GreenFacts
Facts on Health and the Environment

Scientific Facts on

Biodiversity

& Human Well-being

Context - Biodiversity contributes to many aspects of human well-being, for instance by providing raw materials and contributing to health.

The Millennium Ecosystem Assessment shows that human actions often lead to irreversible losses in terms of diversity of life on Earth and these losses have been more rapid in the past 50 years than ever before in human history.

What factors are responsible for this rapid loss? What would need to be done to significantly slow this trend?

This Digest is a faithful summary of the leading scientific consensus report produced in 2005 by the Millennium Ecosystem Assessment (MA):
"Ecosystems and Human Well-being: Biodiversity Synthesis"

The full Digest is available at: https://www.greenfacts.org/en/biodiversity/

ℹ️ This PDF Document is the Level 1 of a GreenFacts Digest. GreenFacts Digests are published in several languages as questions and answers, in a copyrighted user-friendly Three-Level Structure of increasing detail:

- Each question is answered in Level 1 with a short summary.
- These answers are developed in more detail in Level 2.
- Level 3 consists of the Source document, the internationally recognised scientific consensus report which is faithfully summarised in Level 2 and further in Level 1.

All GreenFacts Digests are available at: http://www.greenfacts.org/

1. Biodiversity: What is it, where is it, and why is it important?

1.1 Biodiversity reflects the number, variety and variability of living organisms. It includes diversity within species, between species, and among ecosystems. The concept also covers how this diversity changes from one location to another and over time. Indicators such as the number of species in a given area can help in monitoring certain aspects of biodiversity.

Estimates of the proportion of named species [see Annex 1, p. 8]
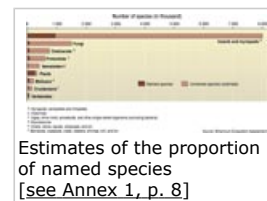
1.2 Biodiversity is everywhere, both on land and in water. It includes all organisms, from microscopic bacteria to more complex plants and animals. Current inventories of species, though useful, remain incomplete and insufficient for providing an accurate picture of the extent and distribution of all components of biodiversity. Based on present knowledge of how biodiversity changes over time, rough estimates can be made of the rates at which species become extinct.

See also our summaries:

Global Biodiversity Outlook 2 of the Convention on Biological Diversity [see https://www.greenfacts.org/en/global-biodiversity-outlook/index.htm]

1.3 Ecosystem services are the benefits people obtain from ecosystems. Biodiversity plays an important role in the way ecosystems function and in the many services they provide. Services include nutrients and water cycling, soil formation and retention, resistance against invasive species, pollination of plants, regulation of climate, as well as pest and pollution control by ecosystems. For ecosystem services it matters which species are abundant as well as how many species are present.

Millenium Ecosystem Assessement [see https://www.greenfacts.org/en/ecosystems/index.htm]

2. Why is biodiversity loss a concern?

Biodiversity provides many key benefits to humans that go beyond the mere provision of raw materials.

2.1 Biodiversity loss has negative effects on several aspects of human well-being, such as food security, vulnerability to natural disasters, energy security, and access to clean water and raw materials. It also affects human health, social relations, and freedom of choice.

See also our Water resource Digest [see https://www.greenfacts.org/en/water-resources/index.htm]

2.2 Society tends to have various competing goals, many of which depend on biodiversity. When humans modify an ecosystem to improve a service it provides, this generally also results in changes to other ecosystem services. For example, actions to increase food production can lead to reduced water availability for other uses. As a result of such trade-offs, many services have been degraded, for instance fisheries, water supply, and protection against natural hazards. In the long term, the value of services lost may greatly exceed the short-term economic benefits that are gained from transforming ecosystems.

2.3 Unlike goods bought and sold in markets, many ecosystem services are not traded in markets for readily observable prices. This means that the importance of biodiversity and natural processes in providing benefits to humans is ignored by financial markets. New methods are being used to assign monetary values to benefits such as recreation or clean drinking water. Degradation of ecosystem services could be significantly slowed down or reversed if the full economic value of these services were taken into account in decision-making.

2.4 Over the last century, some people have benefited from the conversion of natural ecosystems and an increase in international trade, but other people have suffered from the consequences of biodiversity losses and from restricted access to resources they depend upon. Changes in ecosystems are harming many of the world's poorest people, who are the least able to adjust to these changes.

3. What are the current trends in biodiversity?

Virtually all of Earth's ecosystems have been dramatically transformed through human actions and ecosystems continue to be converted for agricultural and other uses.

Living planet index
[see Annex 4, p. 11]

The current loss of biodiversity and the related changes in the environment are now faster than ever before in human history and there is no sign of this process slowing down. Many animal and plant populations have declined in numbers, geographical spread, or both. Species extinction is a natural part of Earth's history. Human activity has increased the extinction rate by at least 100 times compared to the natural rate.
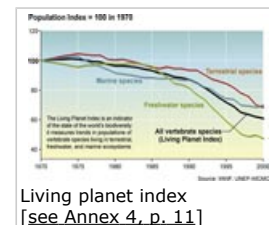
Comparing different types of measurements of biodiversity loss is not simple. The rate of change in one aspect of biodiversity, such as loss of species richness, does not necessarily reflect the change in another, such as habitat loss. Moreover, some aspects of biodiversity loss are not easily measured, for instance the fact that the same species are increasingly found at different locations on the planet and that overall biodiversity is decreasing.

The Living Planet Index, compiled by the WWF, provides an indication of the declines in the overall abundance of wild species (see figure [see Annex 4, p. 11]).

4. What factors lead to biodiversity loss?

4.1 Biodiversity is declining rapidly due to factors such as land use change, climate change, invasive species, overexploitation, and pollution. Such natural or human-induced factors – referred to as drivers – tend to interact and amplify each other.

See also our Climate Change Digests [see https://www.greenfacts.org/en/digests/climate-change.htm]

4.2 While changes in biodiversity are more clearly linked to direct drivers such as habitat loss, they are also linked to indirect drivers that are at the root of many changes in ecosystems. The main indirect drivers are changes in human population, economic activity, and technology, as well as socio-political and cultural factors.

4.3 Different direct drivers have been critically important in different ecosystems over the past 50 years. For example, in terrestrial ecosystems, the main driver has been land cover change such as the conversion of forest to agriculture. In marine systems, however, fishing, and particularly overfishing, have been the main drivers of biodiversity loss.

Extend of cultivated systems
[see Annex 3, p. 10]

4.4 Overall, the main factors directly driving biodiversity loss are: habitat change, such as fragmentation of forests; invasive alien species that establish and spread outside their normal distribution; overexploitation of natural resources; and pollution, particularly by excessive fertilizer use leading to excessive levels of nutrients in soil and water.

4.5 Recent changes in climate have already had significant impacts on biodiversity and ecosystems in certain regions. As climate change will become more severe, the harmful impacts on ecosystem services are expected to outweigh possible benefits, such as a longer growing season, in most regions of the world. Climate change is expected to exacerbate risks of extinctions, floods, droughts, population declines, and disease outbreaks.

4.6 Many drivers affecting biodiversity are stronger today than they were in the past and are also occurring together. Because exposure to one threat often makes a species more susceptible to another, multiple threats may have unexpectedly dramatic impacts on biodiversity. Drivers of extinction range from local to global in scope and from immediate to long-term in their effects. For example, the extinction of species due to habitat loss can be rapid for some species, while it may take hundreds of years for others.

5. How might biodiversity change in the future under various plausible scenarios?

5.1 The Millennium Ecosystem Assessment developed four plausible scenarios to explore the future of biodiversity and human well-being until 2050 and beyond. The different scenarios are based on either increased globalization or increased regionalization, and an either reactive or proactive way of addressing environmental issues.

5.2 Overall, in all four scenarios, agricultural land will expand and forest cover will shrink, particularly in developing countries. This will lead to a continuing decline in local and global biodiversity, mainly as a result of habitat loss. More proactive approaches to the environment will be more successful in slowing these trends.

Land cover map for 2000
[see Annex 5, p. 12]

5.3 Aquatic biodiversity and specific fish populations are expected to decline due to factors such as excessive levels of nutrients, overharvesting, invasion by alien species, and pollution.

5.4 Human well-being will be affected by biodiversity loss both directly and indirectly. Direct effects include an increased risk of sudden environmental changes such as fisheries collapses, floods, droughts, wildfires, and disease. Changes will also affect human well-being indirectly, for instance in the form of conflicts due to scarcer food and water resources.

Though the average income per person (GDP) is projected to rise in all scenarios, this can mask increased inequity for instance in terms of food security. Major decisions will have to address trade-offs between competing goals, for instance between agricultural production and water quality, or between water use and aquatic biodiversity. Policies that conserve more biodiversity are also promoting higher overall human well-being by preserving multiple benefits obtained from ecosystems.

6. What actions can be taken to conserve biodiversity?

6.1 **Protected areas** are an essential part of conservation programs, but they are not sufficient by themselves to protect the full range of biodiversity and can be difficult to enforce. To be successful, sites for protected areas need to be carefully chosen, ensuring that all regional ecosystems are well represented, and the areas need to be well designed and effectively managed.

6.2 **Market tools**, such as direct payments for ecosystem services or transfers of ownership rights to private individuals, can provide economic incentives to conserve biodiversity and to use ecosystem services sustainably.

6.3 Prevention and early intervention have proven to be the most successful and cost-effective way of tacklinginvasive species. Once an invasive species has become established, its control and particularly its eradication through the use of chemicals or through the introduction of other species is not necessarily effective and is extremely difficult and costly.

6.4 To be conserved, biodiversity must be **integrated** into the agriculture, fishery, and forestry sectors. These sectors are directly dependent on biodiversity and affect it directly. The private sector can make significant contributions, for example by adopting certain agricultural practices. Many companies now show greater corporate responsibility and are preparing their own biodiversity action plans.

6.5 **Strong institutions** at all levels are essential to support biodiversity conservation and the sustainable use of ecosystems. International agreements need to include enforcement measures and take into account impacts on biodiversity and possible synergies with other agreements. Most direct actions to halt or reduce biodiversity loss need to be taken at local or national level. Suitable laws and policies developed by central governments can enable local levels of government to provide incentives for sustainable resource management.

6.6 **Informing all of society** about the benefits of conserving biodiversity, and explicitly considering trade-offs between different options in an integrated way, helps maximize the benefits to society. Ecosystem restoration is generally far more expensive than protecting the original ecosystem, but is becoming increasingly important as more areas become degraded.

6.7 Direct and indirect drivers of biodiversity loss must be addressed to better protect biodiversity and ecosystem services. Possible actions include eliminating harmful subsidies, promoting sustainable intensification of agriculture, adapting to climate change, limiting the increase in nutrient levels in soil and water, assessing the full economic value of ecosystem services, and increasing the transparency of decision making processes.

See also our summaries on:

Agriculture [see https://www.greenfacts.org/en/agriculture-iaastd/index.htm]

Fisheries [see https://www.greenfacts.org/en/fisheries/index.htm]

Forests [see https://www.greenfacts.org/en/forests/index.htm]

7. Can the 2010 biodiversity targets be met?

In 2002, the Parties to the Convention on Biological Diversity (CBD) agreed on a target to achieve 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" by 2010.

Given appropriate actions, it is possible to achieve a reduction in the rate of biodiversity loss for certain components of biodiversity and in certain regions within that time frame.

Source: www.biodiv.org [see http://www.biodiv.org]

However, a reduction in the overall rate of biodiversity loss is unlikely to be achieved by 2010. Indeed, current trends show no sign of a slowdown of biodiversity loss, and direct drivers of loss such as land use change and climate change are expected to increase further. Moreover, it can take many years for institutions to take actions and for the positive and negative impacts of human actions on biodiversity and ecosystems to become apparent.

Since changes take place over different time frames, longer-term goals and targets — say, for 2050 — are needed to guide policy and actions, in addition to short-term targets.

Even on economic grounds alone, there is substantial scope for greater protection of biodiversity. Ultimately, however, the level of biodiversity that survives on Earth will be determined not just by considerations of usefulness but also by ethical concerns. Trade-offs between promoting human well-being and limiting biodiversity loss are likely, but synergies are also possible.

8. Conclusion: main findings

The Millennium Ecosystem Assessment (MA) highlights a series of main findings regarding biodiversity.

8.1 **Finding 1.** Human actions are often contributing to irreversible losses in terms of diversity of life on Earth. Changes in biodiversity have been more rapid in the past 50 years than at any time in human history and are expected to continue at the same pace or even to accelerate.

8.2 **Finding 2.** Biodiversity contributes directly or indirectly to many aspects of human well-being, for instance by providing raw materials and contributing to health. Over the past century, many people have benefited from the conversion of natural ecosystems to agricultural land and from the exploitation of biodiversity. However, these changes have increased poverty among some social groups.

8.3 **Finding 3.** Although many individuals benefit from activities that lead to biodiversity loss and ecosystem change, the full costs borne by society often exceed the benefits. This is revealed by improved valuation techniques and growing knowledge about ecosystems. Even when the benefits and costs of ecosystem changes are not entirely known, a precautionary approach may be justified when costs could be high or changes irreversible.

8.4 **Finding 4.** Factors such as habitat change, climate change, and a growing population and consumption will continue to cause losses in biodiversity and changes in ecosystem service at the present pace or even faster.

8.5 **Finding 5.** Many of the actions that have been taken to conserve biodiversity and promote its sustainable use have been successful in limiting biodiversity loss. Overall the losses are now occurring more slowly than they would have in the absence of these actions taken by communities, NGOs, governments, as well as business and industry. To achieve greater progress towards biodiversity conservation, it will be necessary – but not sufficient – to strengthen a series of actions that focus primarily on the conservation and sustainable use of biodiversity and ecosystem services.
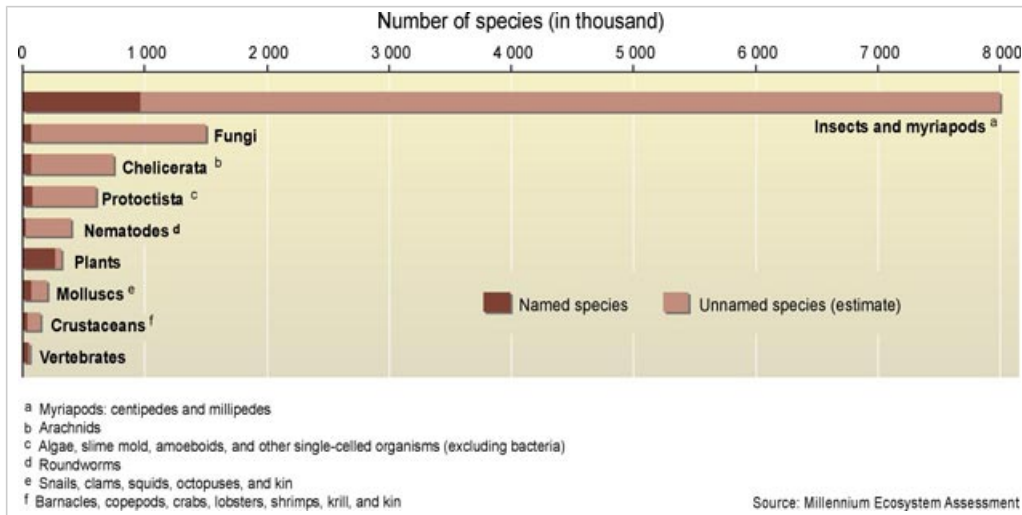
8.6 **Finding 6.** Unprecedented additional efforts would be needed to achieve a significant reduction in the rate of biodiversity loss at all levels by 2010.

Annex

Annex 1:

Figure 1.1. Estimates of Proportions and Numbers of Named Species in Groups of Eukaryote Species and Estimates of Proportions of the Total Number of Species in Groups of Eukaryotes

(C4 [see Annex 2, p. 9] .2.3)

a Myriapods: centipedes and millipedes
b Arachnids
c Algae, slime mold, amoeboids, and other single-celled organisms (excluding bacteria)
d Roundworms
e Snails, clams, squids, octopuses, and kin
f Barnacles, copepods, crabs, lobsters, shrimps, krill, and kin

Source: Millennium Ecosystem Assessment

Source: Millennium Ecosystem Assessment
Ecosystems and Human Well-being: Biodiversity Synthesis (2005) [see https://www.greenfacts.org/en/biodiversity/about-biodiversity.
htm] , p.22

Annex 2:

Direct cross-links to the Global Assessment Reports of the Millennium Assessment

Note that text references to CF, CWG, SWG, RWG, or SGWG refer to the entire Working Group report. ES refers to the Main Messages in a chapter.
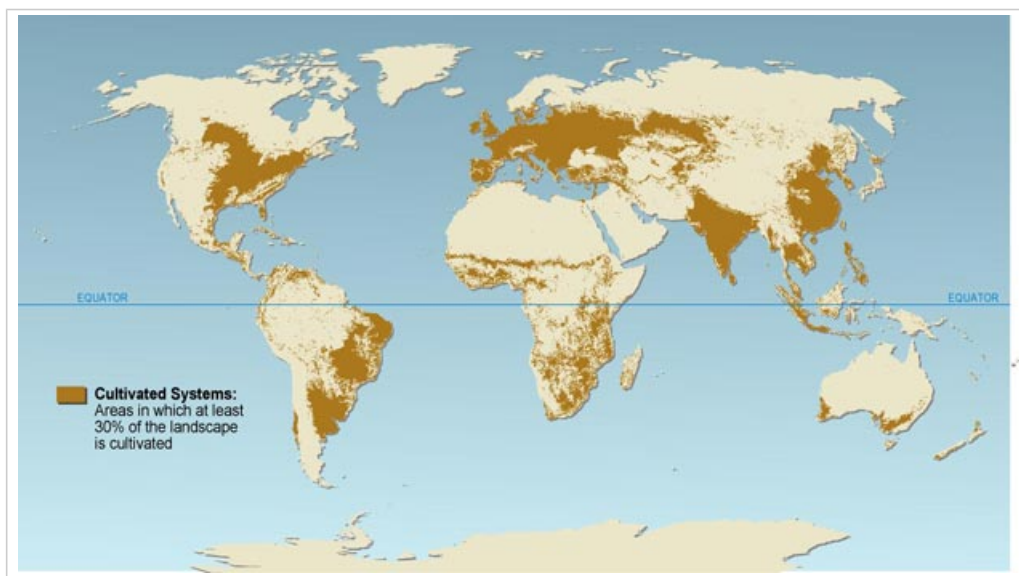
CF: Ecosystems and Human Well-being: A Framework for Assessment [see http://www.millenniumassessment.aspx]	
CF.1 Introduction and Conceptual Framework CF.2 Ecosystems and Their Services CF.3 Ecosystems and Human Well-being CF.4 Drivers of Change in Ecosystems and Their Services CF.5 Dealing with Scale CF.6 Concepts of Ecosystem Value and Valuation Approaches CF.7 Analytical Approaches CF.8 Strategic Interventions, Response Options, and Decision-making	This book offers an overview of the project, describing the conceptual framework that is being used, defining its scope, and providing a baseline of understanding that all participants need to move forward.
C (or CWG): Current State and Trends: Findings of the Condition and Trends Working Group [see http://www.millenniumassessment.org/en/Condition.aspx]	
SDM Summary C.1 MA Conceptual Framework C.2 Analytical Approaches for Assessing Ecosystem Conditions and Human Well-being C.3 Drivers of Change C.4 Biodiversity C.5 Ecosystem Conditions and Human Well-being C.6 Vulnerable Peoples and Places C.7 Fresh Water C.8 Food C.9 Timber, Fuel, and Fiber C.10 New Products and Industries from Biodiversity C.11 Biological Regulation of Ecosystem Services C.12 Nutrient Cycling C.13 Climate and Air Quality C.14 Human Health: Ecosystem Regulation of Infectious Diseases C.15 Waste Processing and Detoxi.cation C.16 Regulation of Natural Hazards: Floods and Fires C.17 Cultural and Amenity Services C.18 Marine Fisheries Systems C.19 Coastal Systems C.20 Inland Water Systems C.21 Forest and Woodland Systems C.22 Dryland Systems C.23 Island Systems C.24 Mountain Systems C.25 Polar Systems C.26 Cultivated Systems C.27 Urban Systems C.28 Synthesis	Richly illustrated with maps and graphs, Current State and Trends presents an assessment of Earth's ability to provide twenty-four distinct services essential to human well-being. These include food, fiber, and other materials; the regulation of the climate and fresh water systems, underlying support systems such as nutrient cycling, and the fulfillment of cultural, spiritual, and aesthetic values. The volume pays particular attention to the current health of key ecosystems, including inland waters, forests, oceans, croplands, and dryland systems, among others. It will be an indispensable reference for scientists, environmentalists, agency professionals, and students.
S (or SWG): Scenarios: Findings of the Scenarios Working Group [see http://www.millenniumassessment.org/en/Scenarios.aspx]	
SDM Summary S.1 MA Conceptual Framework S.2 Global Scenarios in Historical Perspective S.3 Ecology in Global Scenarios S.4 State of Art in Simulating Future Changes in Ecosystem Services S.5 Scenarios for Ecosystem Services: Rationale and Overview S.6 Methodology for Developing the MA Scenarios S.7 Drivers of Change in Ecosystem Condition and Services S.8 Four Scenarios S.9 Changes in Ecosystem Services & Their Drivers across the Scenarios S.10 Biodiversity across Scenarios S.11 Human Well-being across Scenarios S.12 Interactions among Ecosystem Services S.13 Lessons Learned for Scenario Analysis S.14 Policy Synthesis for Key Stakeholders	This second volume of the Millennium Ecosystem Assessment series explores the implications of four different approaches for managing ecosystem services in the face of growing human demand for them. The Scenarios volume will help decision-makers and managers identify development paths that better maintain the resilience of ecosystems, and can reduce the risk of damage to human well-being and the environment.
R (or RWG): Policy Responses: Findings of the Responses Working Group SDM Summary [see http://www.millenniumassessment.org/en/Responses.aspx]	
R.1 MA Conceptual Framework R.2 Typology of Responses R.3 Assessing Responses R.4 Recognizing Uncertainties in Evaluating Responses R.5 Biodiversity R.6 Food and Ecosystems R.7 Freshwater Ecosystem Services R.8 Wood, Fuelwood, and Non-wood Forest Products R.9 Nutrient Management R.10 Waste Management, Processing, and Detoxi.cation R.11 Flood and Storm Control R.12 Ecosystems and Vector-borne Disease Control R.13 Climate Change R.14 Cultural Services R.15 Integrated Responses R.16 Consequences and Options for Human Health R.17 Consequences of Responses on Human Well-being and Poverty Reduction R.18 Choosing Responses R.19 Implications for Achieving the Millennium Development Goals	With the knowledge of possible outcomes, what kind of actions should we take? The Millennium Ecosystem Assessment scored more than 70 response options for ecosystem services, biodiversity, and drivers such as climate change and nutrient loading. This third volume in the Millennium Ecosystem Assessment series presents policy options, analyzing the track record of past policies and the potential of new ones.

SG (or SGWG): Multiscale Assessments: Findings of the Sub-global Assessments Working Group [see http://www.millenniumassessment. org/en/Multiscale.aspx]	
SDM Summary SG.1 MA Conceptual Framework SG.2 Overview of the MA Sub-global Assessments SG.3 Linking Ecosystem Services and Human Well-being SG.4 The Multiscale Approach SG.5 Using Multiple Knowledge Systems: Benefits and Challenges SG.6 Assessment Process SG.7 Drivers of Ecosystem Change SG.8 Condition and Trends of Ecosystem Services and Biodiversity SG.9 Responses to Ecosystem Change and their Impacts on Human Well-being SG.10 Sub-global Scenarios SG.11 Communities, Ecosystems, and Livelihoods SG.12 Reflections and Lessons Learned	Representing the baseline and framework for ongoing assessments of ecosystems and human well-being on a variety of scales around the world, Multiscale Assessments provides students, researchers, and policy-makers with the most comprehensive methodology for assessing ecosystems at local, national, and regional scales.

Source: MA Millennium Ecosystem Assessment
Ecosystems and Human Well-being: Biodiversity Synthesis [see http://www.millenniumassessment.org/proxy/Document.354.aspx] (2005), p.85

Annex 3:

Figure 3.12. Extent of Cultivated Systems, 2000

(C26 [see Annex 2, p. 9])

Source: Millennium Ecosystem Assessment
Ecosystems and Human Well-being: Biodiversity Synthesis (2005) [see http://www.millenniumassessment.org/proxy/Document. 354.aspx] , p.52

Annex 4:

Figure 3.7. The Living Planet Index, 1970–2000

The index currently incorporates data on the abundance of 555 terrestrial species, 323 freshwater species, and 267 marine species around the world. While the index fell by some 40% between 1970 and 2000, the terrestrial index fell by about 30%, the freshwater index by about 50%, and the marine index by around 30% over the same period.
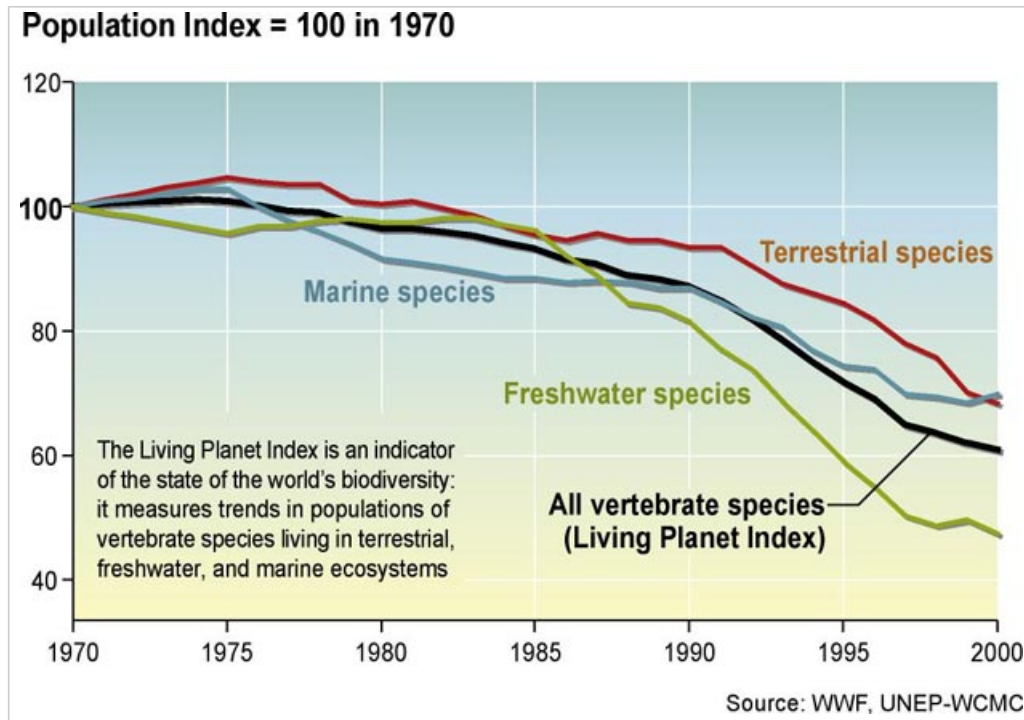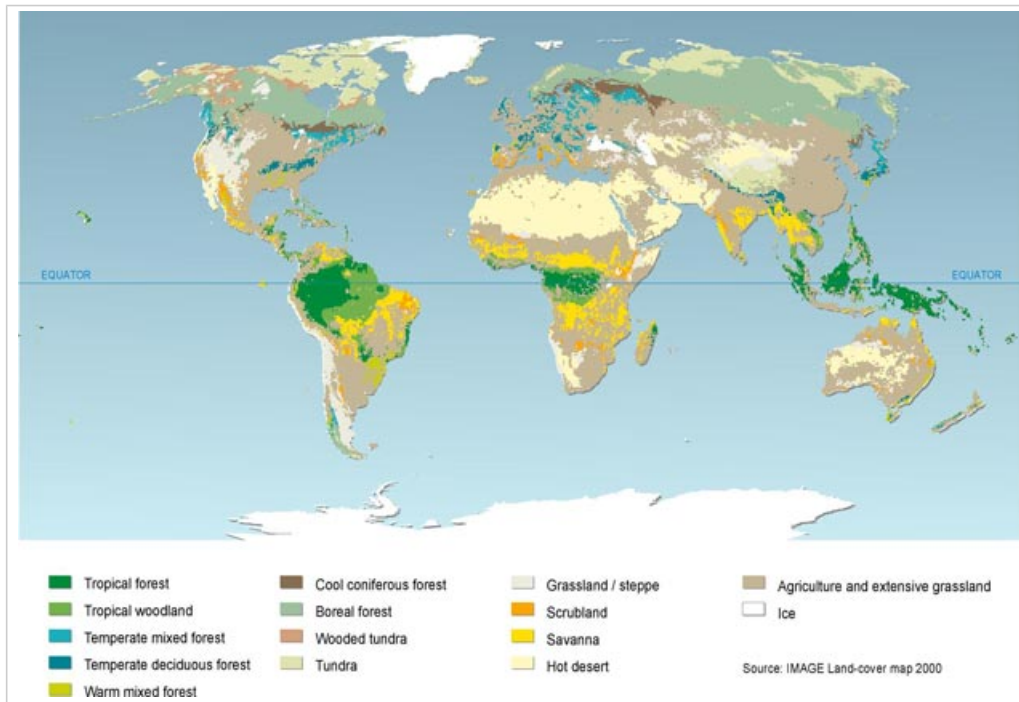

Source: Millennium Ecosystem Assessment
Ecosystems and Human Well-being: Biodiversity Synthesis (2005) [see http://www.millenniumassessment.org/proxy/Document. 354.aspx] , p.47

Annex 5:

Figure 4.3. Land-cover Map for the Year 2000

(S6 [see Annex 2, p. 9])

Legend:
- Tropical forest
- Tropical woodland
- Temperate mixed forest
- Temperate deciduous forest
- Warm mixed forest
- Cool coniferous forest
- Boreal forest
- Wooded tundra
- Tundra
- Grassland / steppe
- Scrubland
- Savanna
- Hot desert
- Agriculture and extensive grassland
- Ice

Source: IMAGE Land-cover map 2000

Source: Millennium Ecosystem Assessment
Ecosystems and Human Well-being: Biodiversity Synthesis (2005) [see http://www.millenniumassessment.org/proxy/Document.
354.aspx] , p.63

Partner for this publication

The Levels 1 & 2 of this study are summaries of "Ecosystems and Human Well–being: Biodiversity Synthesis", a report published in 2005 by the Millennium Ecosystem Assessment (MA).

The summaries have been written by GreenFacts in partnership with:

with the financial support of: