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PROPOSED BIODIVERSITY INDICATORS RELEVANT TO THE 2010 TARGET

Note by the Executive Secretary

I. INTRODUCTION

1. In decision VI/26, the Conference of Parties, adopted a Strategic Plan for the Convention including a target "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". This "2010 target" was endorsed in paragraph 44 of the Plan of Implementation of the World Summit on Sustainable Development.

2. In paragraph 12 of Decision VI/26, the Conference of the Parties recognized that better methods should be developed to objectively evaluate progress in the implementation of the Convention and the Strategic Plan.

3. The Executive Secretary, in collaboration with the World Conservation Monitoring Centre (UNEP-WCMC) and the United Nations Development Programme, convened a meeting to review the 2010 target with the aim of better understanding the target and how its achievement could be assessed. The meeting, held from 21 to 23 May 2003 in London, recommended, *inter alia,* that a set of approximately ten key indicators be identified or developed, which should be based on identifiable and quality controlled datasets making use of existing datasets and assessment processes, and that priority should be given to regional or global indicators (see UNEP/CBD/SBSTTA/9/INF/9). The meeting also requested that an information document on this subject be submitted to the ninth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice.

4. In response to this request, the Executive Secretary has prepared the present note, which explores achievable and reliable regional and global-level indicators that are relevant to the 2010 target. A limited list of feasible candidate indicators relevant to the 2010 target is suggested focusing on the status and trends of the components of biodiversity, threats to biodiversity, and goods and services provided by

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biodiversity and ecosystems. To the extent possible these rely on existing assessments, indicators and data sets.

5. Pursuant to decision VI/7-B of the Conference of the Parties, an expert group on indicators for national-level monitoring prepared, during its meeting held from 10 to 12 February and subsequent inter-sessional work, a document containing (i) a set of principles to develop biodiversity indicators and monitoring in the form of a *step by step procedure*; (ii) a list of key questions with reference to the relevant articles of the Convention; and (iii) a list of tested indicators (see UNEP/CBD/SBSTTA/9/10 and UNEP/CBD/SBSTTA/9/INF/7). The indicators proposed in annex 1 of the present note have been selected in accordance with the framework developed by the expert group on indicators and the guidance on sustainable use (UNEP/CBD/SBSTTA/9/9) prepared by the Fourth Open-ended Workshop on the Sustainable Use of Biological Diversity held in Addis Ababa from 6 to 8 May 2003.

6. The arrangement of the proposed indicators is consistent with the proposal on the integration of outcome-oriented targets into the programmes of work of the Convention, taking into account the 2010 biodiversity target, the Global Strategy for Plant Conservation, and relevant targets set by the World Summit on Sustainable Development, contained in the note by the Executive Secretary on the integration of outcome-oriented targets into the programmes of work of the Convention, taking into account the 2010 biodiversity target, the Global Strategy Plant Conservation, and relevant WSSD targets (UNEP/CBD/SBSTTA/9/14).

II. EXPLORATION OF POSSIBLE INDICATORS

7. A pragmatic approach has been adopted in proposing the indicators listed in annex 1. Emphasis has been placed on those which are readily available, meaningful, sensitive and representative and for which data are at hand or are obtainable. The selection has also assumed that the scarce resources available for conservation should continue to be used for conservation measures rather than being spent to measure progress towards the 2010 target.

8. The notion of ‘biodiversity loss is complex. The London meeting concluded that biodiversity loss can consist of:

(a) A decline in extent, condition or sustainable productivity of ecosystems;

(b) A decline in abundance, distribution or sustainable use of species populations, and extinctions;

(c) Genetic erosion.

9. In accordance with this definition and the objectives of the Convention, indicators which relate to the following sub-targets have been identified:

(a) Status and trends of the components of biodiversity (habitats, species, genetic diversity);

(b) Threats to biodiversity (such as unsustainable use, invasive species, and pollution); and

(c) Goods and services provided by biodiversity and ecosystems.

10. Deserts will inherently have less species than a tropical rainforest but this does not mean that deserts are intrinsically less valuable from a biodiversity viewpoint. Biodiversity is therefore assessed in relation to an expected state and/or size, not as a total number or amount. Accordingly, the indicators assess the quality and/or quantity of components of biodiversity relative to the expected characteristics of an ecosystem.

11. Data are generally available on size and change of ecosystem types and on abundance, presence/absence, distribution, density, biomass, breeding stock of selected species. Limited data are also available on communities and structural characteristics such as: canopy cover, ratio dead/living wood, forest age, forest height, primary/secondary forest, and extent of vital coral reefs or mangrove systems. Extensive information is available on the threat level of species of particular groups.

12. Data availability depends on the type of monitoring techniques and related scales. Some important information sources and reporting mechanisms include:

(a) Convention reports (CBD, UNCCD, Ramsar, CITES, CMS, etc.);

(b) The Global Biodiversity Outlook (CBD/ UNEP-WCMC);

(c) The Global Environment Outlook (UNEP/collaborating centres);

(d) World Resources Report (UNEP, UNDP, World Bank, WRI);

(e) Earth Trends (WRI);

(f) IUCN Red Data Books and Species Survival Commission Reports;

(g) Human Development Report (UNDP);

(h) World Development Report (World Bank) ;

(i) IPCC;

(j) FAO Plant Genetic Resource Assessment;

(k) FAO reporting on fisheries, forest and agriculture;

(l) Millennium Ecosystem Assessment;

(m) Mountain Assessment;

(n) Land Degradation Assessment;

(o) World Water Assessment;

(p) Global International Waters Assessment;

(q) Global Marine Assessment;

(r) GTOS;

(s) UNESCO-MAB Biosphere Biodiversity programme;

(t) WWF, BirdLife International, Wetlands International, Conservation International, TNC, etc.;

(u) National programmes and reports.

13. Although additional monitoring may be required in some cases, it is most productive and realistic to rely to the largest possible extent on currently available knowledge, data, ongoing monitoring

programmes and reporting mechanisms. The information document on "Using existing processes as building blocks in reporting on the 2010 target" (UNEP/CBD/SBSTTA/9/INF/27) provides additional information and discusses how existing international initiatives can be used to assess progress towards the 2010 target.

14. Indicators relevant to the 2010 target should match the following requirements (see also UNEP/CBD/SBSTTA/9/10). They should:

(a) Address the key properties of the process of biodiversity loss;

(b) Be meaningful for the target-audience;

(c) Be measurable in an accurate and affordable way making maximum use of existing data, indicators and assessments;

(d) Be sensitive to measure a reduction in the loss of biodiversity;

(e) Be scientifically sound;

(f) Have broad acceptance;

(g) Be representative for the various biodiversity levels; and

(h) Be flexible for use in a limited number of composite indicators.

15. Key processes to be indicated include the loss of habitats and the decrease in abundance of many ecosystem-specific species and the increase of a few others (the homogeneity process). Decreasing species abundance is caused by habitat loss and by (physical, chemical and biological) pressures on remaining habitats. Indicators which directly measure this process are (i) the *size per ecosystem type* and (ii) the *abundance of ecosystem-specific species* in the remaining ecosystem type (see annex 1).

16. Both indicators meet many of the above requirements. In combination they describe a key process of biodiversity loss, they are simple to understand, are meaningful to the target audience being often laymen, and land cover/land use and species occurrence are globally among the best monitored variables in the past and present. They are sensitive, concern the ecosystem and species levels, and are useful as building blocks for composite indicators. Further, ecosystem size is directly related to land conversion and land cover/land use and can easily be linked to socio-economic scenarios and measures. Ecosystem-specific and sensitive species can be useful indicators because they are the building blocks of ecosystems and can be measured and investigated unambiguously, have specific habitat requirements and cause-effect relationships with pressures and are therefore well linkable to socio-economic scenarios and measures, and finally they are appealing and easy to communicate.

17. Ecosystem size and species abundance appear also to be commonly used indicators according to the responses to the questionnaire on available and potential indicators contained in annex 1 of the note by the Executive Secretary on monitoring and indicators (UNEP/CBD/SBSTTA/9/10). The expert group on indicators for national use also included both indicators in its list.

18. It is neither necessary nor possible to measure the abundance of all species. A representative cross-section of ecosystem-specific species is far more cost-effective to measure general trends 1/ (sample approach). If data on species abundance are not available, indicators at the community level, such as area of vital coral reefs and seagrass beds for marine ecosystems and canopy cover, dead/living wood ratio and

1/ To economic indices such as retail price index (inflation) a similar shopping basket approach is applied.

percentage forest by forest type (primary, secondary or plantations) for forest ecosystems, may be used as an approximate (see annex 1). In general, the more species and/or community indicators contribute, the more accurately the process of biodiversity loss can be described.

19. The Red List of threatened species is a suitable indicator, which is used to provide information on the number of threatened species and their threat status by species group. While the above indicators provide information on the average change in species abundance, the Red List indicator provides supplementary information on species for which urgent action may be needed (see annex 1).

20. The candidate indicators at the genetic level focus on the serious loss of genetic diversity within crops and livestock in agricultural ecosystems. It concerns existing indicators implemented by FAO and CGIAR centres. Data on the genetic diversity of wild species are rarely available. Nevertheless, the Red List may partly compensate for this by indicating species with a high extinction risk.

21. Candidate indicators of biodiversity threats (pressures) concern habitat loss and fragmentation, overexploitation, acidification, eutrophication and climate change (see annex 1). They are of a global or universal character; cover a high share of the impact on biodiversity; and are generally measured and dealt with by various institutions, thereby ensuring that data and indicators are achievable.

22. A candidate response indicator concerns the area of protected ecosystems. Protected area has a global character; covers a high share of the –positive- impact on biodiversity; and data are generally available. Together with the change in pressure and state indicators the area of protected ecosystems provides an indication of the effort and efficacy of policies in reducing the loss of biodiversity.

23. Candidate indicators on biodiversity use and functions concern common indicators on maintaining the capability of delivering goods (harvest of species in natural ecosystems and tourist earnings) and services (carbon sequestration, erosion control and control of floods and droughts) (see annex I below). Similar to the other indicators, they are of a global or universal character; cover a high share of the goods and services of biodiversity beneficial to men; and are generally measured and dealt with by various institutions.

24. The abovementioned – often single – indicators can also serve as building blocks for composite indicators 2/ (figure 1). The Natural Capital Index (NCI) and Wilderness indicator provide information at the ecosystem level. NCI combines the change in ecosystem size (ecosystem quantity) with the change in abundance of a representative set of species (ecosystem quality) into a single measure: the change in average species abundance of an ecosystem. 3/ The Wilderness indicator shows the remaining unfragmented natural area. The Species Assemblage Trend Index (STI) and Red List Indicator (RLI) provide species level information. STI combines various species trends into the change of species groups, for example birds, mammals, species of socio-economic interest, wild-relatives, large herbivores, introduced and pest species, or any desired crosscut such as the biodiversity components listed in Annex I of the Convention. The Red List Indicator (RLI) combines the number of threatened species with their threat category by group. The Pressure Index (PI) combines various pressures into an overall index by scaling their severity and extent by ecosystem type (see fact sheets in annex II of this note). These indicators describe the process of biodiversity loss from different perspectives and they are able to cope with the variety of data types, scales and sources.

2/ Single indicators consist of one single variable. Composite indicators consist of two or more single indicators of which the dimensions have been transformed in one common dimension, usually an index. See also UNEP/CBD/SBSTTA/9/inf/7, Annex 2 D.

3/ Or in different terms: the percentage remaining area of baseline quality.

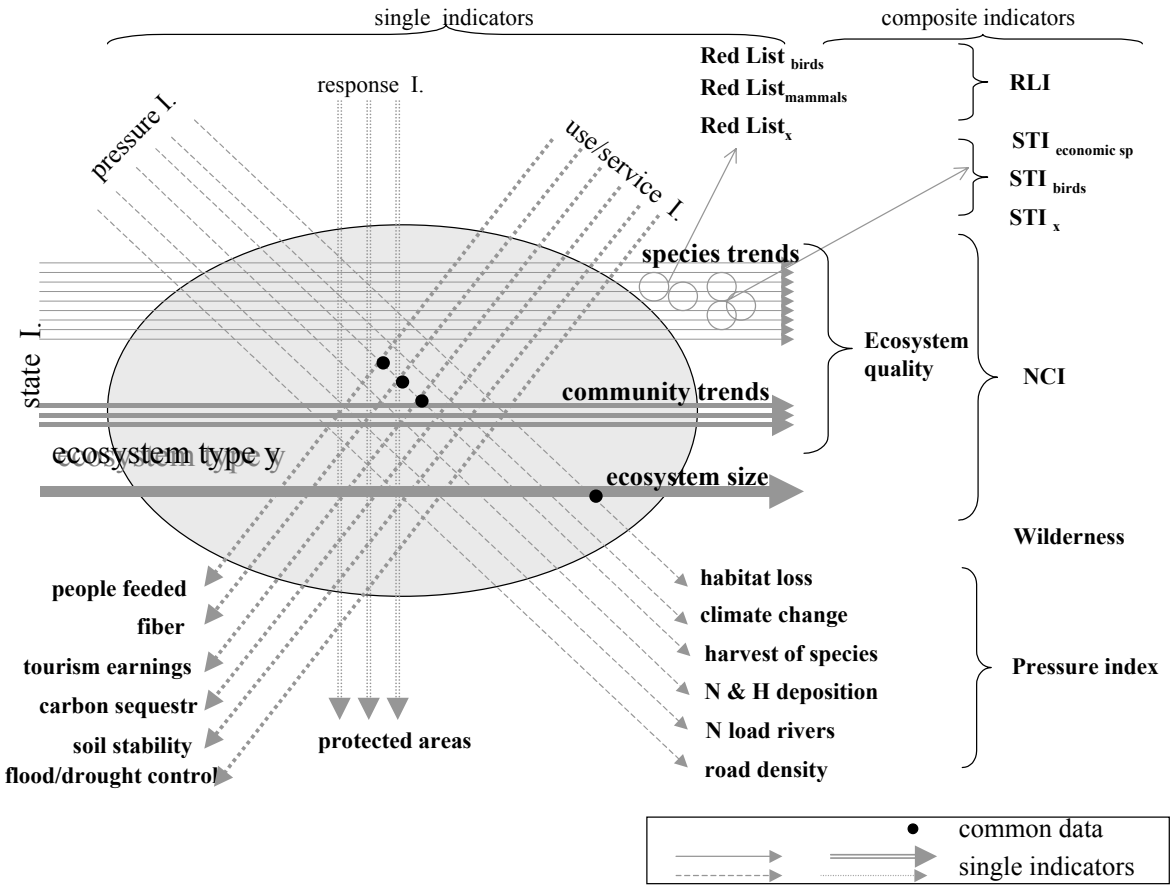


Figure 1: A schematic overview of the various candidate indicators (the arrows) and their complementary information on an ecosystem type (y), its pressures, conservation measures and uses. Possible combinations of single indicators into composite indicators are showed (Natural Capital Index NCI; Species Assemblage Trend Index STI; Red List Indicator RLI; Pressure Index). Some indicators are based on the same data (crossing indicators with dots) such as ecosystem size and habitat loss. The circles symbolize different assemblages of species trend data resulting in various STIs.

Annex I.

PROPOSED INDICATORS RELEVANT TO THE 2010 TARGET

2010 targets	Generic indicator	Illustrative list of indicators	Meaning	Some existing sources of information	Relation to MDG goals
Significant reduction to the loss of biodiversity					
1. Significant reduction of the loss of ecosystems	Size per ecosystem type	- Forest area by type - Area of dry and sub-humid lands by type - Inland waters area - Agricultural area by type - Coastal area by type - Built-up area	How much remains per ecosystem type (no conversion into other type).	FAO, NASA, UNEP/GRID EROS Data Centre, Wetland International, UNEP-WCMC, CIFOR, EFI, National land cover and land use statistics. Satellite data from: NOAA, Vegetation 4, Landsat, MODIS, others.	Eradicate hunger and poverty of people which depend on these ecosystems
	Ecosystems protected	Percentage and size of ecological region protected in	According to IUCN categories	IUCN, EEA, etc	
	Trends in ecosystem structure	Trends in: Forest -canopy cover -age -dead-living wood ratio -primary, secondary, plantation Marine communities -vital coral reef area -sea grass area -mangrove area -intertidal area -salt marsh area Agriculture -% (semi)natural area -other Inland waters -flood plain area	These variables of ecosystem structures can be used as proximate for species trends in case insufficient data on species trends is available	FAO, UNEP-WCMC, CIFOR, IUCN, NGOs, diverse remote sensing sources such as NASA, national institutes, etc GMA, GIWA, Ramsar Convention FAO WWA, Ramsar Convention	

2010 targets	Generic indicator	Illustrative list of indicators	Meaning	Some existing sources of information	Relation to MDG goals
	Trends in ecosystem functioning	Trophic integrity of ecosystems		TSBF, FAO, ICLARM FishBase	
2. Significant reduction of the loss of species	Trends in species abundance	Trends in: - Mammal species -large carnivores -large herbivores -other - Bird species - Reptile species - Amphibian species - Fish species - Plant species - herbious species - tree species - wild relatives - Butterfly species - other species	Show homogeneity process within ecosystem types at species level Show decline (gain) in quality of ecosystem type Show loss (gain) of productivity of ecosystems Species abundance can be expressed in e.g.: total numbers, population density, distribution, biomass, breeding pairs, etc	FAO, IUCN, UNEP-WCMC, WWF, Birdlife International, GBIF, national institutes, individual scientists, indigenous people, NGOs, etc	In case of species or communities of direct or indirect economic importance the indicators relate to MGD on hunger and poverty
	Red List	Red List: - vascular plants - mammals - birds - reptiles - amphibians - fishes - butterflies - other groups	Number of threatened and extinct species by group and their threat status	IUCN, WCMC, CITES, etc	
3. Significant reduction of the loss of genes	Number of livestock breeds Number of crop varieties	Number of: -cattle breeds - goat breeds - pig breeds - sheep breeds - other species Number of: - rice varieties - corn varieties - potato varieties - other	Which genetic resources are threatened, being the basis of human food production	FAO, CGIAR centres, various national and regional institutes, … FAO, CGIAR centres, various national and international institutes, …	Eradicate hunger and poverty

2010 targets	Generic indicator	Illustrative list of indicators	Meaning	Some existing sources of information	Relation to MDG goals
Threats to biodiversity					
4. Control threats from habitat loss, fragmentation,	Loss area per ecosystem type	Converted area of: - Forest - Grassland - Tundra - Inland waters - Desert and semi-desert - Ice - Agricultural area	How much of the natural ecosystems is lost? This is the reverse of the state indicator on extent of area	Same as in 1.	
	Fragmentation	Road density	Local impact by roads, industry, mines and urban area	UNEP/GRID Arendal, etc	
5. Control threats from exploitation	Exploitation	Harvested species in tons/year: - tree species - fish species - game species - cetaceans - others	Direct impact on the abundance of species	FAO, CITES, World Fish Centre, Millennium Ecosystem Assessment, various national and regional institutes..	
6. Reduce pressures from climate change, pollution	Climate change	Mean temperature Mean precipitation	Changing conditions for ecosystems and species	IPCC, not measurable, should be modelled	
	Acidification and eutrophication	Nitrogen and Sulfur deposition in equivalents/km^2	Eutrophication and acidification by air pollution related to critical loads	UNEP/GEO; RIVM (deposition models required)	
		Nitrogen loads in rivers	Conversion of natural ecosystems and intensified agricultural production often result in increasing riverine nitrogen fluxes and damage to aquatic and marine systems	UNESCO-IOC Global Nutrient Export from Watersheds project; UNEP/GEO; SCOPE studies.	
Maintain and share benefits/services from biodiversity					
7. Maintain capacity of ecosystems to deliver goods	Harvesting of species	Amount harvested: - tree species - fish species - game species - cetaceans	Harvest expressed in: - tons/year (as indicator 5) - US$ - number of people depending on these natural resources	FAO, World Fish Centre, Millennium Ecosystem Assessment, national institutes, etc	Eradicate hunger and poverty

2010 targets	Generic indicator	Illustrative list of indicators	Meaning	Some existing sources of information	Relation to MDG goals
		- extensive cattle grazing	- contribution to Gross Domestic Product		
	Income	Income from tourism	- US$ - number of people depending on the sector - contribution to GDP	World Tourism Organisation; World Travel and Tourism Council; Millennium Ecosystem Assessment, national and regional statistics, etc	Eradicate hunger and poverty
		Trophic integrity of inland waters and oceans	- changes in trophic level of fishes and other aquatic taxa being exploited	FAO	
8. Maintain capacity of ecosystems to deliver services	Climate regulation	Carbon sequestration Pg C/yr. ecosystem type (Petagram of C per year)	Especially for forest, but other ecosystems contribute too.	IPCC, FAO, Millennium Ecosystem Assessment, … Not measurable, models required	Ensure environmental sustainability
	Soil stability	Total suspended solids in main rivers	Relation with vegetation cover and land use;	UNESCO, USGS, EEA, various national and regional institutes..	Eradicate hunger and poverty
	Flood/drought control	River flow characteristics major rivers (hydrograph)	River flow characteristics will become more extreme (flooding and droughts) due to loss of water holding capacity of the catchment area as a result of conversion of natural ecosystems in agriculture and built-up area, deforestation and unsustainable soil management practices.	GRDC-Koblenz ; IGBP-BAHC; various national and international institutes, etc	Eradicate hunger and poverty

Annex II

EXAMPLES OF FACT SHEETS FOR CANDIDATE INDICATORS

1. The fact sheets below provide a general description on various aspects and data sources of the candidate indicators listed in annex I above. Additional technical details are contained in the literature or available from implementing organizations.

2. Most indicators have been implemented in a specific form and at specific scales. However, others are still in development and their design is not fixed. Implementation at the regional and global levels may require some adjustments. For almost all indicators, data on the various time points or regions will be incomplete. However, it is expected that sufficient data will be available or achievable to provide a sufficiently clear picture on the trends of the various components of biodiversity, its functions, pressures and responses.

A. Single indicators

Name	Size of ecosystem type
Type	PSR: State Level: ecosystem Aggregation: single
Meaning	- Remaining area per ecosystem type per region (ecosystem quantity) - Remaining natural area not being conversed into man-made area. - A direct measure of biodiversity loss: a loss of x% area of an ecosystem type will approximately result in a similar loss of the *mean* abundance of its ecosystem-specific species. - The indicator does not measure the actual biodiversity and its loss within the remaining ecosystem (ecosystem quality), only its spatial potential. - The indicator "Trends in species abundance" provide complementary information on biodiversity within the remaining ecosystem type (ecosystem quality).
Unit – dimension	ha or km2 percentage of region or world
Valuation/Baseline	Reference year in the period 1990-2000.
Description	Many divisions in ecosystem types possible such as biomes (Prentice et al, 1992) and (Olson et al.2001), Holdridge Life Zones, Bailey ecoregions, thematic areas according to CBD, WWF ecoregions, etc A possible division in ecosystem types is a distinction between natural (self-regenerating) and man-made ecosystems, which can be further sub-divided: (see UNEP/CBD/SBSTTA/3/INF/13): Man-made (cultural) ecosystems: Heavily modified areas intensively used by humans. Sub-categories: - Agricultural area: arable land; planted pasture for permanent livestock; permanent crop land, rice paddies, forest plantation; and all self- regenerating patches < 100 ha. within agricultural land - Artificial waters - Built-up area Natural (self-regenerating) ecosystems: All other primarily natural and semi-natural areas, possibly extensively used ecosystems, irrespective to which it is impacted by human activities,

	larger than 100 ha. such as: nature areas; extensively used areas such as shifting cultivation areas, areas with nomadic livestock and areas with indigenous people living in traditional way; all forests (including production forests, except for forest plantations); rangelands of native pastures; inland waters (except for artificial waters); marine areas. Sub-categories: - forests - grassland/savannah - desert and semi-desert - tundra - inland waters/wetlands - marine Ecosystem types (and the regions they are part of) should be well defined and not overlap.
Scale – resolution	By region and globally. Data resolution will be generally > 1km2. In principle the indicator is applicable on all spatial scales
Data	Various data sources available, providing data for different time points. This necessitates harmonisation and interpretation between the various data sources to track changes over time. Sources: Global Land Cover 2000, IGBP Global Land Cover Data- Base (1992-93), various national and regional land cover data, FAO-FRA forest cover statistics, FAOSTAT database, UNEP/GRID EROS Data Centre and others. Data for most regions available or achievable.
Implementation	Examples of application: Global Environment Outlook 1-3, Millennium Ecosystem Assessment, FAO-FRA2000, etc
Reference	see above

Name	Trends in species abundance
Type	PSR: state Level: species Aggregation: single
Meaning	- This indicator provides direct information on the process of biodiversity loss as described in the document. - In case of ecosystem-specific (native) species, a downward trend is negative. In case of plague or introduced species a downward trend is positive. - This indicator can be applied for all species. - The more data on species and their abundance is available the more it provides general information on the process of biodiversity loss of the ecosystem as a whole (quality). This indicator is complementary to indicator “size of ecosystem types”.
Unit – dimension	Many units are possible, depending on the species and availability of data: population numbers, density, presence/absence, biomass, number of breeding pairs, area of distribution, etc by ecosystem type or region.
Valuation/baseline	Reference year in the period 1990-2000.
Description	Species abundance is a measure or proximate of the number of individuals of a single species. This can be measured in many ways (see units). Because loss of biodiversity is characterized by a decrease in abundance of many species and an increase of a few other species, this indicator provides a direct measure of this process.

Scale-resolution	By ecosystem type or by region. Data resolution will vary per species. In most cases abundance will be based on sample areas. In principle the indicator is applicable on all scales.
Data	International: IUCN-SIS development, FAOSTAT, FISHSTAT, UNEP-WCMC, Birdlife international, Wetlands International, CGIAR System amongst which World Fish Centre and CIFOR, Global Invasive Species Database, and many other international and regional organisations. National: national research institutes, universities and NGOs. For most ecosystem types many data on species abundance exist but often scattered. So far the available data have been little used in regional and global assessments. They need to be compiled and analysed, especially the numerous quantitative data at national level. Data quality and geographical coverage is highly variable. Most data are expected to be on mammals and birds.
Implementation	Most countries, as well as the above mentioned organisations, have applied indicators on species trends,
Reference	-

Name	Trends in community structure
Type	PSR: state Level: community of species Aggregation: single
Meaning	• In some cases it is easier to get data on the "abundance of a community" than on the abundance of single species. • This is especially the case in covered, complex and/or species-rich ecosystems such as tropical rain forest and parts of marine ecosystems such as coral reefs, mangroves and seagrass beds. • Area loss of for instance vital coral reefs, mangroves or seagrass provide a pragmatic approximate of a similar decrease in abundance of the numerous species associated with these marine sub-ecosystems. • This indicator provides nearly direct information on the process of biodiversity loss as described in the document. • A downward trend is negative and upward trend positive. • This indicator can be applied on any other community, which is specific and relevant for a particular ecosystem type and can be easily measured.
Unit – dimension	Many units are possible, depending on the community. Area per ecosystem type (or region) is a commonly used unit.
Valuation/baseline	reference year in the period 1990-2000
Description	Community dependent. See e.g. factsheets of vital coral reefs and mangroves
Scale	By ecosystem type. Data resolution will vary per ecosystem type. In most cases community abundance will be based on sample areas. In principle the indicator is applicable on all scales.
Data	Many International, regional and national. As for species, data on community abundance is existing but often scattered over many scientists, institutes and local communities and so far only partly been used in regional and global assessments. Mobilized and brought together they will enlarge the evidence base considerably. Data quality and geographical coverage is highly variable.

Implementation	see factsheets on vital coral reefs, mangroves, seagrass beds and natural and ancient semi natural forest.
Reference	-

Name	Trends in community structure: Vital coral reefs
Type	PSR: State Level: community Aggregation: single
Meaning	• Loss of the area of vital coral reefs, provide a pragmatic proxy of the change in abundance of the numerous species associated with these marine sub-ecosystems. • Consequently this indicator provides nearly direct information on the process of biodiversity loss as described in the document. • A downward trend is negative and upward trend is positive.
Unit-dimension	Area of vital coral reef (km²)
Valuation/baseline	reference year in the period 1990-2000 intact coral reefs
Description	Healthy coral reefs, measured by % affected by coral diseases, bleaching and broken-up areas and % reefs at risk.
Scale	From sub-national – global; methods from diver surveys to remote sensing from satellites and manned space vehicles.
Data	World wide. Reasonably complete data sets from 1990's and around 2000. Will probably continue to be collected in the future. Collected particularly by: US Defence Mapping Agency (*Mundocart*); UNEP; WCMC; World Fish Centre (*reefbase*); AIMS; NASA; WRI; ICRI (*World Atlas of Coral Reefs*); Global Coral Reef Monitoring Network; Reef Check; CORDIO; IFRECOR. Many other organisations also involved, at a local as well as global scale.
Implementation	UNEP-WCMC; World Fish Centre (assessment of bleaching events and other threats to coral reefs); World Atlas of Coral Reefs;
Reference	WRI et al., 1996. Reefs at Risk report; Wilkinson, C., 1998: Status of Coral Reefs of the World: 1998; Wilkinson, C., 2000: Status of Coral Reefs of the World: 2000; Spalding, M.D. et al., 2001: World Atlas of Coral Reefs.

Name	Trends in community structure: Mangroves
Type	PSR: State Level: community Aggregation: single
Meaning	• The loss of the area of vital mangroves provides a pragmatic proxy of the change in abundance of the numerous species associated with these marine sub-ecosystems. • Consequently this indicator provides nearly direct information on the process of biodiversity loss as described in the document. • A downward trend is negative and upward is positive.
Unit-dimension	Area of remaining mangrove vegetation (km²)
Valuation/baseline	reference year in the period 1990-2000
Description	• Area of remaining mangrove forest is measured.
Scale	From sub-national – global, depending on resolution of data. Most data

	are collected locally, many by volunteers. But also some observations by remote sensing from satellites are known.
Data	Data mainly from between 1980 and 2000; recent better coverage. Originally assembled fragmentary, but increasingly more structurally. MAP (Mangrove Action Project). International Society for Mangrove Ecosystems (ISME). Data also mentioned in World Atlas of Coral Reefs.
Implementation	World Mangrove Atlas; Global Mangrove Status Report.
Reference	Spalding, M.D., et al., 1997;

Name	Trends in community structure: Sea grass
Type	PSR: State Level: community Aggregation: single
Meaning	• Loss of the area of sea grass fields provide a pragmatic proxy of the change in abundance of the numerous species associated with these marine sub-ecosystems. • Consequently this indicator provides nearly direct information on the process of biodiversity loss as described in the document. • A downward trend is negative and upward is positive.
Valuation/baseline	reference year in the period 1990-2000 vital, intact sea grass beds
Description	Area of see grass beds
Scale	From sub-national – global, depending on resolution of data
Data	Structural assembly of data since approximately 1980. Increasingly better coverage. World Atlas of Coral Reefs of UNEP-WCMC.
Implementation	World Atlas of Coral Reefs of UNEP-WCMC
Reference	Spalding et al., 2001; UNEP-WCMC: World Atlas of Coral Reefs.

Name	Trends in community structure Area of natural and ancient semi natural forest
Type	PSR: State Level: community Aggregation: single
Meaning	• The decrease in area natural and ancient semi natural forest area is an approximate for the abundance of species associated with or dependent on natural forest ecosystems. • Consequently this indicator provides proximate information on the process of biodiversity loss as described in the document. • A downward trend is negative and upward trend is positive.
Unit-dimension	• ha or km2 per forest type by region • % natural and ancient semi natural forest of total area of forest type.
Valuation/baseline	reference year in the period 1990-2000
Design	Naturalness is characterized by species composition of main taxa and also by structural factors such as age composition of trees and amount of dead wood.
Scale-resolution	By ecosystem type. Data resolution will vary per ecosystem type. In most cases data will be based on sample areas. In principle the indicator is applicable on all scales.

Data	CIFOR, FAOSTAT, EFI, ...
Implementation	FAO-FRA reports, WWF-reports
Reference	see above

Name	**Trophic integrity of ecosystems**
Type	PSR: state Level: community of species Aggregation: single
Meaning	• This indicator is a measure of changes in the representation of species within specific guilds • It also is an indicator of the population structure (e.g. number of individuals of a particular size/age) • A change in trophic structure, e.g. a relative decrease in the number of predators, indicates a change of the biological and/or physical environment • A change in the population structure, e.g. a relative decrease in large size individuals, indicates over-harvesting of the resources
Unit – dimension	% of representatives of guild or size class
Valuation/baseline	Natural "ideal" composition of
Description	This indicator can be applied to many taxa (arthropods, nematods, mollusks etc.) but may be particularly relevant for fishes. There may be a natural seasonal variation.
Scale	By ecosystem type (e.g. mangrove, coral reef, high sea) and region.
Data	FAO, ICLARM FishBase, TSBF, local resource users
Implementation	
Reference	Pauly *et al.* 1998. Fishing down marine food webs. Science 279: 860-863. Sea Around Us Project (http://saup.fisheries.ubc.ca/)

Name	Trends in species abundance: Red List
Type	PSR: state Level: species Aggregation: single
Meaning	Degree of threat per species in terms of a prediction of the extinction risk
Unit-dimension	number of species at risk of particular assemblage of species
Valuation/baseline	no threat, no risk of extinction
	The IUCN Red List system contains 9 categories, of which 4 consider species threatened with extinction or being extinct: 1. vulnerable 2. endangered 3. critically endangered 4. extinct Classification is through a set of 5 quantitative criteria, which are based on biological factors related to extinction risk and include rate of decline, population size, and area of distribution. Regional and national systems sometimes use adapted categories and criteria. This is not a major problem if consequently applied in order to track changes over time.

Scale-resolution	Usually applied on the global, regional and national scale. Data resolution will vary.
Data	IUCN and national and international institutes and organisations. Baseline data from 1990-2000 do not cover all current Red List species.
Implementation	IUCN, 2002. IUCN Red List of Threatened Species. http://redlist.org.
Reference	The IUCN Red List consortium: BirdLife International, Conservation International (Centre for Applied Biodiversity Science), the IUCN Species Survival Commission and NatureServe; http://www.redlist.org/info/categories_criteria2001.html

Name	Trends in genetic abundance: Number of livestock breeds
Type	PSR: state Level: genetic Aggregation: single
Meaning	• This indicator provides direct information on the process of biodiversity loss at the genetic level in agri-ecosystems as described in the document: decrease in abundance of many (traditional) livestock breeds and increase of a few other (highly productive) breeds. • This is complementary ("quality") information to indicator "size of agricultural ecosystem types". • In principle a downward trend is negative and vice versa. • However, besides the number of breeds is also important the diversity within the breeds. It is possible that the genetic diversity decreases while the number of livestock breeds increases in a region. • The diversity within breeds can be approximated by taking into account the population size of the various breeds. This would result in a composite indicator (not elaborated here, but similar to the Species Assemblage Trend Index for wild species). • The above measures are in situ measures. They do not provide a picture of the ex-situ conservation which may compensate losses in-situ.
Unit-dimension	Number of breeds of livestock species per region.
Valuation/baseline	The FAO World Watch List on livestock provide information on the current state and recent trends. From the latter information baseline information can be derived from before 2000.
Description	This indicator can be applied for all livestock species. Subdivisions are possible.
Scale	By region and world. In principle applicable on all scales.
Data	FAO, ILRI/CGIAR, various regional and national institutes. Data are available for most countries.
Implementation	FAO World Watch List (2002) and nationally for most countries.
Reference	FAO World Watch List, 2002

Name	Trends in genetic abundance: Number and share of crop varieties
Type	PSR: state Level: genetic Aggregation: single
Meaning	1. The total number of crop varieties per crop available to farmers describes the richness of available diversity. The balance between i) registered varieties and ii) named varieties/farmer managed-units of diversity indicates the types of agriculture systems in a region. 2. Share of major varieties in total production for individual crops describes the evenness of biodiversity in use. It also relates to the vulnerability. • These indicators provide information on the process of biodiversity loss at the genetic level in agri-ecosystems as described in the document: a decrease in abundance of many crop varieties (traditional varieties /landraces) and increase of a few others (high external input/high productive varieties). • It also indicates the change in production systems. • The above measures are in situ (on farm) measures. They do not provide a picture of the ex-situ conservation of crop varieties which may compensate losses in-situ (seed banks).
Unit-dimension	Number of varieties per crop by region
Valuation/baseline	Reference year in the period 1990-2000
Design	Share of major varieties in total production for individual crops: varieties accounting for [50%] total [acreage] [production] [consumption]
Scale-resolution	Per region and world. In principle applicable on all scales, but some problems in aggregation likely due to: i) double counting because of the same entity been given different names in different places and ii) missing data.
Data	FAO, IPGRI and other CGIAR institutes, various regional and national institutes. Good are good for registered varieties and for some heritage varieties, and reasonable for landraces of major crops that have been well-collected. Limited for other landraces.
Implementation	FAO, IPGRI and others.
Reference	http://dad.fao.org/en/refer/library/reports/Ninth.htm

Name	**Threats to biodiversity / Single pressures**
Type	PSR: pressure Level: not applicable Aggregation: single
Meaning	• Indicates the intensity of direct human pressures causing biodiversity loss. They can be of physical, chemical or biological nature. • The pressure as such does not provide sufficient information on the impact on biodiversity. If critical loads or doses-effect relationships are available they might be included in the indicator (scaling on impact). • In principle the lower the pressure the better.

	• Pressures also provide indirect information on biodiversity loss. This could be useful in case of lack of state indicators. However, doses-effect relationships seldom concern all biodiversity components. Effects of combined pressures are not well known and different pressures have impacts on different time scales (e.g. climate impact versus fisheries).
Unit-dimension	Varies
Valuation/baseline	Reference year in the period 1990-2000 optional additional baseline: critical loads or doses-effect relationships
Description	Many pressure indicators have been elaborated by OECD, RIVM, WRI, UNEP-GRID Arendal and many others. Elaboration of these indicators is beyond the scope of this paper. Most relevant pressures are: For self-regenerating areas: • Habitat conversion (inverse of indicator of size of ecosystem type) • Climate change • Acidification • Eutrophication • Contamination • Disturbance • Fragmentation • Road density • Lowering groundwater tables • Habitat alteration • Invasive species • Exploitation • Fire • Any relevant pressure in an particular ecosystem type..... For agricultural areas: • N and P load • Pesticides load • Lowering groundwater table • Number of crops per year • Loss of (semi)natural elements • Etc, A few indicators are worked out as examples in fact-sheets below.
Scale-resolution	By ecosystem type. In principle possible on all scales. Resolution of the data varies by pressure and region. For a high resolution data models are useful.
Data	International: IPCC and RIVM (climate), OECD (various chemical and physical pressures), WRI (pressures on coasts, coral reefs and forests), FAO and CITES (exploitation of timber, fish, other species), FAO (agriculture intensity), World Fish Centre (various marine species), RIVM and UNEP GRID Arendal in UNEP's Global Environment Outlook (climate, population density, clear cutting, energy use, road density, abandonment of agricultural land), NGOs, etc National: national and regional institutes, universities and NGOs. Data available for many countries but serious lack of data for certain areas expected.

Implementation	UNEP's Global Environment Outlooks; OECD; Millennium Ecosystem Assessment ; WRI reports; national State of the Environment reporting; and many others.
Reference	See above organizations

Name	**Threats to biodiversity: Climate change**
Type	PSR: pressure Level: not applicable Aggregation: single
Meaning	• Indicates the increase in temperature and precipitation above 1990 values as a result of climate change. • Both are key pressures on biodiversity; • However, climate change is a long term process with large time lags. Increase or decrease of this pressure will likely not be measurable in the context of the 2010 target. • Modelling the future pressure on the bases of the current green house gas emissions might be an alternative.
Unit-dimension	Average annual temperature per ecosystem type and region (in degree Celsius) Average annual precipitation per ecosystem type and region (mm per day)
Valuation/baseline	The data is compared to the climatic normal period of 1961-1990.
Description	After 2000, data comes from global temperature calculations of climate models, scaled back to the grid level using outputs from a Global Circulation Model.
Scale	Grid level (5 x 5 degree)
Data	IPCC; Historic data on temperature and precipitation at grid level are available from the gridded climatology database developed by New et al. (1999). Data on future temperature and precipitation change are available from different Global Circulation Model runs (e.g. ECHAM4, CGCM1, HADCM2, CSIRO-MK2).
Implementation	IPCC third assessment report; UNEP's Global Environment Outlooks; Millennium Ecosystem Assessment.
Reference	IPCC third assessment report

Name	**Threats to biodiversity: Acidification and Eutrophication of terrestrial ecosystems**
Type	PSR: pressure Level: not applicable Aggregation: single
Meaning	• The risk of acidification and eutrophication, expressed in terms of exceedances of critical loads. • The actual impacts of acidification and eutrophication are medium-long term processes with time lags often occurring years after 2010.
Unit-dimension	Exceedances of critical loads
Valuation/baseline	Critical loads
Description	• Critical loads refer to a quantitative estimate of maximum exposure

	below which significant harmful effects on specified elements of the environment do not occur according to present knowledge. The critical loads are compared to the deposition of sulphur and nitrogen, to assess whether exceedances of critical loads due to acid and nitrogen deposition occur. • World-wide, critical loads have not been empirically established, but they have been estimated on the basis of ecosystem and soil information. • For deposition, measurements are available, but only very fragmented. Output data from atmospheric chemistry models and emission data can be used instead.
Scale	Grid level (0.5 x 0.5 degree)
data	JRC; Met Office; Data on deposition of sulphur and nitrogen deposition are available from global atmospheric chemistry models. Data on critical loads are available from Kulentsierna et al. (1998) and Bouwman and Van Vuuren (1999).
Implementation	UNEP's Global Environment Outlook-2. UNEP's Global assessment of acidification and eutrophication of natural ecosystems (1999).
Reference	UNEP ; Bouwman et al., 2003; Kulentsierna et al. (1998) ; Bouwman and Van Vuuren (1999); ...

Name	**Threats to biodiversity: Eutrophication Nitrogen load in rivers**
Type	PSR: State Level: Not applicable Aggregation: Single
Meaning	• Increasing population densities, conversion of natural ecosystems and intensifying agricultural production often result in increasing riverine Nitrogen fluxes. For example, riverine N fluxes from most of the temperate regions surrounding the North Atlantic Ocean have increased from 2- to 20-fold since industrialisation started. • In estuaries and coastal seas eutrophication is most often caused by human N sources, which may cause hypoxia and anoxia. Low oxygen conditions have led to significant losses of fish and shellfish resources. In estuaries and coastal seas eutrophication is often associated with a loss of diversity, both in the benthic community and among planktonic organisms, as manifested by algae blooms. • In many freshwater systems phosphorous (P) is the element most limiting net primary production. Increasing N inputs to freshwater systems can, if sufficient P is present, cause eutrophication, generally accompanied by decreased diversity of both plant and animal species. • Since the residence times of water and nitrogen in groundwater systems may be long compared to that in rivers, there may be a long time lag. This means that nitrogen that infiltrated in groundwater decades ago may cause pollution of surface water now. So large scale abatement measures not necessarily show direct effects.
Unit-dimension	Annual Total N load in tons in major rivers
Valuation/baseline	Reference year in the period 1990-2000 pre-agricultural concentrations or critical levels
Description	• Increases of N concentrations in rivers over natural levels are

	strongly related to agricultural activities and waste water from urban areas (households, industries). • The importance of each of these anthropogenic sources of river nitrogen depends on the development of the country or region. Generally, first sewage systems in cities are built, and later sewage water treatment systems. In the mean time the contribution of nitrogen from wastewater may strongly increase. • With increasing intensity of agriculture the use of nutrients also increases, leading to leaching Nitrogen from agricultural soils.
Scale	River basin/sub-basin
Data	UNESCO-IOC; USGS; EEA; national and regional institutes
Implementation	UNESCO-IOC Global Nutrient Export from Watersheds project; SCOPE studies on nitrogen in Atlantic; UNEP's Global Environment Outlook 3;
Reference	Vitousek et al. (1997); Schindler (1977); Howarth et al. (1996); Seitzinger and Kroeze (1998); Seitzinger et al. (2002); Van Breemen et al. (2002); Van Drecht et al. (2003); Maybeck and Ragu (1995); USGS (1996).

Name	**Threats to biodiversity: Road density**
Type	PSR: pressure Level: not applicable Aggregation: single
Meaning	• Infrastructure is a major condition to various direct and indirect pressures on biodiversity such as land conversion, fragmentation, pollution, exploitation, disturbance etc. • Therefore road density provides a direct quantitative measure of fragmentation and a proxy to a complex of potential pressures and related risk to biodiversity loss. • Generally an increase in road density increases biodiversity loss. However, this especially depend on the activities which actually take place as a consequence of the road development.
Unit-dimension	Road density/km2
Valuation/baseline	reference year in the period 1990-2000 natural state
Description	• roads and other infrastructure are mapped • impact classes are defined related to the distance to infrastructure • % area per impact class are calculated • applicable on terrestrial ecosystems and some freshwater and partly coastal marine ecosystems
Scale-resolution	At all levels down to ca. 1 km2 units Down to 1 km2 units, global databases available.
Implementation	UNEP used it in various reports amongst which GEO3.
Reference	www.globio.info, Nelleman et al. (2003); UNEP (2002)

Name	**Response: protected areas**
Type	PSR: response level: ecosystem aggregation: single

Meaning	Status and trends in the designation of protected areas
Valuation/baseline	Reference year in the period 1990-2000 protection category
Description	Status and trends in protected areas, expressed as: - numbers, and/or - surface area (ha), and/or - % of a region. Results can be further specified according to: - biomes - IUCN protected area management category
Scale	Global, regional, national, sub-national
Data	World Database on Protected Areas; various national and international organisations.
Implementation	2003 United Nations list of protected areas; IUCN; UNEP WCMC, and others. http://sea.unep-wcmc.org/wdbpa/growth.cfm
Reference	Chape (2003). see implementation

Name	**Services of biodiversity: Carbon sequestration per ecosystem type**
Type	PSR: N.A. Level: N.A. Aggregation: single
Meaning	• Ecosystems play a key role in stabilising the c-cycle. • This indicator measures how much carbon is removed from the atmosphere by ecosystem type. • Increase or decrease of C-sequestration can only be estimated by modelling.
Unit-dimension	Pg C/yr (Petagram of C per year)
Valuation/baseline	reference year in the period 1990-2000 natural state
Description	• Net primary production (NPP, plant photosynthesis minus plant respiration) is modelled as a function of climate, soil, atmospheric CO2-concentration, altitude, land-cover (vegetation) and land-cover history. • Based on pre-defined allocation fractions for each land-cover type, the NPP is allocated to four separate carbon pools as distinguished: stems, branches, leaves, and roots.
Scale	Grid level (0.5 x 0.5 degree), ecosystem types, regions and world
Data	Data on carbon sequestration world-wide is available from models. Various elaborated carbon cycle models exists.
Implementation	IPCC's Special Report on Emission Scenarios; PIK; and others.
Reference	IPCC; IMAGE-team, 2001;

Name	**Services of biodiversity and threats to biodiversity: Harvest of species**
Type	PSR: pressure and use. Level: N.A Aggregation: single

Meaning	• This indicator provides a direct measure of the extraction of individuals from a species, by which its abundance decreases. • The actual effect on the species abundance depends on the population dynamics of the species and the characteristics of the extracted individuals. • The volume provides a measure on the number of people nourished (or dependent) from this natural resource. • Comparison with a maximum sustainable catch level provides information on the sustainability of the use.
Unit-dimension	• Ton per year by ecosystem type (threat and service) • US$ per year by ecosystem type, region, world (service) • Contribution to Gross Domestic Product • Number of people nourished from this resources (service)
Valuation/baseline	Reference year in the period 1990-2000 optional: maximum sustainable harvest/catch
Description	Harvest can be calculated by species but also for species groups such as fish, cetaceans, timber.
Scale-resolution	By ecosystem type. In principle possible on all scales. Resolution of the data varies.
Data	FAOSTAT, FISHSTAT, IUCN, CITES, WRI, World Fish Centre, and many others, especially on forest and marine species. Next to that data in many regional and national institutes available. Lack of data in certain areas might be estimated by expert judgement.
Implementation	Reports of FAO; IUCN; CITES, Millennium Ecosystem Assessment and others
Reference	See above institutes

Name	**Services of biodiversity: Tourism earnings**
Type	PSR: n.a. Aggregation: single
Meaning	• Tourism is one of the largest sectors world-wide. • Ecotourism may significantly contribute to Gross Domestic Product and to peoples livelihood in regions • There is not always a clear distinction between ecotourism and other tourism forms.
Valuation/baseline	Reference year in the period 1990-2000
Description	Status and trends in recreational revenues
Scale	Sub-national – global, depending on country
Data	Data are generally scattered and for some countries available.
Implementation	Most studies are case-studies. Overall picture lacks. Organisations of interest are: World Tourism Organisation; World Travel and Tourism Council; ...
Reference	UNEP's reporting on ecotourism (2002)

Name	**Services of biodiversity: Soil stability Suspended solids in rivers**
Type	PSR: N.A. Level: N.A. Aggregation: single

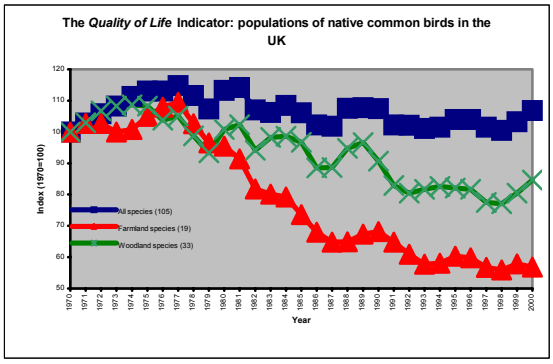
Meaning	• Biodiversity and natural vegetation cover have an important function in sustaining top-soil stability. • Increasing load of suspended solids in rivers is related to erosion due to amongst others conversion of natural ecosystems into agriculture, deforestation and degradation of ecosystems by human activities • To what extent agricultural systems take over this role depend on agricultural management and soil conservation management. • Unsustainable use of agricultural ecosystems, causing uncontrolled erosion is apparent in rivers transporting increased loads of suspended solids, mainly sediments. • Not only vegetation cover but also other factors such as climate change and dams influence sediment load. This should be integral part of the analysis. • In river basins where dams and reservoirs have been constructed, the load of suspended solids should be determined upstream of the dam, since most sediment is deposited in reservoirs.
Unit	Ton sediment km^{-2} total river basin; or multiple year mean sediment load in g sediment m^{-3} .
Valuation/baseline	reference year in the period 1990-2000 Pre agricultural/natural levels
Description	• Erosion can occur in several ways, including sheet erosion leading to loss of fertile topsoil, and rill and gully erosion. • Climate is an important factor determining soil erosion. It is not the annual precipitation but its distribution which during the year, intensity of individual rainfall events and wetness/soil cover during such events which determine soil erosion risk. • The rate of soil loss and thus river loads of suspended solids also depends on the characteristics of the soil material. Soil with high silt content (e.g., loess soils) are more susceptible to erosion than soils with low silt content. Therefore baseline values are river-basin specific.
Scale	River basin
Data	UNESCO; USGS; EEA; national and regional institutes. Data on natural or pre-agricultural load of suspended solids is known for a limited number of river basins .
Implementation	UNESCO-IOC Global Nutrient Export from Watersheds project;
Reference	Ludwig and Probst (1996; 1998); Hovius (1998); Milleman and Meade (1983); Milleman and Syvitski (1992); Meybeck and Ragu (1995).

Name	**Services of biodiversity: River flow characteristics/ floods and drought**
Type	PSR: N.A. Level: N.A. Aggregation: single
Meaning	• Living vegetation, along with other characteristics of the land surface, plays a key role in modulating the Earth water cycle and climate. • Changing vegetation cover, deforestation, land conversion and degradation on a large scale generally affect the water holding

	capacity of ecosystems. • Different vegetation patterns also produce different precipitation patterns • Both directly affect the magnitude and timing of the run off and the intensity of frequencies of flooding and drought. • Changes in flood and drought periods provides a measure of the intactness of water control and water precipitation functions in the river basin by natural or agricultural ecosystems. • Increase in floods and drought periods often reflect a loss of the water holding capacity of ecosystems. • Not only vegetation cover but also other factors such as climate change, water use (irrigation) and dams influence the river flow regime. This should be integral part of the analysis of the causal factors.
Unit	Number of days < or > x m3/s water
Valuation/baseline	Reference year in the period 1990-2000 historical data series or pre agriculture or pre deforestation state
Description	• 5-year average of drought and flood period, exceeding long term average of low and high water discharges • long term averages are river or tributary-specific • it concerns the major river systems.
Scale	River basin or tributary
Data	GRDC-Koblenz; IGBP-BAHC; WL; University of New Hampshire and others; Various regional and national institutes. Long term data available on major river systems; scattered on minor rivers.
Implementation	Various reserach institutes and programmes
Reference	Shiklomanov (1999); Peterson and Peteke (1999); Arnell (1999); Vorosmarty (2000); Kabat (2002)

B. Composite indicators

Name	**Species assemblage Trend Index (STI)**
Type	PSR: State Level: species (groups) Aggregation: composite
Meaning	• Mean trend in abundance of a group of species compared to a reference year, e.g.: Taxonomic species groups (e.g. farmland birds) Species of cultural interest Endemic species Migratory species Exploited species All other species assemblages • Generally an increase is positive and an decrease negative. • It is recommended to exclude pest species to avoid perverse messages. They may mask the decreases in abundance. • If the ecosystem is already heavily affected in the reference year the indicator may pass the 100% in case of a slight improvement. The losses before the reference year are not incorporated in the index and may provide the perverse message of a intact ecosystem.

Valuation/baseline	Reference year in the period 1990-2000 optional: as far as possible back in time
Unit-dimension	Index by ecosystem type, by region, or globally.
Design	Average (geometric) of yearly indices (based on population size or density) of a selected group of species
Scale	Per ecosystem type. Potentially applicable on all scales.
Data	As indicator "trends in species abundance"
Implementation	"Quality of life indicator" UK Government; The Netherlands; Pan-European common bird monitoring programme; Living Planet Index 
Reference	Gregory et al. (2003); www.rspb.org.uk; Loh, (2002). www.rivm.nl

Name	**Ecosystem quality** **mean abundance of ecosystem-specific species**
Type	PSR: State Level: Ecosystem Aggregation: composite
Meaning	• The mean abundance of ecosystem-specific species compared to the expected abundance of the intact ecosystem. • This indicator is a direct measure of the overall process of biodiversity loss within ecosystems as a result of all pressures (excluding area loss). • This indicator is complementary to indicator "size of ecosystem type". • The indicator provides general information on the average ecosystem state, not on specific components (species, extinctions, pests, communities). • Absence of data on the low-impact state may lead to perverse messages on ecosystem quality and the rate of biodiversity loss at the ecosystem level, etc
Unit-dimension	Mean current/baseline abundance -> index 0-100% quality by ecosystem type
Valuation/baseline	Reference year in the period 1990-2000 low-impact baseline: a fourth measure point as far as possible back in

	time
Description	• Ecosystem quality is defined as the ratio between the current state and the baseline state (%) • Ecosystem quality is calculated as the mean (arithmetic) of the yearly quality indices of the selected species. For representativeness reasons this may be a weighted mean or any other function. • The yearly quality index (%) of a species is calculated as the current/baseline state. • Abundance can be expressed in various terms: population numbers, density, presence/absence, biomass, number of breeding pairs, area of distribution, etc, depending on the species and data availability • The more species are included the more robust and the better approximate for the change in abundance of all ecosystem-specific species. This multi-species indicator is similar to the "shopping bag" approach applied in the Retail Price Index.
Scale-resolution	Per ecosystem type. Potentially applicable on all scales. Resolution of species trends varies per species and region.
Data	See indicator "trends in species abundance" and "trends in communities". Data will be scattered over national and international institutes, but probably sufficient for most ecosystem types to provide a general picture on the general process of biodiversity loss.
Implementation	Dutch National Nature Outlook 2; GEF projects in Kenya, Ecuador, Philippines and Ukraine.
Reference	UNEP/CBD/SBSTTA/3/9 and UNEP/CBD/SBSTTA/3/INF/13; www.rivm.nl

Name	**Natural Capital Index (NCI)- species based or pressure based**
Type	PSR: state Level: ecosystem Aggregation: composite

Meaning	• The indicator is a direct measure of the process of biodiversity change (loss or gains).
	• Describes the general process of the change in abundance of species due to all human interventions.
	• For natural ecosystems:
	  • intactness/naturalness
	  • change in biodiversity of natural ecosystems in recent, industrial times.
	• For agri-ecosystems
	  • change in biodiversity of agricultural ecosystems since intensification started.

Unit-dimension	Index (0-100%) by ecosystem type, region or world
Valuation/baseline	Natural ecosystem types: low-impact state Agri-ecosystems: traditional agriculture state
Description	• The NCI is the product of the above indicators "size of ecosystem type" and "ecosystem quality". • In case of absence of ecosystem quality data, this component can be substituted by the inverse of the Pressure Index (NCI-pressure

	based). • NCIs of ecosystem types can be added up at the regional and global level.
Scale-resolution	Per ecosystem type. Applicable on all scales.
Data	See indicators "Size of ecosystem types", "trends in species abundance" and "trends in communities".
Implementation	Species-based in The Netherlands; GEF project in Kenya, Ecuador, Philippines and Ukraine; Pressure-based in UNEP's Global Environment Outlook 1 –3.
Reference	UNEP/CBD/SBSTTA/3/9 and UNEP/CBD/SBSTTA/3/INF/13; RIVM (2002), OECD (2003); UNEP (1997, 1999 and 2002);

Name	Red List Indicator
Type	PSR: state Level: species Aggregation: composite
Meaning	The status and change in extinction risk or threatened status of • a selected set of species or • groups of species, that are 100% assessed.
Unit-dimension	number of species at risk weighted by risk category
Valuation/baseline	No species threatened to extinction
Description	*Extinction Risk Indicator* The number of species in each Red List category is weighted by the predicted extinction risk associated with each category. Because of this weighting, changes in this index largely reflect species moving into the Critically Endangered or Extinct categories. It thus represents the slide of biodiversity towards extinction. *Threatened Status Indicator* The number of species in each Red List category is weighted by scores that increase incrementally with category . This index reflects the number of species in the different categories.
Scale	Global
Data	Red List
Implementation	In development
Reference	Forthcoming discussion paper from the IUCN-SSC Red List Programme Committee

Name	**Wilderness**
Type	PSR: state Level: ecosystem Aggregation: composite
Meaning	• The remaining pristine area per region and world • Wilderness provides additional information to the other indicators.
Unit-dimension	km2 of nearly pristine area/ region and world
Valuation/baseline	Pristine state (no significant human impacts)
Design	• large areas of pristine ecosystems dominated by natural vegetation further than particular distance from human settlements and

	infrastructure. • combination of land cover, land use, ecosystem quality and pressure information
Scale-resolution	Resolution depends on data
Data	See indicators "size of ecosystem types", "ecosystem quality" and single "pressures".
Implementation	Conservation International, World Atlas of Biodiversity (UNEP-WCMC)
Reference	Conservation International; Lesslie

Name	**Pressure Index**
Type	PSR: Pressure Level: N.A. Aggregation: composite
Meaning	• Total pressure on biodiversity from various pressures • It concerns a coarse measure on bases of a few available pressures and doses-effect relationships such as from pollution, fragmentation, climate change and exploitation. • It scales the various pressures on their impact on biodiversity. • Provides a coarse picture of the trends of the total pressure at the regional and global level • It does take into account the different time lags of the different pressures.
Units-dimension	loss of ecosystem quality per ecosystem type (0-100%)
Valuation/baseline	The lower the pressure, the better
Description	• The intensity of each individual pressure is indicated on a scale of 1-1000 per grid cell (no effect – ecosystem practically deteriorated respectively). • The combined Pressure Index is calculated as a function of the individual pressures per grid cell or entire ecosystem type. • Spatial representation is possible.
Scale	Depending on the data and pressure, resolution may vary from 1 km^2 to 2500 km^2
Data	see pressure indicators
Implementation	UNEP's Global Environment Outlook 1 –3; WRI
Reference	UNEP (1997, 1999 and 2002); WRI (1997,1998);

LIST OF ACRONYMS AND ABBREVIATIONS

CBD	Convention on Biological Diversity
CGIAR	Future Harvest Centers
CIFOR	Center for International Forestry Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
EEA	European Environment Agency
EFI	European Forest Institute
EROS	Earth Resources Observation Systems
FAO	Food and Agriculture Organization of the United Nations
GBIF	Global Biodiversity Information Facility
GEO	Global Environment Outlook of UNEP
GIWA	Global International Waters Assessment
GMA	Global Marine Assessment
GRDC	Global Run-off Data Centre
GRID	Global Resource Information Database of UNEP
GTOS	Global Terrestrial Observing System
ICLARM	International Center for Living Aquatic Resources Management
IGBP-BAHC	International Geosphere Biosphere Programme
IOC	Intergovernmental Oceanographic Commission of UNESCO
IPPC	International Plant Protection Convention
IUCN	World Conservation Union
JRC	Joint Research Centre
MAB	UNESCO Man and Biosphere Programme
MODIS	Moderate Resolution Imaging Spectroradiometer
NASA	National Aeronautics and Space Administration
NCI	Natural Capital Index
NGO	non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
PI	Pressure Index
PIK	Potsdam Institut für Klimaforschung
RIVM	Rijksinstituut voor Volksgezondheid en Milieu
RLI	Red List Indicator
SCOPE	Scientific Committee on Problems of the Environment
STI	Species Assemblage Trend Index
TNC	The Nature Conservancy
TSBF:	Tropical Soil Biology and Fertility Programme
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-WCMC	World Conservation and Monitoring Centre of UNEP
UNESCO	United Nations Educational, Scientific and Cultural Organization
USGS	United States Geological Survey
WL	Delft Hydrolics
WRI	World Resources Institute
WWA	World Water Assessment Programme
WWF	World Wide Fund for Nature
