



Definitions

Biological diversity, or 'biodiversity', simply means the variety of life on Earth. Stated another way, it refers to 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.

Ecology is the study of the relationships and interactions between living organisms and their natural or developed environment.

Ecosystem services are the benefits of nature to people - households, communities and economies. They comprise provisioning, regulating, supporting and cultural services.

Ecological Footprint of an individual, a city, a country, or humanity is a measure of how much productive land and water they require to produce all the resources they consume and to absorb all the waste they generate, using prevailing technology. The term was coined by William E. Rees and Mathis Wackernagel in the early 1990s. The Ecological Footprint is measured in global hectares. Today, humanity's Ecological Footprint is over 23% larger than the planet can regenerate. (<http://www.footprintnetwork.org/>) In other words, it now takes more than one year and two months for the Earth to regenerate what we use in a single year. We maintain this overshoot by liquidating the planet's ecological resources.

Overview

Human wellbeing is related to security, having the basic material for a good life, health, good social relations, and freedom of choice and action¹. Ecosystem services influence many of these factors, playing a key role in providing materials for a good life, health, secure access to resources and security from disasters. Whether we are wealthy or poor, or live in urban or rural areas, we rely heavily on ecosystem services.

People may use biodiversity directly (e.g. food, materials, medicines, fuel, fibre, commercial goods) or may rely on it indirectly (e.g. water purification services, grazing for livestock, pollination services for crops, protection from floods). In addition, many people value ecosystems and their living components for their visual, spiritual, sense of place or cultural attributes.

In the face of climate change, our ability to adapt and be resilient to a changing environment relies on the persistence and ongoing evolution of living organisms. Conserving biodiversity is thus seen to give us 'adaptation insurance'.

The basis for ecosystem services is healthy ecosystems. Healthy, diverse ecosystems in turn rely on resilient and functional communities of living organisms. The loss of biological diversity destabilizes ecosystems and makes them more vulnerable to shocks and disturbances such as hurricanes and floods, which may further reduce their ability to provide for human well-being. The rural poor, who are often directly dependent on ecosystem services, are most vulnerable to the negative consequences of deteriorating ecosystems. Despite broad agreement to achieve a significant reduction in the current rate of biodiversity loss at all levels by 2010 (the so-called 2010 target²), biodiversity is in decline at all levels and geographical scales³. Deforestation and conversion of natural habitats like mangroves, grasslands and wetlands is rife. The average abundance of species is on the decline: many forms of pollution, the spread of alien organisms, and intensified harvest, hunting and fishing is leading to this decline.

Footnotes

¹ Millennium Ecosystem Assessment Synthesis Report (2005) (accessed March 2006).

² The target agreed by all Parties to the Convention in the Hague in 2002 "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth." Heads of State and Government at the World Summit for Sustainable Development in Johannesburg in 2002 committed themselves to the 2010 Biodiversity Target, Support for the commitment was reiterated at the Millennium Summit in New York in 2005.

³ [Global Biodiversity Outlook 2](#) . Secretariat of the Convention on Biological Diversity 2006, Montreal, Canada. (Global Biodiversity Outlook 3 will be formally launched in 2010.)

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Global biodiversity conventions

[Six international conventions](#) focus on biodiversity issues:

1. The Convention on Biological Diversity or 'CBD' (year of entry into force: 1993)

Contracting parties to the CBD must develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes which shall reflect, *inter alia*, the measures set out in the Convention relevant to the Contracting Party concerned. Parties must integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies.

2. The Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat (1971)

3. The Convention on Conservation of Migratory Species

4. The Convention on International Trade in Endangered Species of Wild Fauna and Flora, or 'CITES' (1975)

5. The International Treaty on Plant Genetic Resources for Food and Agriculture (2004) 6. The World Heritage Convention (1972)

In addition to the above, there are three conventions that have an important bearing on biodiversity, namely:

1. Convention to Combat Desertification (1974)

2. Basel Convention on transboundary impacts (1989)

3. UN Framework Convention on Climate Change (1992)

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Biodiversity-inclusive impact assessment

Typically, impact assessment considers such things as Red List species and impacts on protected areas. However, it often fails to look at the dynamics of ecosystems (the various ecological processes and functions), as well as the interdependencies between socio-economic and natural systems. Also, the distributional effects of positive and negative impacts of development on, and implications for access to, biodiversity, are seldom addressed; the most vulnerable sectors of society are often most affected by changes to ecosystem services brought

about by development. Unless the full spectrum of functions provided by natural systems, as well as the objectives of biodiversity conservation are fully integrated into policy-formulation and planning, we run the risk of sanctioning development that undermines the very basis for our wellbeing. That is, biodiversity mainstreaming into development strategies and programs is essential to poverty alleviation and development.

'Biodiversity-inclusive' impact assessment describes an approach that addresses not only the intrinsic values of biological diversity, but also the range of direct (e.g. food, fuel, materials) and indirect (e.g. water delivery, soil conservation) use values, as well as non-use values (e.g. cultural significance) associated with species, communities, ecosystems and natural landscapes. In addition, it embraces the **conservation**, **sustainable use** and fair **sharing** of biological resources.

Two guidance documents have been seminal in promoting biodiversity-inclusive impact assessment: [Voluntary Guidance on Biodiversity-inclusive Impact Assessment](#), covering both project-level EIA and Strategic Environmental Assessment at programme, plan and policy levels (endorsed by the Convention on Biological Diversity in 2006), as well as the [IAIA's guiding principles on Biodiversity in Impact Assessment](#) (2005).

A number of key principles underpin biodiversity-inclusive impact assessment:

- **The precautionary principle** is stated as follows: 'Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation' (Rio Declaration, 1992, Principle 15). The Preamble to the Convention on Biological Diversity expresses this principle as 'Where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat'. In general, these measures should be proportionate to the anticipated risks to biodiversity. Since our understanding of the 'tipping points' of ecosystems and their complex, non-linear dynamics is limited, and given that many impacts on biodiversity may be irreversible or result in irreplaceable loss, use of precaution is crucial.

A range of initiatives¹ are underway to provide guidance on applying the precautionary principle in different sectors or contexts. [Guidelines for applying the Precautionary Principle to biodiversity conservation](#) have been developed by The Precautionary Principle Project.

- **The mitigation hierarchy** focuses on the principle that prevention is better than cure. The first and most important step of the hierarchy as applied to development planning is thus to avoid negative impacts on biodiversity through iterative consideration of location, siting, design, phasing and other options. The next step is to minimize these negative impacts, again through

adjusting the proposal. Once impacts have been either avoided or minimized, opportunities to restore or rectify negatively affected areas should be sought (e.g. after construction). Finally, where residual negative impacts remain despite efforts to avoid, minimize and restore or rectify, compensation or offsets should be provided to strive either for 'no net loss' or a net gain of biodiversity.

- [The ecosystem approach advocated by the Convention on Biodiversity](#) emphasizes that human beings are an integral part of wider ecosystems. Impact assessment must, therefore, look at people as one component of 'the bigger picture', within a complex and dynamic system. This approach recognizes, amongst others, that the objectives of management of land, water and living resources are a matter of societal choice. Impact assessment and management must consider the effects of activities beyond the particular development site (i.e. on adjacent and other ecosystems). The conservation of ecosystem structure and functioning should be a priority target, in order to maintain ecosystem services. Ecosystems must be managed within the limits of their functioning, and objectives for ecosystem management should be set for the long term. All forms of information should be taken into account, both scientific and local, indigenous knowledge, in arriving at an optimum outcome. A framework for adaptive management of affected ecosystems and biodiversity should be provided, recognizing that change is inevitable over time.

Footnotes:

¹ e.g. Cooney, R. & Dickson, B. (ed.) (2006). Biodiversity and Precautionary Principle: Risk and Uncertainty in Conservation and Sustainable Use. Earthscan Publication Ltd.

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Climate change implications for biodiversity and ecosystem services

The changes in rainfall, runoff, temperature, sea level – amongst others – associated with climate change will affect the distribution and range of ecosystems and species respectively. These changes will also affect the viability, persistence and resilience of ecosystems on land and in water. Changes in ecosystems will in turn affect the delivery of ecosystem services, thereby affecting human wellbeing and resilience.

Climate change can be **mitigated** through reducing greenhouse gas emissions. In addition, measures to **adapt** to climate change must be set in place.

Tropical deforestation is a major cause of biodiversity loss. It also releases carbon dioxide, a

major cause of climate change. For these reasons, reducing and/or preventing deforestation is an important option to mitigate climate change. Reducing Emissions from Deforestation and Forest Degradation, or '[REDD](#)', provides an incentive mechanism to this end.

Planning and maximizing opportunities for adaptation to climate change mean addressing the anticipated effects at policy and landscape planning levels, as well as at project level. Restoring degraded ecosystems to improve ecosystem services delivery, and safeguarding links across climatic gradients to enable shifts in ranges of species, are important components of adaptation.

Useful references with regard to biodiversity, ecosystem services and climate change include:

- <http://www.cbd.int/climate> ; <http://www.unep-wcmc.org/climate>
- Kapos V., Ravilious C., Campbell A., Dickson B., Gibbs H.K., Hansen M.C., Lysenko I., Miles L., Price J., Scharlemann J.P.W., Trumper K.C. (2008) Carbon and biodiversity: a demonstration atlas. UNEP-WCMC, Cambridge, UK. <http://www.cbd.int/doc/gbo/gbo2/cbd-gbo2-en.pdf>
- The Natural Fix? The role of ecosystems in climate mitigation (2009) http://www.grida.no/res/site/file/publications/natural-fix/BioseqRRA_scr.pdf

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Biodiversity planning

To conserve biodiversity, it is necessary to safeguard viable and representative examples of the full range of life on earth. It is essential to ensure the persistence of these examples by maintaining ecological and evolutionary processes in the wider landscape. **Systematic**

conservation planning

(SCP) sets out to achieve this end through a systematic and scientifically defensible method of selecting and prioritizing areas to achieve explicit conservation goals. SCP may be integrated into a wider spatial planning exercise, involving stakeholder engagement to focus on key biodiversity and ecosystem services issues. Given the need to address the conservation of biodiversity, ecosystems and their valued services at landscape scale, particularly in the face of climate change, SCP provides a useful tool to prioritize areas in the landscape.

A number of different software tools have been developed to support SCP: Marxan, Marzone, Zonation and C-Plan are some such tools.

Biodiversity impacts in relation to trade in agricultural produce

Agriculture is the most important economic activity in many of the world's poorest and most vulnerable countries. Whilst global trade in agricultural produce presents employment opportunities and other social benefits, it also potentially presents significant threats to biodiversity. In recognition of these implications, the CBD Conference of Parties called for the impact of trade liberalization on agricultural biodiversity to be studied in cooperation with international organizations, including UNEP. UNEP's Economics and Trade Branch is near to completing its ['Trade and Biodiversity Initiative'](#) and preparing accompanying guidance manuals.

The effective treatment of biodiversity in the impact assessment of trade policies and agreements can help to ensure that the potential benefits of international trade are accompanied by effective conservation and sustainable use of biodiversity.

Emerging tools and practice

1. **Valuing ecosystem services:** A number of tools have been, or are being, developed to assist in the valuation of biodiversity and ecosystem services. These tools include the following:

- [ARIES](#) (*Artificial Intelligence for Ecosystem Services*), is under development by a consortium of groups - the University of Vermont's Gund Institute for Ecological Economics, Conservation International and Earth Economics as well as with collaboration from experts at Wageningen University. The computer model and decision-support system aims to assist decision-makers and researchers by estimating and forecasting ecosystem services provision and their correspondent range of economic values in a specific area.
- [InVEST](#) (*Integrated Valuation of Ecosystem Services and Tradeoffs*) is being developed by The Natural Capital Project—a joint venture among Stanford University's Woods Institute for the Environment, The Nature Conservancy, and World Wildlife Fund. The tool is a decision-making aid to assess how distinct scenarios might lead to different ecosystem service and human well-being related outcomes in particular geographic areas.
- [MIMES](#) (*Multiscale Integrated Models of Ecosystem Services*) is a multi-scale, integrated suite of models developed by the Gund Institute for Ecological Economics (University of Vermont) that enables understanding of the contributions of ecosystem services by quantifying the effects of varying environmental conditions derived from land use change. The Models evaluate land use changes and subsequent effects on ecosystem services on global, regional and local levels.

- **Ecological Footprint:** Global Footprint Network's core research calculates both the Ecological Footprint, the demand on nature, and biocapacity, the capacity to meet this demand, of more than 200 countries. The results, updated annually, as well as the calculations are shown in the National Footprint Accounts. The 2008 National Footprint Accounts use over 5,400 data points for each country, each year, derived from internationally recognized sources (see data sources, below) to determine the area required to produce the biological resources a country uses and to absorb its wastes, and to compare this with the area available. The actual implementation of the National Footprint Accounts through database-supported templates is described in the Guidebook to the National Footprint Accounts 2008.

- *The Ecological Footprint Atlas summarizes the ecological footprint and biocapacity results from the 2008 Edition of the National Footprint Accounts, which are produced by Global Footprint Network on behalf of its partners and others in the world community who wish to use these results. The Atlas can be accessed at <http://www.footprintnetwork.org/atlas>*

- *Potential of the Ecological Footprint for monitoring environmental impact from natural resource use*, is available at <http://ec.europa.eu/environment/natres/studies.htm>

- **Biodiversity offsets:** Work on biodiversity offsets is being spearheaded by the Business and Biodiversity Offsets Program (BBOP). An overview on BBOP, interim guidance on biodiversity offsets (Offset Design, Cost-Benefit and Implementation Handbooks), resource documents on biodiversity offsets, impact assessment and participation, and case studies of BBOP pilot projects and other experiences. 2009. <http://www.forest-trends.org/biodiversityoffsetprogram/guidelines/index.php>

- **Biodiversity banking or mitigation banking:** Creating payment schemes for biodiversity through mechanisms that give nature a value and force the economy to look into its blind spots may help to conserve biodiversity. Both the USA's Wetland Mitigation and Conservation Banking Schemes, as well as approaches introduced in Australia (e.g. BushBroker and BushTender) work on a system of habitat credits. A useful reference is *Conservation and Biodiversity Banking: A Guide to Setting Up and Running Biodiversity Credit Trading Systems*, edited by N Carroll, J Fox and R Bayon, and published by Earthscan in 2007.

- **Socio-ecological systems thinking and socio-ecological resilience:** The [Resilience Alliance](#) is a multidisciplinary research group that explores the dynamics of complex social-ecological systems.

- **Sustainability Assessment** strives to bridge gaps between social and ecological thinking, introducing criteria that 'talk to' the need to build and maintain socio-ecological system integrity. An example of this approach can be found in R.B. Gibson, S Hassan, S Holtz, J Tansey and G Whitelaw's book *Sustainability Assessment:*

Criteria, Processes and Applications
published by Earthscan in 2005.

- **Making the business case for considering biodiversity; promoting a Green Economy** : UNEP has started a '[Green Economy Initiative](#)' with the objective of making a credible economic and development case for conserving, sustainably using, and investing in biodiversity and ecosystems with equitable sharing of benefits. This initiative is supported by the Convention on Biological Diversity. The aim of the Economics of Ecosystems and Biodiversity (TEEB) study, one of the Initiative's projects, is to provide policy makers with the tools they need to incorporate the true value of ecosystem services into their decisions.

- **Payment for ecosystem services**: The [Katoomba Group](#) is driving the research agenda on payment for ecosystem services world-wide.
<http://www.ecosystemmarketplace.com>

- **[Wetland mitigation banking](#)** : the United States Environmental Protection Agency, 2008.

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Good practice guidance and tools

[Voluntary Guidelines on Biodiversity-inclusive Impact Assessment](#) (2006), endorsed by the CBD Conference of Parties, COP 8, 2006.

[Integrated Biodiversity Assessment Tool \(IBAT\)](#) for business (together with Conservation International, BirdLife International, and IUCN as observer. This tool is an internet-based tool to facilitate corporate sector access to critical data on KBAs.

[Corporate Ecosystem Services Review \(ESR\)](#) : Guidelines for Identifying Business Risks and Opportunities Arising from Ecosystem Change (World Business Council for Sustainable Development together with the Meridian Institute and the World Resources Institute) (2008).

Best Practice Guidance for Biodiversity-inclusive Impact Assessment: A Manual for Practitioners and Reviewers in South Asia (2007). [International Association for Impact](#)

[Assessment](#) . Capacity Building in Biodiversity and Impact Assessment (CBBIA) program. Contact info@iaia.org to order.

Guidance Document on Biodiversity, Impact Assessment and Decision-making in Southern Africa (2009). [International Association for Impact Assessment](#) . Capacity Building in Biodiversity and Impact Assessment (CBBIA) program. Contact info@iaia.org to order.

[The Global Reporting Initiative \(GRI\)](#) : Guidelines on corporate sustainability reporting, and associated indicators, including biodiversity indicators. (co-founded by UNEP's Division of Technology, Industry and Economics).

[Good Practice Guidance for Mining and Biodiversity](#) (2006).

[Integrating Biodiversity Conservation into Oil & Gas Development](#) (2007). The Energy and Biodiversity Initiative, USA.

[Good Practice in the Prevention and Mitigation of Primary and Secondary Biodiversity Impacts](#) (2007). The Energy and Biodiversity Initiative, USA.

[Biodiversity Indicators for Monitoring Impacts and Conservation Actions](#) (2007). The Energy and Biodiversity Initiative, USA.

Integrating Biodiversity Conservation into Oil and Gas Development (2003a). The Energy and Biodiversity Initiative (EBI), BP, Chevron Texaco, Conservation International, Fauna and Flora International, IUCN, The Nature Conservancy, Shell, Smithsonian Institution, Statoil.

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[Integrating Biodiversity into Environmental Management Systems](#) (2004). The Energy and Biodiversity Initiative. UK: Conservation International.

[A Guide to Developing Biodiversity Action Plans for the Oil and Gas Industry](#) (2005).

[Key Biodiversity Questions in the Oil and Gas Lifecycle](#) . (2006). IPIECA. [An Ecosystem Approach to Oil and Gas Industry Biodiversity Conservation](#) . (2007) IPIECA.

[Biodiversity and the Petroleum Industry: A Guide to the Biodiversity Negotiations](#) (2000). IPIECA.

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Good Practice Guidance for Mining and Biodiversity. International Council for Mining and Metals. London (2005). International Council on Mining and Metals (ICMM).
<http://www.icmm.com/uploads/1295GPG.pdf>

Integrating Mining and Biodiversity Conservation: Case Studies from Around the World (2004). IUCN & ICMM. http://www.icmm.com/library_pub_detail.php?rcd=173

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Biodiversity Offsets: Good for Business and Biodiversity? http://www.forest-trends.org/publication_details.php?publicationID=656

Local Business for Global Biodiversity Conservation http://www.forest-trends.org/publication_details.php?publicationID=524

Business and Biodiversity: Offsetting the impacts on biodiversity http://www.forest-trends.org/publication_details.php?publicationID=534

Useful sources of information

- [World Database on Protected Areas \(WDPA\)](#) : (together with IUCN's World Commission on Protected Areas). The WDPA is the only comprehensive inventory of the world's protected areas. It has technical and financial support of the Proteus 2012 Partnership, involving 17 private sector partners, and was re-launched in 2008.
- [Key Biodiversity Areas \(KBAs\)](#)
- [Global Biodiversity Information Facility \(GBIF\)](#) :GBIF enables free and open access to biodiversity data online, and is an international government-initiated and funded initiative focused on making biodiversity data available to all and anyone, for scientific research, conservation and sustainable development.
- [Biological Diversity and Strategic Environmental Assessment](#) SEA is increasingly applied throughout the world, in different shapes and forms. In spite of existing differences in procedural and methodological approaches, all good practice SEAs comply with common basic principles, e.g. IAIA's SEA performance criteria. The final objective of SEA is to contribute to sustainable development, poverty reduction and good governance. Biodiversity provides livelihoods to millions of people and is often considered as a " life insurance for life itself ". Consequently, biodiversity needs to be properly addressed in SEA.

Global/regional financial institutions' policies and performance

standards for addressing biodiversity

- World Bank Safeguard Policies on Environmental Assessment, Natural Habitats, Forests, International Waterways and Pest Management are of principal relevance. <http://go.worldbank.org/WTA1ODE7T0>
- International Finance Corporation (IFC) Performance Standards on Social and Environmental Sustainability: Performance Standards on Social and Environmental Assessment and Management Systems (1) and on Biodiversity Conservation and Sustainable Natural Resource Management (6) are of principal relevance.
 - European Bank for Reconstruction and Development's performance requirement for biodiversity conservation and sustainable management of living natural resources (Performance Requirement 6)
 - Others (e.g. Asian Development Bank)

Web sites

[Global Footprint Network](#) : Advancing the Science of Sustainability

[Business and Biodiversity Offsets Program](#)

[Convention on Biological Diversity](#) Web Pages

CBD's [Climate Change and Biological Diversity](#) page [Joint Web Site of the Biodiversity Related Conventions](#) [Global Biodiversity Outlook 2](#)

. Secretariat of the Convention on Biological Diversity 2006, Montreal, Canada. (Global Biodiversity Outlook 3 will be formally launched in 2010.)

[Voluntary Guidance on Biodiversity-inclusive Impact Assessment](#)

: Covers both project-level EIA and Strategic Environmental Assessment at programme, plan and policy levels (endorsed by the Convention on Biological Diversity in 2006)

[Ecosystem Approach Sourcebook](#)

. This website was created in response to a request of the seventh meeting of the Conference of the Parties (decision VII/11, paragraph 9) as a tool to help practitioners implement the ecosystem approach and share experiences.

[Reducing Emissions from Deforestation and Forest Degradation \(REDD\)](#)

[The Katoomba Group](#) is an international network of individuals working to promote, and improve capacity related to, markets and payments for ecosystem services (PES). The Group serves as a forum for the exchange of ideas and strategic information about ecosystem service transactions and markets, as well as site for collaboration between practitioners on PES projects and programs.

[The Katoomba Group's Ecosystem Marketplace](#)

Millennium Ecosystem Assessment Synthesis Report (2005) (accessed March 2006).

[IAIA's guiding principles on Biodiversity in Impact Assessment](#) (2005).

[IAIA Key Citation Series: Biodiversity](#) (Updated Feb 2010)

[Guidelines for applying the Precautionary Principle to biodiversity conservation](#)

United Nations Environment Programme - World Conservation Monitoring Centre ([UNEP-WC MC](#))
Climate change and biodiversity pages

[Carbon and biodiversity: a demonstration atlas](#) (2008). UNEP-WCMC, Cambridge, UK.

[The Natural Fix? The role of ecosystems in climate mitigation](#) (2009)

Initiative on Integrated Assessment of Trade-Related Policies and Biological Diversity in the Agriculture Sector. <http://www.unep.ch/etb/areas/biodivAgriSector.php>, UNEP, Economics and Trade Branch.

[\(ARIES\)](#) - Artificial Intelligence for Ecosystem Services

[\(INVEST\)](#) - Integrated Valuation of Ecosystem Services and Tradeoffs

[\(MIMES\)](#) - Multiscale Integrated Models of Ecosystem Services

["Potential of the Ecological Footprint for monitoring environmental impact from natural resource use"](#), EUROPA.