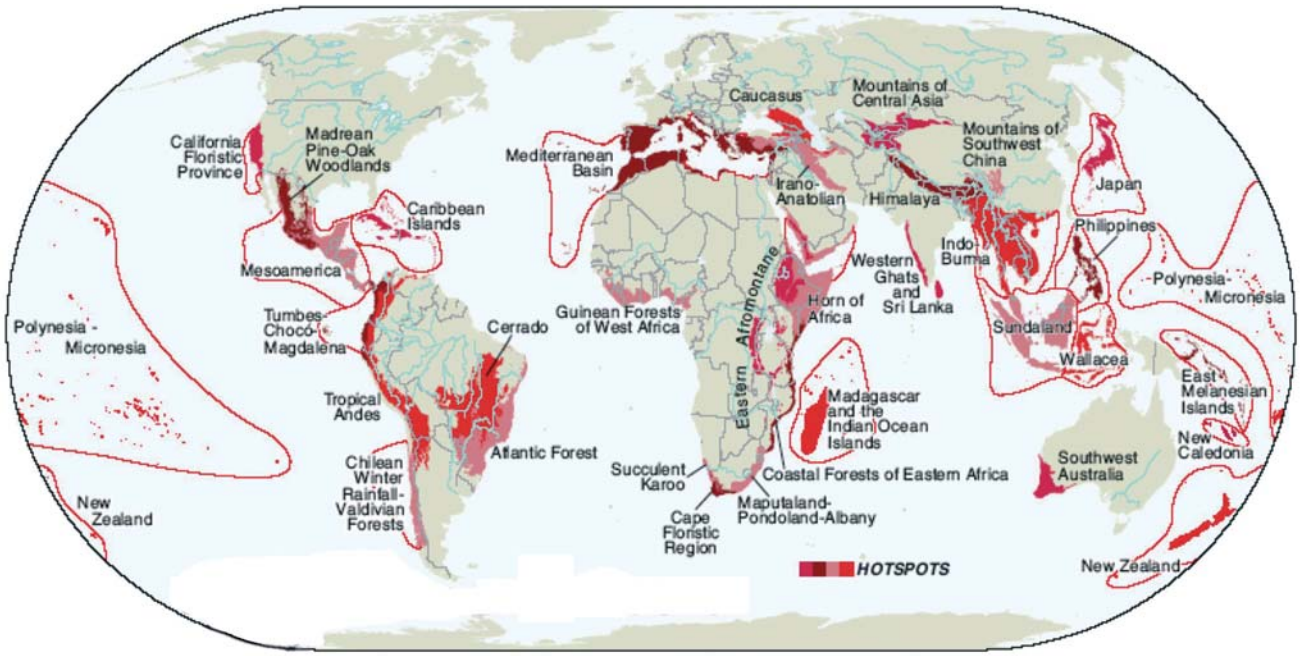

Fig. 1
The world map of biodiversity hotspots, 2005
Source: Conservation International (www.conservation.org)

species and 42% of all terrestrial vertebrate species are endemic to 34 biodiversity hotspots. However, their combined surface area covers only 2.3% of the Earth's land mass (Fig. 1). Some NGOs, such as Conservation International (Box 1), have adopted the Myers concept of hotspots into their institutional framework. Nonetheless, hotspots are not the only way of assessing global conservation priorities. For instance, BirdLife International has identified 218 'endemic bird areas' and the World Wildlife Fund (United States) has proposed '200 global ecoregions'.

The biodiversity hotspots approach has drawn considerable criticism (4, 7), pointing out that this concept does not make any allowance for changing patterns of land use. Although hotspots represent regions that have already experienced considerable habitat loss, other regions that are relatively intact are also currently losing habitats at considerable rates. Furthermore, biodiversity hotspots do not protect ecosystem services but only areas of rich endemism. By focusing on geographically localised areas, biodiversity hotspots have also concentrated on specific countries with rich biodiversity, the 'mega-diverse' countries, and may have prioritised conservation spending on these regions, to the detriment of others.

In 2002, an organisation called 'Like-Minded Megadiverse Countries' (LMMC) (Box 1) was formed in Mexico by 17 countries rich in biological diversity and associated traditional knowledge. The LMMC countries aim to act co-operatively to promote their interests in terms of biological diversity, the protection of traditional knowledge, access to genetic resources and the fair and equitable sharing of benefits derived from their use. This organisation does not include all the mega-diverse countries, as identified by the World Conservation Monitoring Centre (Box 3).

Box 3
A list of biodiversity databases, monitoring networks and indicators

This is not an exhaustive list

- Biocase (Biological Collection Access Services)
  www.biocase.org
- Biodiversity Information Standards
  www.tdwg.org
- Census of Marine Life
  www.coml.org
- Global Biodiversity Information Facility
  www.gbif.org
- Global Invasive Species Database
  http://issg.appfa.auckland.ac.nz/database/welcome/
- Global Ocean Observing System
  www.ioc-goos.org
- Global Taxonomy Initiative
  www.cbd.int/gti
- Global Terrestrial Observing System
  www.fao.org/GTOS
- 2010 Biodiversity Indicators Partnership
  www.twentyten.net
- World Conservation Monitoring Centre
  www.unep-wcmc.org

By focusing on areas, territories and, finally, States, the biodiversity hotspot approach may have found its limitations. The ecosystem approach, which emphasises the goods and services provided by ecosystem functions to human societies, avoids this focus on specific territories.

Ecosystem services and biodiversity

Variability among ecosystems is a key element of biodiversity. Climate changes, land-use changes, the over-use of living resources and bioinvasion all affect biodiversity, not only by increasing species loss but also by potentially damaging the functioning of ecosystems. Theoretical and empirical work have both identified links between global changes, biodiversity and the way in which ecosystems function (1) (Fig. 2).

The ecosystem approach has been endorsed by both the CBD and the Millennium Ecosystem Assessment (Box 2) as a conceptual framework. Ecosystem services are defined as the benefits that people obtain from ecosystems, as noted above (Fig. 2). These services, which are largely free, have been estimated by Costanza *et al.* (3) to be worth, in economic terms, some US$33 trillion per year. This is nearly twice the value of the global gross national product of approximately US$18 trillion (3).

The Millennium Ecosystem Assessment was initiated in 2001. Its objectives were to assess the consequences of ecosystem change for human well-being and to provide the scientific basis for the actions needed to enhance conservation and sustainable use. More than 1,360 experts throughout the world worked on this project, with the goals of:

– examining the present condition and future trends of the ecosystems of the world

– assessing the services that such ecosystems provide

– developing solutions to enhance the sustainable use of these ecosystems.

Among the benefits obtained by humans from the regulation of ecosystem processes are:

– the regulation of human and animal diseases, since any changes in ecosystems can directly affect human pathogens or disease vectors, such as mosquitoes

– biological control, since any changes can affect crop pests and plant diseases.

One important concept has emerged from the ecosystem approach, the idea of 'ecosystem health'. This term is often applied in the evaluation of ecosystems, although it is also used to refer to the links between ecosystems and human (and animal) health, by emphasising the regulating role of ecosystems on pathogens (Fig. 3).

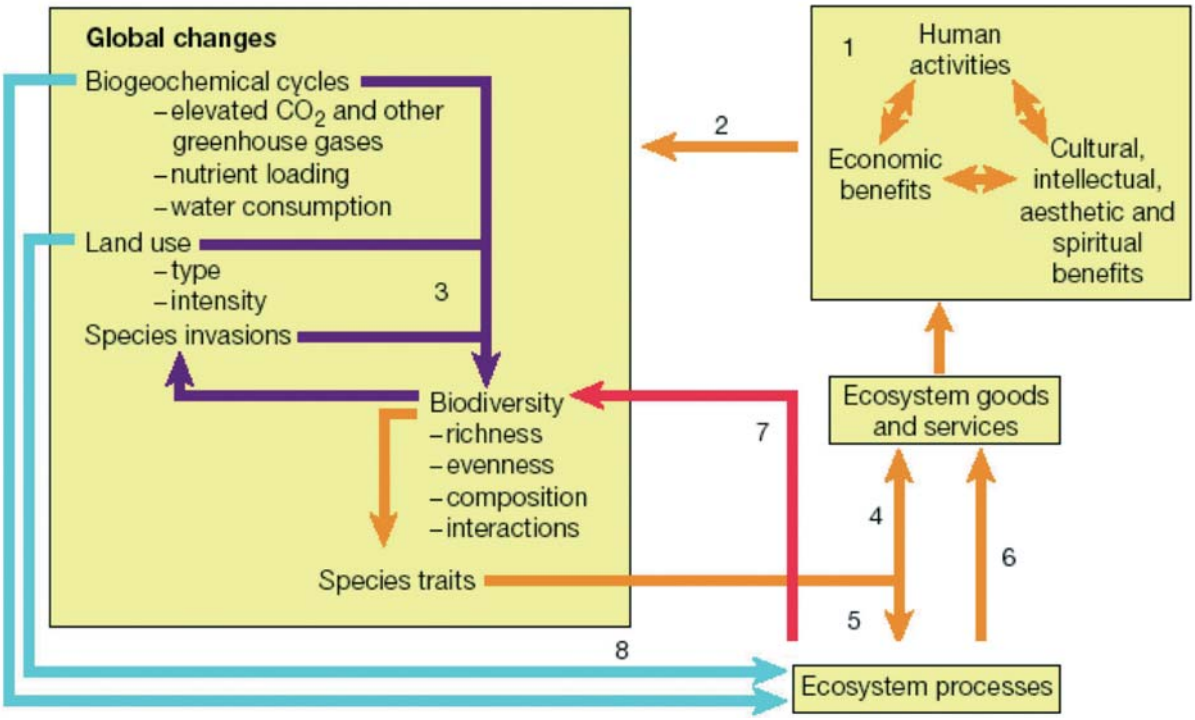

Fig. 2
How global changes which affect biodiversity may influence the goods and services provided to humans by ecosystems (1)

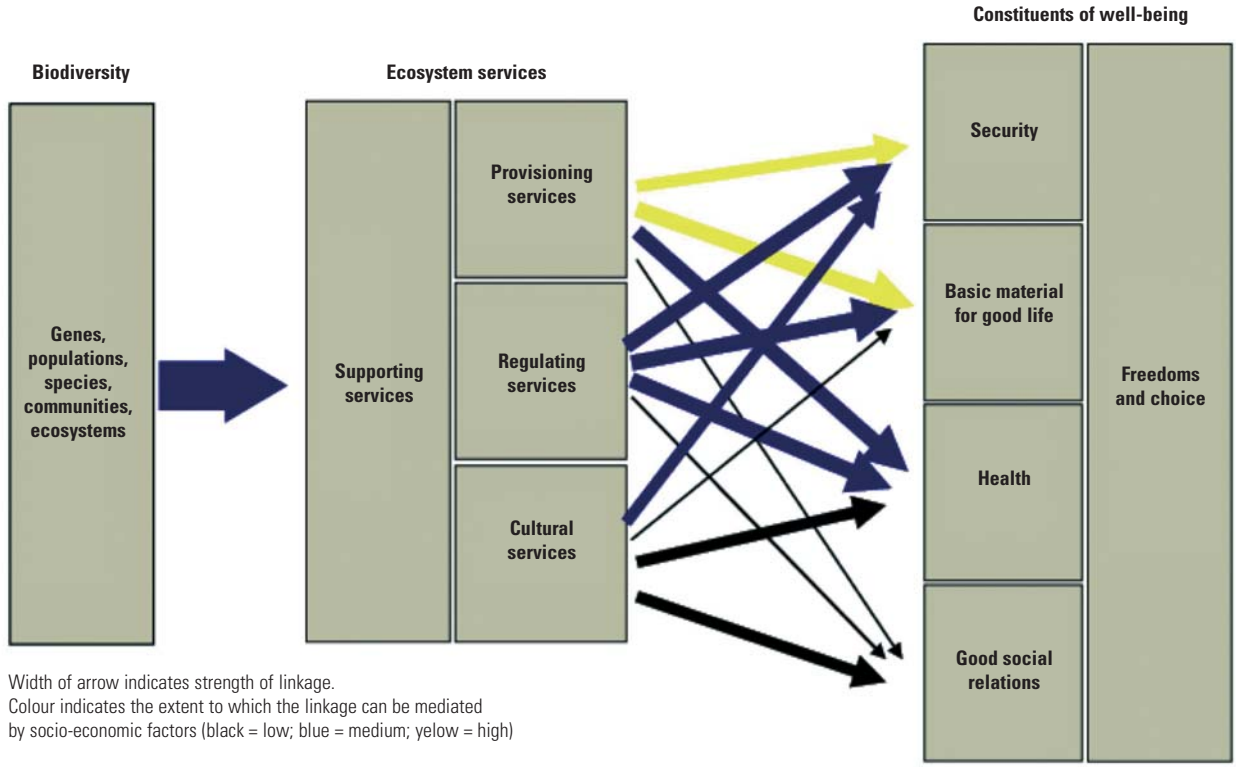

Fig. 3
Relationships between biodiversity, ecosystem services and the constituents of human well-being
Source: Millennium Ecosystem Assessment (www.milleniumassessment.org)

The Millennium Ecosystem Assessment was also designed to provide decision-makers with the information they need to manage ecosystems in a more sustainable manner, maintaining both biodiversity and the ecosystem services that are essential to human well-being. In particular, goal seven of the Assessment, entitled: 'Ensure environmental sustainability', identifies the following priorities:

– to integrate the principles of sustainable development into national policies and programmes and reverse the loss of environmental resources

– to halve, by 2015, the proportion of people without sustainable access to safe drinking water

– to have achieved, by 2020, a significant improvement in the lives of at least 100 million slum-dwellers.

Global databases and monitoring

All the institutions, organisations and programmes involved in maintaining biodiversity and/or the preservation of ecosystem services recognise the importance of databases and monitoring. Several international programmes are specifically targeted at such tasks (Box 3). The International Geosphere – Biosphere Programme has identified 17 types of land cover, using satellite data of 1 km resolution, which are considered proxies of aggregate ecosystem types. The World Wildlife Fund for Nature has developed a global system of 871 terrestrial eco-regions, nested within 14 biomes and 8 bio-geographic realms, based largely on patterns of potential natural vegetation. The Taxonomic Database Working Group Biodiversity Information Standards, affiliated with the International Union of Biological Sciences, was formed to aid international collaboration among biological database projects. This working group focuses on the development of standards for the exchange of biological/biodiversity data. The Global Biodiversity Information Facility is also a significant force in this work (Box 3).

Indicators of biodiversity

The next step was to develop biodiversity indicators. Twenty-two biodiversity indicators have been developed by the international organisations which participated in the 2010 Biodiversity Indicators Partnership (Box 3). However, the development of these indicators has recently been found to be incomplete. Moreover, these indicators do not include any measure of the impact of climate

change on biodiversity, and few may be used to estimate the goods and services that people gain from biodiversity and ecosystems (8).

Conclusion

Biodiversity is fundamental to many ecosystem services. Biodiversity provides sustainability for the livelihoods of many people, especially the rural poor, as they obtain goods and services from the functioning of ecosystems. Biodiversity has a stabilising and buffering function in ecosystem processes (Fig. 2). Following the CBD and Millennium Ecosystem Assessment, there is now global agreement that human well-being and the reduction of poverty are dependent upon biodiversity and ecosystem health. In April 2002, government delegates at the sixth meeting of the Conference of the Parties to the Convention on Biological Diversity agreed to: 'achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national levels as a contribution to poverty alleviation and to the benefit of all life on earth' (2). This target was endorsed by the World Summit on Sustainable Development.

■

Une perspective internationale sur la biodiversité

S. Morand

Résumé

L'auteur examine la manière dont la biodiversité est désormais inscrite à l'ordre du jour des organisations internationales, y compris les organisations non gouvernementales, et des programmes internationaux. La biodiversité est couverte par la Convention sur la diversité biologique, mais elle fait aussi l'objet de discussions plus larges qui ont trait aux ressources génétiques, aux points sensibles de la biodiversité et aux services fournis par les écosystèmes. L'auteur recense les principales institutions, organisations, conventions et programmes internationaux qui traitent spécifiquement de la biodiversité, de l'environnement ou des services fournis par les écosystèmes. Plus récemment, l'« approche écosystémique » a radicalement transformé la perception de la biodiversité, en mettant l'accent sur les services rendus par celle-ci. Pour conclure, l'auteur souligne l'impérieuse nécessité de mettre au point des indicateurs des services fournis par les écosystèmes, qui représentent des avantages pour l'être humain et pour les sociétés en général.

Mots-clés

Accès – Biodiversité – Indicateurs – Partage des bénéfices – Point sensible de la biodiversité – Points sensibles – Ressources génétiques – Services rendus par les écosystèmes.

■

Diversidad biológica desde el punto de vista internacional

S. Morand

Resumen
El autor examina el modo en que la diversidad biológica se ha ido incorporando a los temas de trabajo de gran número de programas y organizaciones internacionales, comprendidas las no gubernamentales. Aunque el concepto de "diversidad biológica" viene definido en el convenio internacional que lleva el mismo nombre, también suele utilizarse en relación con temas como los recursos genéticos, las zonas de gran biodiversidad o los servicios ecosistémicos. El autor enumera las principales instituciones, organizaciones, convenciones y programas internacionales que se centran específicamente en cuestiones de diversidad biológica, medio ambiente o servicios ecosistémicos. Este reciente 'planteamiento ecosistémico', al centrarse en los servicios que presta la diversidad biológica, ha modificado radicalmente la perspectiva desde la que solía abordarse la cuestión. El autor recalca por último la urgente necesidad de elaborar indicadores de los servicios ecosistémicos que la biodiversidad puede ofrecer a personas y sociedades.

Palabras clave
Acceso – Beneficios compartidos – Diversidad biológica – Indicadores – Punto sensible – Recursos genéticos – Servicios ecosistémicos – Zonas de gran diversidad biológica.

References

1. Chapin F.S. III, Zaveleta E.S., Eviner V.T., Naylor R.L., Vitousek P.M., Lavorel S., Reynolds H.L., Hooper D.U., Sala O.E., Hobbie S.E., Mack M.C. & Diaz S. (2000). – Consequences of changing biotic diversity. *Nature*, **405**, 234-242.

2. Convention on Biological Diversity (2002). – COP 6 Decision VI/26: Strategic plan for the Convention on Biological Diversity. *In* Proc. 6th Meeting of the Conference of the Parties to the Convention on Biological Diversity, 7-19 April, the Hague, the Netherlands. Available at: www.cbd.int/decisions/cop/ (accessed on 13 April 2010).

3. Costanza R., d'Arge R., de Groot R., Farber S., Grasso M., Hannon B., Limburg K., Naeem S., O'Neill R.V., Paruelo J., Raskin R.G., Sutton P. & van der Belt M. (1997). – The value of the world's ecosystem services and natural capital. *Nature*, **387**, 253-260.

4. Kareiva P. & Marvier M. (2003). – Conserving biodiversity coldspots. *Am. Scientist*, **91**, 344-351.

5. Myers N. (1988). – Threatened biotas: 'hot spots' in tropical forests. *Environmentalist*, **8** (3), 187-208.

6. Myers N., Mittermeier R.A., Mittermeier C.G., da Fonseca G.A. & Kent J. (2000). – Biodiversity hotspots for conservation priorities. *Nature*, **403** (6772), 853-858.

7. Possingham H.P. & Wilson K.A. (2005). – Biodiversity: turning up the heat on hotspots. *Nature*, **436** (7053), 919-920.

8. Walpole M., Almond R.E., Besançon C., Butchart S.H., Campbell-Lendrum D., Carr G.M., Collen B., Collette L., Davidson N.C., Dulloo E., Fazel A.M., Galloway J.N., Gill M., Goverse T., Hockings M., Leaman D.J., Morgan D.H.W., Revenga C., Rickwood C.J., Schutyser F., Simons S., Stattersfield A.J., Tyrell T.D., Vié J.-C. & Zimsky M. (2009). – Ecology. Tracking progress toward the 2010 biodiversity target and beyond. *Science*, **325** (5947), 1503-1504.