United Nations
Educational, Scientific and
Cultural Organization

Division of Ecological and
Earth Sciences

SCOPE
Scientific Committee
on Problems of the Environment

UNEP
United Nations
Environment Programme

UNESCO - SCOPE - UNEP
Policy Briefs

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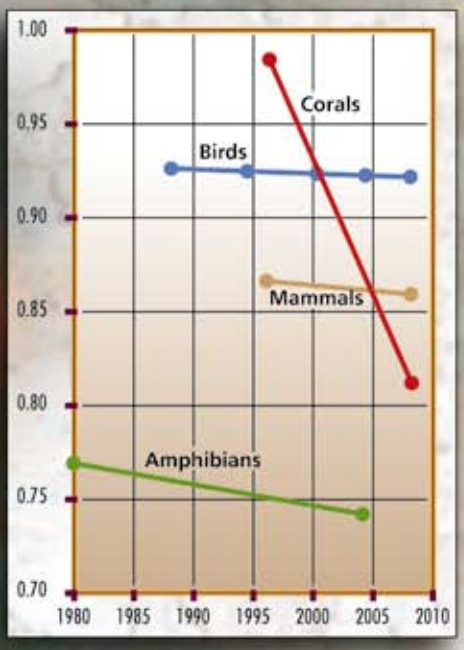
Biodiversity, health and well-being

Critical links



Biodiversity supports health and well-being by

providing food, clean air, water and life's other basic needs;

preventing the emergence and spread of pests and disease agents;

supplying medical and genetic resources to prevent illness or provide suitable cures;

maintaining psychological health by providing opportunities for recreation, creative outlets, therapeutic spiritual retreats, and cognitive development.

DIVERSITAS
an international programme of biodiversity science

Biodiversity for health and well-being

Global biodiversity degradation significantly impacts the key components of human **health and well-being**.

Ecosystem services, i.e. the benefits people obtain from ecosystems, are indispensable for the health and well-being of people around the world. Biodiversity degradation leads to changes in the supply and flow of these goods and services.

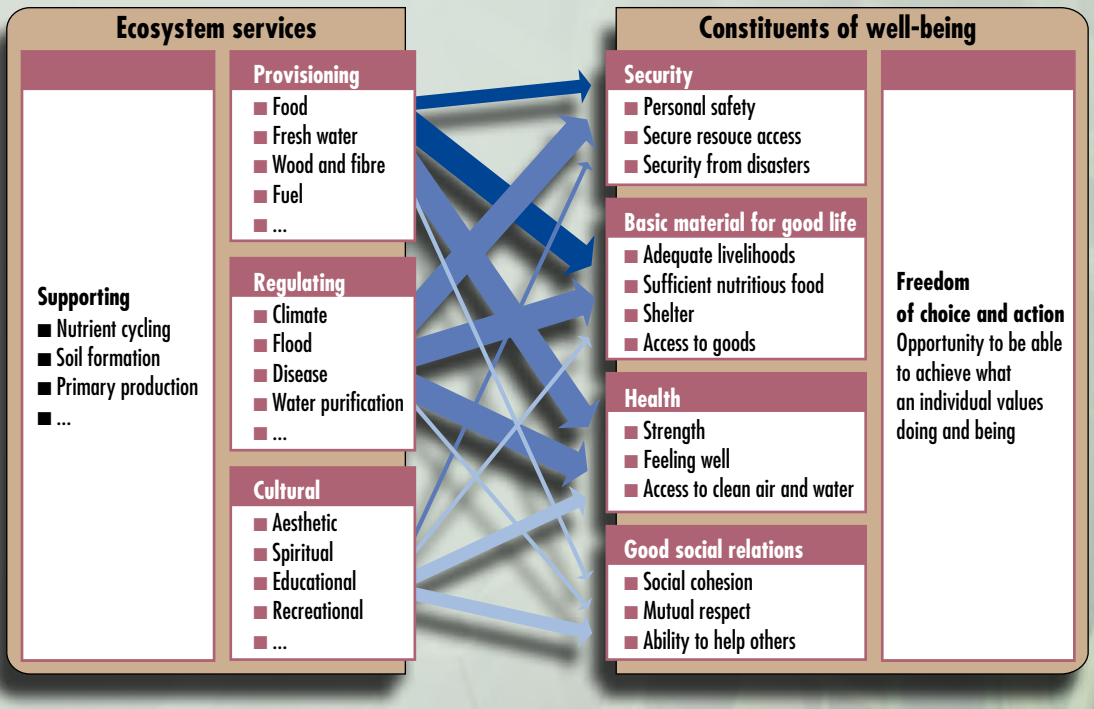
The resulting impacts on economic and physical security, freedom and social relations have wide ranging consequences on human well-being and health.

Health, well-being and the quality of life

Our well-being depends on the state of our physical and psychological health. Health is defined as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO 1946).

Quality of life is defined as "an individual's perception of their position in life, in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns" (WHO 2004).

Links between ecosystem services and constituents of well-being



Millennium Ecosystem Assessment, 2005

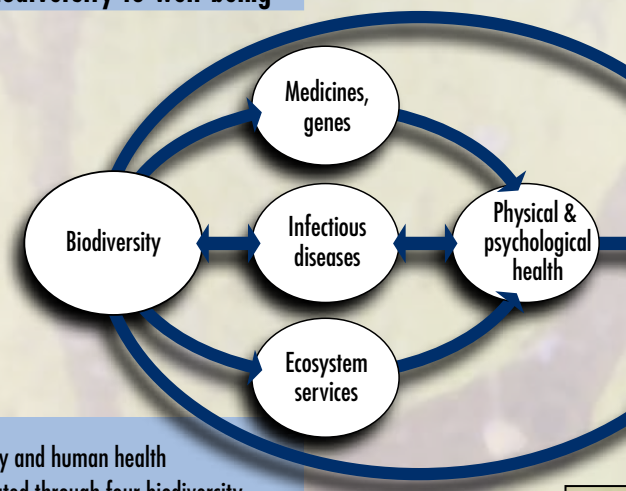
Impacts of biodiversity change on human health

When animal and plant species go locally extinct, genetic diversity is reduced, biological communities become altered, and ecosystems begin to lose their key functions.

Services provided by genetic building blocks, species and ecosystem processes may become compromised, diminish in effectiveness, or even shift from being positive influences on health to having negative consequences.

Systems with lower genetic diversity are less buffered against degradation due to human activities or natural disasters. They potentially provide fewer direct resources e.g. foods and medicines.

From biodiversity to well-being



Biodiversity and human health can be related through four biodiversity drivers of health and well-being, including quality of life, medicinal and genetic resources, constraints on infectious diseases, and ecosystem services.
Adapted from SCOPE 69.

Impacts on provision of food and medicines

The provision of food and medicines provides the main link between biodiversity and human health. All food species, whether hunted or gathered in the wild, or grown in the most intensive production systems, occur within ecosystems whose productivity is impacted by the activity of other elements that exist within those ecosystems. The current decline in dietary diversity that ensures essential components such as proteins, fatty acids and vitamins, in both rural and urban populations, may lead to serious deficiencies of minerals, vitamins and trace elements with negative effects on human health.

Provision of food

The Cree Nation people of northwestern Quebec, Canada, have traditionally been a society of hunters, fishers and trappers. Damming of the La Grande River in the 70s for the James Bay hydroelectric megaprojects show how short-term solutions to societal needs can lead to unforeseen long-term problems for both physical health and quality of life of local populations. Water quality was compromised, and fish and wildlife were lost or contaminated by methyl mercury from flooded land. Remedial measures and educational programmes were developed to teach community and traditional bush families about the health hazards of methyl mercury poisoning and to restrict consumption of fish. However, with the shift from the traditional diet to processed frozen foods, community levels of obesity, diabetes and heart disease rose rapidly. Diminution of traditional fishing furthermore led to the erosion of social practices, diminished the transmission of local knowledge to the younger generation, altered relationships with nature, and weakened social cohesion.

Provision of medicines

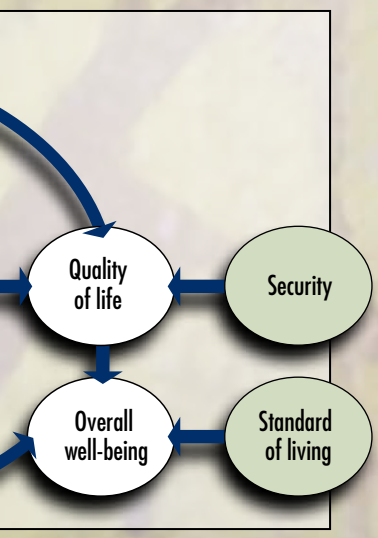
Historically, biodiversity has been the major source of pharmaceuticals. Even today, 85% of the world's population depends on such resources for primary health care.

Abundant and genetically variable biodiversity is the resource base for innovative technologies used for disease treatment. These allow for thousands of plant and animal extracts to be rapidly screened for hundreds of new compounds to target disease.

However, this research has been severely hampered by habitat loss and associated species extinctions that have been particularly severe in places of highest biodiversity, such as tropical rainforests and coral reefs. Opportunities to develop new therapies may be compromised by losing biodiversity.

Disease patterns

Lyme disease results from bacterial infection by *Borrelia burgdorferi* transmitted through a tick bite. Recently, its incidence has notably increased in Europe and USA, with up to 32-fold increase in the North-East USA. This increase has been tracked back to 200 years of biodiversity degradation. Human-driven changes in regional biodiversity include hunting to extinction top predators, such as wolves, mountain lions and grizzly bears. This has led to unnaturally high numbers of deer and mice that are excellent reservoirs for both the bacteria and native ticks that transmit the bacteria to humans. Suburban expansion into natural areas has led to closer proximity between humans, wild deer and mice, resulting in increased exposure of humans to infected ticks, hence increases in disease incidence in human populations.



Impacts of climate change on disease emergence

Climate change is expected to affect disease incidence and emergence by :

- shifting the geographic locations of hosts, vectors and disease-causing parasites into new regions;
- altering the abilities of parasite species to survive, reproduce, and be transmitted from hosts to humans;
- increasing the frequency and intensity of floods and droughts that create health threats by disrupting sanitation and drinkable water supplies. Such extreme climate events also create a favourable environment for many diseases, such as diarrhoea.

The World Health Organization has estimated that 67% of vector-borne diseases are driven by climate variability. For example, with changing climate conditions in the future, the malaria agent, the *Plasmodium falciparum* parasite, might be able to spread into new areas. On the other hand, historically affected areas might become uninhabitable by the parasite and its mosquito vectors and thus malaria-free.

Biodiversity-health trade-offs

The linkages between environmental change, health and biodiversity are highly complex. Changes to the environment that benefit our health can be viewed as trade-offs against biodiversity. Gains in one domain can come at the expense of losses in another:

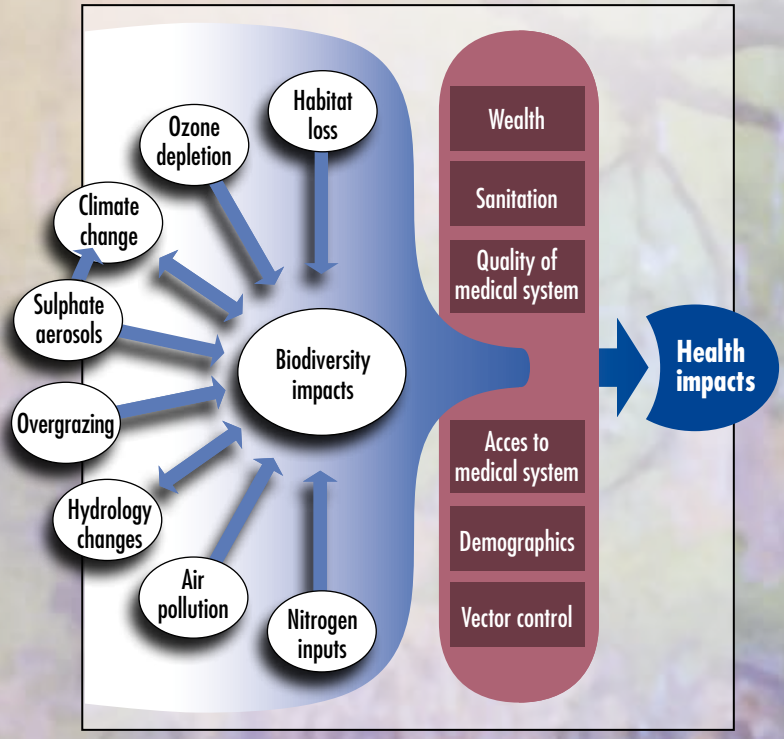
- drainage of the swamps in the Great Lakes Area of North America, while reducing biodiversity (i.e. biota that thrived in swamps) improved human health through elimination of malaria-carrying mosquitoes;
- elimination of vampire bats, which spread rabies to cattle in Latin America increased cattle productivity and thus improved human health via better nutrition.

But also

- in Africa, the presence of tsetse flies and their host species over large regions has prevented the colonization of some grazing areas by people and cattle thus preserving biodiversity and other ecosystem services in those areas.

Societal and health care systems can buffer or exacerbate the impacts

High income, high GDP (Gross Domestic Product), effective water and sanitation infrastructure and good quality available health care (high quality medical systems and easy access to health professionals) may buffer the negative impacts of biodiversity loss or degradation on human health. Conversely, impoverishment and poorer, inaccessible health care services can exacerbate them.



The case of dengue fever

More than 2000 million people are at risk from dengue fever, a tropical mosquito-borne disease. It is increasing in impoverished urban populations primarily because of ample stagnant water pools, poor garbage collection and traditional water storage methods that are often open-air, providing breeding grounds. Restricted health education budgets, inadequate mosquito control programmes and a growing resistance to insecticides are exacerbating factors in many countries.

Prevention strategies include covering water containers and tanks, burning or burying rubbish, biological controls, bacterial pesticides and chemical controls, use of nets, screens, coils and repellents. Implementation is highly dependent on the local standard of living. For example, during a dengue virus outbreak in 1999, blood samples from inhabitants in Laredo, Texas contained only 1/20 of the levels of dengue antibodies compared to those of people living just across the river in Nuevo Laredo, Mexico. This reflects significantly less exposure to and transmission of the disease for USA inhabitants that benefit from better-sealed buildings and higher prevalence of air-conditioning.

Main challenges

As global population rises towards nine billion in 2050, trade-offs between human well-being and competing uses of resources and physical space for food supply and energy production will make it more difficult to maintain functioning levels of biodiversity.

Much of future global population growth will occur in areas where human health is at greatest risk because of poverty and natural resource scarcity. Simultaneously, this is where there is significant potential for disease transmission from the wild into human populations.

Climate change adds uncertainty. It becomes more difficult to predict which biotic resources and ecosystem functions may be needed for human adaptation to projected food supply disruptions and ecosystem alterations. There will also be shifts in disease patterns and risks, as well as more direct health threats. WHO estimates that half of childhood deaths in low-income countries are caused by malnutrition. Large-scale conversion of cropland to other forms of production, including non-food energy production coupled with inadequate pricing of agricultural goods and services might increase the risk of deaths from malnutrition in the future.

Conflicts can arise between short-term benefits versus long-term costs. There are tradeoffs between positive and negative impacts of local biodiversity. For example, malaria can be reduced in the short term by draining wetlands, but in the long term this loss of wetlands causes major shortages in traditional foods and livelihoods (e.g. local fisheries collapse).

Shifts to irrigated agriculture increase food production and improve nutrition but, conversely, also expand habitat for mosquitoes. In tropical and sub-tropical regions, this raises the local incidence of mosquito-borne diseases such as malaria, dengue fever and dengue haemorrhagic fever.

While there are multiple benefits of biodiversity, biodiversity can also pose a risk to human health and quality of life. For example, in the case of HIV and SARS, there is evidence pointing to the shift of these diseases from animal populations to humans being sparked by increased hunting and consumption of bush meat.

Photo: The Earth Institute, Columbia University

Way forward

- **Management of biodiversity to benefit human health and well-being** will require specific policies at appropriate levels (e.g. regional, national, sub-national) that address health needs and criteria for good quality of life of the particular cultures that are affected. Local policies need to strike a balance between biodiversity conservation, economic pressures, maintenance of cultural integrity, and immediate crisis abatement (e.g. disease epidemics, water shortages or floods, electric system overloads, or housing shortages).

- **Full economic evaluation of human management of resources, energy strategies and potential developmental pathways** should be based on sound planning and development policies. Policies should incorporate long-term, as well as short-term costs and benefits to health and well-being, as well as to the economy.

- **Responses** that mitigate the impacts of ecosystem changes on human health often ***involve policies and actions outside the health sector.*** Action to mitigate impacts of climate change will similarly require cooperation across multiple sectors.

- **Quantifying impacts of biodiversity loss on quality of life requires careful assessment** using direct measures where outcomes from interventions that change biodiversity cannot be readily anticipated. New assessments of quality of life, recently developed by the World Health Organization, are now available in around 50 languages, tailored to the needs of a range of very diverse cultures world-wide.

This policy brief draws on the findings of the joint SCOPE / DIVERSITAS Assessment of Biodiversity, Health and the Environment.

Useful links

United Nations Educational, Scientific and Cultural Organization (UNESCO): http://www.unesco.org
Scientific Committee on Problems of the Environment (SCOPE): http://www.icsu-scope.org
United Nations Environment Programme (UNEP): http://www.unep.org
Center for Health and the Global Environment, Harvard Medical School: http://chge.med.harvard.edu/
Convention on Biological Diversity: http://www.cbd.int/
DIVERSITAS – an international programme of biodiversity science: www.diversitas-international.org
Lyme disease and climate change: http://www.euro.who.int/document/E89522.pdf
WHO Field Centre for the Study of Quality of Life: http://www.bath.ac.uk/whoqol

Suggested readings

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GEO-4, Global Environment Outlook—Environment for Development, Chapter 5- Biodiversity. UNEP, 2007: http://www.unep.org/geo/geo4.asp
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Sala, O., C. Parmesan and L. Myers (Eds). 2009. SCOPE/DIVERSITAS Assessment: *Biodiversity, Global Change and Human Health: from Ecosystem Services to Spread of Disease* (SCOPE 69). Washington, DC. Island Press.
United Nations Development Programme, United Nations Environment Programme, World Bank, World Resources Institute. 2000. *World Resources 2000-2001: People and ecosystems: The fraying web of life.*

SUPPORTING INSTITUTIONS

WHO Field Centre for the Study of Quality of Life
University of Bath
ESI Environmental Science Institute

COVER IMAGES

Cluster of vividly fluorescent coral in daylight found in waters off Lord Howe Island, Australian scientists have discovered that the brilliant shallow-water corals could provide vibrant illumination for cancer research. The corals were discovered by scientists tracking the recovery of coral bleaching linked to global worming.
Source: Anya Salih/UWS.

Red List Index showing the proportion of warm-water coral, bird, mammal and amphibian species expected to survive into the near future without aditional conservation actions.
Source: IUCN, in Global Biodiviersity Outlook 3 (Secretariat of the Convention on Biological Diversity, 2010)

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Authors:
Camille Parmesan,
University of Texas
Suzanne Skevington,
WHO Centre for the Study of Quality of Life

Editor: Ana Persic
Design: Ivette Fabbri

Contacts :
■ SCOPE Secretariat
5 rue Auguste Vacquerie
75116 Paris, France
secretariat@icsu-scope.org,
secretariat@scopenvironment.org
www.icsu-scope.org,
www.scopenvironment.org
■ UNESCO, SC/EES
1 rue Miollis
75015 Paris, France
mab@unesco.org
www.unesco.org/mab
■ UNEP
P.O. Box 30552
00100 Nairobi, Kenya
uneppub@unep.org
www.unep.org

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