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MONITORING AND INDICATORS: DESIGNING NATIONAL-LEVEL MONITORING PROGRAMMES AND INDICATORS

Note by the Executive Secretary

EXECUTIVE SUMMARY

In its decision VI/7-B, the Conference of the Parties requested the Executive Secretary to report on the development and use of indicators in all the thematic areas and cross cutting issues (paragraph 1), and urged Parties that had not yet done so to respond to the questionnaire on the subject of indicators that had been sent by the Executive Secretary in May 2001 (paragraph 2). In paragraph 3 of the same decision, the Conference of the Parties requested the Executive Secretary to convene a meeting of an expert group to further develop the three annexes to the note of the Executive Secretary on ongoing work on indicators (UNEP/CBD/SBSTTA/7/12) and provided guidance on how this should be done (paragraph 4).

In response to this decision, the Executive Secretary has prepared the present note, which contains: (i) a summary of the progress made on the development and use of indicators within the context of the Convention; (ii) an updated analysis of biodiversity indicators in use; and (iii) guidelines and principles for designing national-level monitoring programmes and indicators for biodiversity.

Summary of the progress on the development and use of indicators within the context of the Convention

The need to develop suitable indicators for monitoring biodiversity components is reflected in the programmes of work on the biological diversity of agricultural, forest, dry and sub-humid lands, inland waters, coastal and marine and mountain ecosystems. Where progress on the development and use of indicators has been significant, this is reported in the progress report on the implementation of the thematic programmes of work (UNEP/CBD/SBSTTA/9/2). Progress on the development and use of indicators in cross-cutting themes of the Convention is reported on in the progress report on the implementation of the work on cross-cutting issues (UNEP/CBD/SBSTTA/9/3)

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Analysis of indicators in use

In response to paragraph 1 (b) of decision V/7 of the Conference of the Parties, requesting the Executive Secretary to develop a list of available and potential indicators, the Executive Secretary sent out a questionnaire requesting Parties to indicate which indicators they currently use. Annex I provides an analysis of the responses received.

Expert meeting on indicators for national-level monitoring

Pursuant to the request in decision VI/7-B (paragraph 3), the Executive Secretary convened an expert meeting to further develop the three annexes to the note of the Executive Secretary on ongoing work on indicators. The meeting was held in Montreal from 10 to 12 February 2003. Following the guidance provided in paragraph 4 of the same decision, the group of experts prepared, during its meeting and in subsequent inter-sessional work, a report containing: (i) a set of principles for indicator development in the form of a guiding manual on indicator development; (ii) a list of key questions with reference to the relevant articles of the Convention; and (iii) a list of tested indicators. The full report is available as an information document (UNEP/CBD/SBSTTA/9/INF/7).

To provide guidance to Parties on the selection and use of indicators and the setting-up of a national biodiversity monitoring system, the principles for developing biodiversity indicators for national-level monitoring have been embedded into a stepwise procedure. The seven-step procedure provides a general framework for the process of selection and design of indicators as well as the choices involved. It represents a flexible system, which can be adapted according to individual country's needs, institutional organization and capacities.

A small number of standard questions provide guidance on the initial steps of the procedure. They serve to define precisely the issues to be addressed and monitored through indicators. A set of key questions that indicators should help to answer is also included. These are segregated by indicator categories and reference is made to the relevant articles of the Convention: state, pressure and use indicators relate to Article 7; response indicators concern Articles 6, 8, 9, 10 and 11; indicators on capacity relate to Articles 12, 13 and 14. To assess the effectiveness of measures, a combination of state and response indicators is required.

The document includes a list of available and tested biodiversity indicators, which meet the set of principles and are generally applicable to all ecosystems and in all countries, and as a combination cover the major issues. Although this document focuses on state indicators, the list presented in section D of annex 2 of the present note also includes indicators of pressures and use, responses and capacity. Parties may need to adapt these according to their country-specific biodiversity, threats, capacity and goals.

Ongoing initiatives on indicator development—such as those in the countries participating in the project funded by the Global Environment Facility (GEF) on biodiversity indicators in national use (BINU), which is implemented by the World Conservation Monitoring Centre (WCMC) and the Netherlands National Institute of Public Health and the Environment (RIVM)—have provided and continue to provide additional insights and examples. The provision of training is considered an important element to enable Parties to develop suitable indicators for national-level monitoring of biodiversity and to put them in a position to measure and monitor the direction and magnitude of change of biodiversity and feed that into the policy process. If indicators should be used as a tool to assess the effectiveness of measures to conserve and sustainably use biodiversity, the provision of training and the dedication of financial resources to develop and apply these will be essential. Initial experiences drawn from the practical application of the document by participants of the BINU project are reflected in the suggested recommendations.

Overall, the document has been prepared to provide a flexible approach in choosing the indicators to be monitored by countries based on their priorities, capabilities, and data availability, thereby taking fully into account national and regional differences.

SUGGESTED RECOMMENDATIONS

The Subsidiary Body on Scientific, Technical and Technological Advice may wish to recommend that the Conference of the Parties:

(a) *Notes* the indicators already in use by Parties as reported in annex 1 to the present note, and *welcomes* the ongoing efforts on the development of biodiversity indicators within the various thematic programmes and cross-cutting themes of the Convention;

(b) *Also welcomes* the report prepared by the expert group on indicators of biological diversity including indicators for rapid assessment of inland water ecosystems;

(c) *Thanks* the Government of the United Kingdom of Great Britain and Northern Ireland for its financial support for the expert meeting on indicators of biological diversity, the co-chairs and all the experts for their contributions to the meeting;

(d) *Notes* and *encourages* the collaboration between the Convention on Biological Diversity and other conventions and organizations in the development of indicators;

(e) *Recognizes* that regional and national differences and different national priorities on the conservation and sustainable use of biodiversity on the one hand and the need for a consistent framework for data acquisition, computation and reporting on the other hand suggest a flexible approach with respect to the elements that contribute to commonly agreed indicators;

(f) *Urges* all Parties that have not done so to develop a set of biodiversity indicators as part of their national strategies and action plans, taking into account, as appropriate, the targets of the Global Strategy for Plant Conservation and the target to achieve by 2010 a significant reduction in the current rate of biodiversity loss at the global, regional and national level, as well as the guidance, lessons learned and list of indicators provided in this document, and to report on progress to the eighth meeting of the Conference of the Parties;

(g) *Invites* Parties, other Governments and relevant organizations to make use of biodiversity indicators in their assessment of biodiversity, in particular in their assessment of progress towards the achievement of globally agreed targets such as those of the Global Strategy for Plant Conservation, the Strategic Plan of the Convention, the Plan of Implementation of the World Summit on Sustainable Development and the Millennium Development Goals;

(h) *Agrees* that the framework contained in annex 2 to the present note provides useful guidance for the development of national-level biodiversity indicators and monitoring;

(i) *Recognizes* that the development and use of indicators, particularly in the development phase, requires a financial and technical commitment from Parties, and therefore *encourages* bi-lateral and multilateral funding agencies to assist developing countries and countries with economies in transition through the provision of financial assistance and training, as required, to develop and implement effective biodiversity indicators;

(j) *Acknowledges* that the GEF-funded project on "Biodiversity Indicators in National Use" might illustrate how each step proposed in the guidelines for indicator development contained in this document could be carried out in practice and thereby provides lessons on the practical development of biodiversity indicators;

(k) *Encourages* Parties to share experience in the development and use of indicators and to cooperate and promote, where useful, harmonized procedures and formats for data acquisition, computation and reporting, especially at sub-regional and regional levels;

(l) *Requests* the clearing-house mechanism of the Convention to develop an effective system of information sharing on lessons learned on the development of national-level biodiversity indicators, including through the presentation of worked examples and case studies;

(m) *Requests* the Executive Secretary to further develop the identification, development and testing of indicators based on accrued experience and making particular efforts on indicators (i) concerning the fair and equitable sharing of the benefits arising out of the utilization of genetic resources; and (ii) on the states and trends of biodiversity at the genetic level, taking into account the ongoing work of FAO, IPGRI and other relevant organizations, and *invites* him to report on progress for the ninth meeting of the Conference of the Parties.

CONTENTS

I. INTRODUCTION

1. In its decision VI/7-B, the Conference of the Parties requested the Executive Secretary to report on the development and use of indicators in all the thematic areas and cross cutting issues (paragraph 1), and urged Parties that had not yet done so to respond to the questionnaire on the subject of indicators that had been sent by the Executive Secretary in May 2001 (paragraph 2). In paragraph 3 of the same decision, the Conference of the Parties requested the Executive Secretary to convene a meeting of an expert group to further develop the three annexes to the note of the Executive Secretary on:

(a) Principles for developing national-level monitoring and indicators;

(b) A set of standard questions for developing national-level indicators; and

(c) A list of available and potential indicators based on a conceptual framework that has a qualitative and quantitative approach.

2. Paragraph 4 of decision VI/7-B provided guidance on the content and structure of the report to be prepared by the Executive Secretary for consideration by the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) prior to the seventh meeting of the Conference of the Parties.

3. In response to this decision, the Executive Secretary has prepared the present note, which contains (i) a summary of the progress made on the development and use of indicators within the context of the Convention; (ii) an updated analysis of biodiversity indicators in use including a synthesis of responses to the questionnaire on available and potential indicators contained in annex 1 to the present note; and (iii) a framework with guidelines and principles for designing national-level monitoring programmes and indicators for biodiversity, contained in annex 2.

II. SUMMARY OF THE PROGRESS ON THE DEVELOPMENT AND USE OF INDICATORS WITHIN THE CONTEXT OF THE CONVENTION

4. The need to develop suitable indicators for the monitoring of components of biodiversity is reflected in the programmes of work on agricultural (decisions III/11 and VI/5), forest (decisions IV/7 and VI/22), dry and sub-humid lands (decision V/23), inland waters (decision IV/4) and coastal and marine (decision IV/5) biological diversity. The proposed programme of work on mountain biological diversity provides for the development of monitoring systems based on identification of key abiotic and biotic indicators of changes in ecosystem structure and function. Where progress on the development and use of indicators has been significant, this is reflected in the progress report on the implementation of the thematic programmes of work (UNEP/CBD/SBSTTA/9/2).

5. While the indicators required for the implementation of the thematic programmes of work are largely state and impact indicators, those relevant to cross cutting themes include driver, pressure and response indicators. The Global Taxonomy Initiative promotes research on sensitive species that can serve as indicators of habitat change (decision VI/8); the Global Strategy for Plant Conservation recognizes the need for baseline data and a series of indicators for the monitoring of progress towards achieving the targets (decision VI/9). Several organizations are currently organizing, in collaboration with the Secretariat, a series of stakeholder consultations to, *inter alia*, develop baseline data and a series of indicators to monitor the progress towards achieving the targets laid out in the strategy. Decision VI/10 on Article 8j stipulates the design of social development indicators consistent with the views of indigenous and local communities. Decision VI/24 on access and benefit-sharing requests the development of instruments, tools, and indicators to monitor and assess the implementation of capacity-building for access to genetic resources and benefit-sharing at all stages. Clear targets and indicators for the evaluation of incentive measures and the assessment of policies are called for in decision VI/15. For

the long-term monitoring and assessment of the impacts of tourism on biological diversity, suitable indicators need to be developed and used (decision V/25). Indicators should also be used to assess the level of the integration of the ecosystem approach into the programmes of work of the Convention (decision VI/12). Indicators are also recognized as an important tool to assess the coverage and effectiveness of management of protected areas. The Ad Hoc Technical Expert Group on Biodiversity and Climate Change established under the Convention on Biological Diversity considered indicators as a possible tool for evaluating the effectiveness of projects to mitigate climate change (UNEP/CBD/SBSTTA/9/11). Indicators for sustainable use are further elaborated in annex I of the Addis Ababa Principles and Guidelines for sustainable use of biodiversity (UNEP/CBD/SBSTTA/9/INF/8). Where progress on the development and use of indicators has been significant, this is reported in the progress report on the implementation of the work on cross-cutting issues (UNEP/CBD/SBSTTA/9/3).

III. ANALYSIS OF INDICATORS IN USE

6. In response to paragraph 1 (b) of decision V/7 of the Conference of the Parties, requesting the Executive Secretary to develop a list of available and potential indicators, the Executive Secretary sent out a questionnaire to Parties in May 2001. Only 32 Parties and other Governments had responded to this request by August 2001. In paragraph 2 of decision VI/7 B, the Conference of the Parties therefore urged those Parties that had not responded to do so. Accordingly, the Executive Secretary re-sent the same questionnaire on 11 October 2002. An additional 20 Parties had responded by May 2003. Annex 1 to the present note provides an analysis of the responses received.

7. Several Parties felt that the **list of indicators originally mentioned in the questionnaire did not adequately reflect their thinking on the subject** and that a framework and targets needed to be developed. In particular, some Parties were concerned that the list included many environmental indicators with no established link to biodiversity and that several indicators might be difficult to implement or lead to conclusions at the national level. For this reason, the expert meeting developed a general framework to provide practical guidance to Parties engaged in developing national-level biodiversity indicators and monitoring.

IV. OUTPUTS OF THE EXPERT MEETING ON INDICATORS FOR NATIONAL-LEVEL MONITORING

8. In response to paragraph 3 of decision VI/7-B, the Executive Secretary convened the meeting of experts in Montreal from 10-12 February 2003 with financial support from the Government of the United Kingdom of Great Britain and Northern Ireland. The report of the expert meeting is contained in document UNEP/CBD/SBSTTA/9/INF/7. In Annex 2, the present note provides the main elements from the expert meeting and subsequent inter-sessional work:

(a) A **set of principles** to guide the development of suitable biodiversity indicators and monitoring programmes (section B of annex 2 of the present note). These principles are integrated into a **manual**, which follows a **stepwise approach**, which should allow Parties to develop indicators and a monitoring system that are relevant to their specific situation;

(b) A small number of **standard questions** that indicators should help to answer developed to accompany the initial steps of the manual. These questions are in section C of annex 2 of the present note; they are organized by type of indicator and make reference to the corresponding articles of the Convention;

(c) An **indicative list of available and tested biodiversity indicators**, developed taking into account the list of indicators submitted by Parties, other Governments and organizations (see Annex 1 to this note), contained in section D of annex 2 of the present note. Preference was given to tested

biodiversity indicators, which meet the set of principles mentioned above and are generally applicable to all ecosystems and in all countries;

(d) A number of **lessons** from the experience gathered in various processes on indicator development, contained in Appendix 1 to annex 2 of the present note;

(e) An **indicative list of indicator initiatives and sources of information** on biodiversity indicators (Appendix 2 to annex 2 of the present note).

9. Although the document prepared by the expert group focuses on state indicators, the list presented in section D of annex 2 of the present note also includes some indicators of pressure and use, response and capacity. Parties may wish to adapt these according to their country-specific biodiversity, threats, capacity and goals. It was not considered to be helpful in this document to provide a long list of site or country-specific indicators that would apply to local situations and management questions; instead, the document provides the tools and elements needed to develop indicators that can be useful in answering key questions for national level policy makers.

10. Indicators and monitoring should be designed to detect changes in time frames and on the spatial scales that are relevant to policy objectives and decisions. It is important to detect changes before it is too late to correct any problems that are found. Within the context of the Convention on Biological Diversity, indicators may be required to show status and trends of biodiversity, progress on the implementation of the Convention and the effectiveness of the measures taken.

11. This document focuses on the conservation of biodiversity at ecosystem and species levels; sustainable use at ecosystem and species levels is not treated in any depth. Indicators for sustainable use are further elaborated in annex I to the Addis Ababa Principles and Guidelines for Sustainable Use of Biodiversity (UNEP/CBD/SBSTTA/9/INF/8). Indicators for benefit sharing are not considered in this document. Indicators for plant genetic resources for food and agriculture have been developed by the Food and Agriculture Organization of the United Nations (FAO) in collaboration with the International Plant Genetic Resources Institute (IPGRI).

Annex I

SYNTHESIS OF RESPONSES TO THE QUESTIONNAIRE ON AVAILABLE AND POTENTIAL INDICATORS

1. The table below provides a compilation of responses to the questionnaire[1] on available and potential indicators to which the following 52 Parties and other Governments replied between May 2001 and February 2003: Argentina, Armenia, Austria, Bahamas, Bahrain, Belgium, Bosnia and Herzegovina, Canada, Colombia, Costa Rica, Cyprus, Denmark, Eritrea, Estonia, European Community, Finland, Guatemala, Guinea Bissau, Honduras, Hungary, Iran (Islamic Republic of), Ireland, Japan, Lao People's Democratic Republic, Latvia, Lebanon, Macedonia, Mauritius, Moldova, Mongolia, New Zealand, Niue, Norway, Palau, Panama, Poland, Portugal, Qatar, Romania, Singapore, Slovak Republic, South Africa, Spain, Sri Lanka, Sudan, Sweden, Switzerland, Tunisia, Turkey, United Kingdom, United States of America, and Zimbabwe.

Number of Parties using a given indicator	Indicators for general application
38	Total area of protected areas (use IUCN definition of protected areas)
38	Percentage of protected area to total area
37	Size and distribution of protected areas
33	Percentage area in strictly protected status
32	Number of endemic/threatened/ endangered/vulnerable species by group
31	Soil quality
28	Existence of institutional capacity, policy and regulatory framework for the planning, management and conservation of biological diversity
28	Species threatened with extinction (number or percent)
28	Endemic species threatened with extinction
28	Endemic species in protected areas
27	Threatened species in protected areas
27	Diversity of native fauna
25	Species with decreasing populations
25	Species richness (number, number per unit area, number per habitat area
23	Density of road network
23	Recorded species present by group
23	Species used by local residents
23	Population growth and fluctuation trends of special interest species
22	Threatened species in *ex-situ* collections
21	Species group: total number versus threatened species
21	Temporal change in number of species (increase/decrease)
20	Species with stable or increasing populations
20	Species threatened with extirpation
19	Sex ratio, age distribution and other aspects of population structure for sensitive species, keystone species, and other special interest species
19	Indigenous species present by group
18	Change in number and/or distribution of keystone or indicator species

[1]/ The notification of 17 May 2001 containing the questionnaire can be found at http://www.biodiv.org/doc/notifications/2001/ntf-2001-05-17-ind-en.pdf. The questionnaire did not refer to indicators of dry and sub-humid land, mountain biodiversity or protected areas. It also did not contain indicators relevant to the cross-cutting issues considered under the Convention.

18	Threatened species with viable *ex-situ* populations
17	Change in habitat boundaries
17	Number of introduced species and genomes
16	Change in composition of species over time
14	Non-indigenous species present by group
14	Changes in average size of a particular habitat type
14	Change in presence, location, area, numbers of invasive plant or animal species
13	Quantity of specimens or species of economic/scientific interest removed from the environment
13	Changes in limiting factors for key species e.g. nest holes for parrots, fruit bat roosting trees
12	Slope failure (landslides)
12	Diversity in total area of a particular habitat type
11	Spatial differences in the number of rare vs. common species
10	Changes in largest block of a particular habitat type
9	Species risk index
9	Species with small populations vs. larger population size
8	Spatial differences in the restricted vs. wide range species
8	Percentage of area dominated by non-domesticated species
7	Representativeness of intra-specific variability of endangered and economically important species
6	Volcanic unrest
6	Presence of taxa on environmental integrity
6	Karst activity
6	Relative wilderness index
4	Change in mean nearest distance between blocks of a particular habitat type
4	Degree of connectivity of food web
2	Change in average width of break in an identified habitat corridor
2	Percentage of area dominated by non domesticated species occurring in patches greater than 1,000 km^2
1	Frozen ground activity
Number of Parties using a given indicator	**Indicators of forest biodiversity**
45	Total forest area
43	Total forest area as a percentage of total land area
38	Percentage forest cover by forest type (primary, secondary or plantation)
38	List of flora and fauna
36	Percentage protected area of total forest area
33	Reforested and afforested areas
30	Forest area change by forest type (primary, secondary or plantation)
30	Number of extinct, endangered, threatened, vulnerable and endemic forest dependent species by group (e.g. birds, mammals, vertebrates, invertebrates)
29	Number and size of forest fires
27	Change in land use, conversion of forest land to other land uses (deforestation rate)
27	Contribution of forest sector to GDP
27	Area and percentage of forest area affected by anthropogenic effects (logging, harvesting for subsistence)
27	Absolute and relative abundance, density, basal area, cover, of various species
26	Percentage forest managed for wood production
26	Existence of procedures for identifying endangered, rare, and threatened species

25	Number of threatened, keystone, flagship species
25	Existing strategies for *in situ/ex situ* conservation of genetic variation within commercial, endangered, rare and threatened species of forest flora and fauna.
24	Percentage protected area with clearly defined boundaries
24	Annual volume and area of timber harvested-indigenous and plantation
22	Area and percentage of forest area affected by natural disasters (insect attack, disease, fire and flooding)
22	Number and extent of invasive species
21	Percentage forest protected areas (by forest type, age, class, and successional stage)
21	Wood harvesting intensity
21	Managed forest ratio
20	Changes in the proportions of stands managed for conservation and utilization of genetic resources (gene reserves, seed collection stands, etc.)
20	Per capita wood consumption
19	Extent of mixed stands
18	Estimate of carbon stored
18	Percentage forest land managed for recreation and tourism to total forest area
17	Number of forest dependent species whose populations are declining
17	Fragmentation of forests
16	Threatened tree species as a percentage of the 20 most used for commercial purposes
15	Area and extent of degraded lands reclaimed through forest operations
14	Area and percentage of forests managed for catchment protection
14	Self-regenerating area as a percentage of total area
13	Population levels of representative species from diverse habitats monitored across their range
12	Self-regenerating area per habitat type
10	Ratio between exotic species and native species in plantation area
9	Forest conversion affecting rare ecosystems by area
8	Area and length and numbers of biological corridors
5	Relationship between forest cover and frequency of flooding
Number of Parties using a given indicator	**Indicators of agricultural biodiversity**
35	Use of agricultural pesticides
34	Agricultural area by crops (cereal, oil crops, forage, woodlands)
32	Change in area of agricultural land (conversion to or from agriculture)
29	Agricultural area (intensively farmed, semi-intensively farmed and uncultivated)
22	Species diversity used for food
21	Intensification and extensification of agricultural land use
16	Erosion/Loss of genetic diversity patrimony
15	Replacement of landraces with few imported ones
15	Crops/livestock grown as a percentage of number of 30 years before
14	Replacement of indigenous crops
13	Number of species threatened by agriculture by group (e.g. birds, mammals, vascular plants, vertebrates, invertebrates)
13	Accession of crops and livestock in *ex-situ* storage (number or percentage)
11	Number of vertebrate species using habitat on agricultural land by species.
9	Accessions of crops generated in the past decade (per cent)
6	Differences in species diversity and abundance of arthropods and earthworms in organically and conventionally cultivated arable land
6	Coefficient of kinship or parentage of crops

6	Rate of change from dominance of non-domesticated species to domesticated species
6	Inbreeding/outbreeding rate
4	Rate of genetic interchange between populations (measured by rate of dispersal and subsequent reproduction of migrants)
Number of Parties using a given indicator	**Indicators of inland waters biodiversity**
33	Surface water quality: Nitrogen, Dissolved oxygen, pH, pesticides, heavy metals, temperature
30	Ground water quality: nitrates, salinity, toxicants
29	Biological Oxygen Demand (BOD) on water bodies (re: eutrophication)
29	Fish family diversity
28	Wetland area
27	Groundwater level (water table level)
25	Benthic macroinvertebrates: communities
25	Stream flow
24	Number of inland fish species introduced
23	Number of endemic flora and fauna
22	Number of extinct, endangered, threatened/endangered/vulnerable/ endemic inland water species by group (e.g. birds, aquatic mammals, invertebrates, amphibians, vascular plants, bottom fauna)
21	Macrophytes: species composition and depth distribution
20	Threatened freshwater fish species as a % total freshwater fish species known
20	Changes in fish catches by species
19	Indicator species
18	Number of exotic flora and fauna species (e.g. fish, aquatic weeds)
17	Changes in distribution and abundance of native flora and fauna
17	Species richness (number per unit area, number per habitat)
14	Stream sediment storage and load
13	Extent of wetland drainage and filling
10	Changes in vegetation type along water courses
7	Water resource vulnerability index
7	Ratio between maximum sustained yield and actual average abundance
2	Glacier fluctuations
Number of Parties using a given indicator	**Indicators of marine and coastal biodiversity**
22	Change in proportion of fish catches by species per specific season
17	Threatened fish species as a percentage of total fish species known
17	*Escherichia coli* counts and nutrient levels as % of baseline levels
15	Lake levels and salinity
13	Shoreline position
11	Percentage coastal zone with populations exceeding 100 inhabitants/km2
11	Coral chemistry and growth pattern
9	Annual rate of mangrove conversion
9	Algae index
6	Number of large scale bottom trawling vessels per 1 000 km of coastal area
2	Surface displacement
1	Frozen ground activity
1	Amount of poison chemicals and dynamite used for reef fishing.

Annex II

DESIGNING NATIONAL-LEVEL MONITORING PROGRAMMES AND INDICATORS

A. Framework for designing national-level monitoring programmes and indicators

1. This document aims to provide guidance to the Parties to the Convention on Biological Diversity on the development of national-level[2] indicators and monitoring for biodiversity. It recognizes that many countries and institutions are engaged in indicator development initiatives and processes[3]. Given the emphasis of this document on state indicators for the conservation of biodiversity at species and ecosystem level, it is important to recognize existing indicators that have been developed in complementary issues not covered in this document.

2. A stepwise procedure is proposed which can be summarized into three main elements (see figure 1):

(a) Identification of relevant policy issues and goals;

(b) Development of suitable indicators; and

(c) Development of an appropriate monitoring programme, which allows progress towards policy goals to be measured.

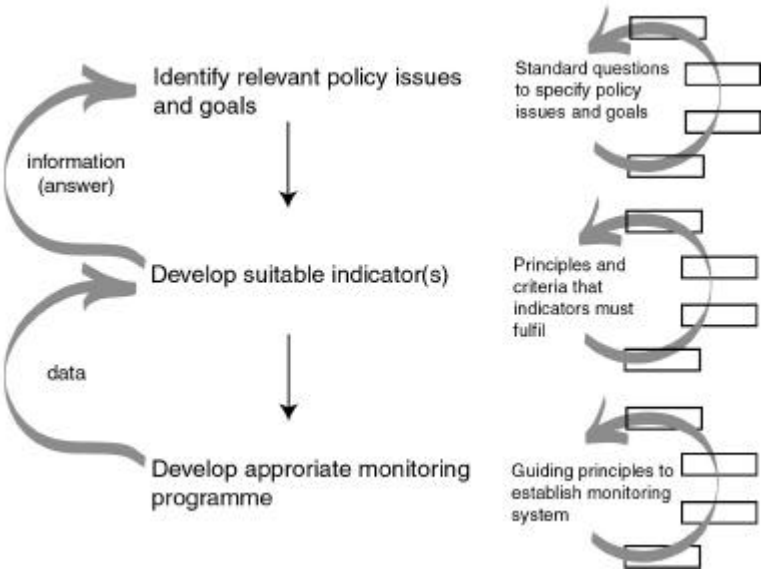

Figure 1. Main elements of the framework for national-level indicators and monitoring

3. This framework provides a specification for monitoring programmes intended to support national-level indicators. Monitoring and surveillance activities are also required for other purposes, including site management, impact assessment, policy evaluation and building general scientific

[2] The focus of this document is on indicators relevant to national-level policy makers, not those used at the site management level. Experience has shown the need to clearly distinguish between the use of indicators at a specific site ("management indicators") and nationally applicable indicators ("policy indicators"). For most countries and situations, the former are too narrowly focused and detailed for national policy applications. However, management indicators can serve as individual variables for policy indicators (e.g. the proportion of protected sites in favourable condition).

[3] A list of web-based sources of information on indicators is contained in appendix 2 to the present note.

understanding. Wherever possible, monitoring and surveillance activities should be designed to be inter-compatible and multi-purpose in order to make efficient use of resources.

4. In accordance with the ecosystem approach, policy indicators should be meaningful in terms of ecosystem processes and management. They should integrate information across sectors and thematic areas and be relevant to defined policy goals[4], thereby providing information essential for decision-making. In most cases, a single indicator will be insufficient to inform policy decisions. Therefore, a set of complementary indicators will generally be necessary to provide a sufficiently complete picture relating to the articles of the Convention.

5. Indicators serve four basic functions: simplification, quantification, standardization[5] and communication. They summarize complex and often disparate sets of data and thereby simplify information. They should be based on comparable scientific observations or statistical measures. They should provide a clear message that can be communicated to, and used by, decision makers and the general public.

6. Indicators and monitoring are important tools for adaptive and cost-effective management and policy making. Such effective management systems need:

(a) Verifiable policy targets;

(b) Timely and sufficient knowledge about the current and projected state and the progress made towards a target; and

(c) Measures for making corrections, i.e., implementation of management or policy actions to protect or improve biodiversity.

7. Indicators link monitoring, research and evidence-based policy making. Scientists and policy makers select a set of relevant indicators, which reflects both scientific and societal perspectives. Subsequently, policy makers set targets and measures, while scientists identify specific parameters and establish corresponding monitoring programmes, baseline values and cause-effect relationships. The current state is determined from monitoring, while models of cause-effect relationships provide information on the effectiveness of measures and point towards responses needed.

8. Indicators and monitoring should thus be designed to detect changes in time frames and on the spatial scales that are relevant to policy objectives and decisions. It is important to detect changes before it is too late to correct any observed problems.

9. Within the context of the CBD, indicators may be required to show status and trends of biodiversity, progress on the implementation of the Convention and the effectiveness of the measures taken.

10. The purpose of **assessing the status and trends of biodiversity** is to inform national-level planners and managers to ensure that projects, activities and policies are compatible with nationally defined biodiversity plans and strategies and contribute to the achievement of relevant biological outcomes. This type of monitoring is called for under Article 7 (b) of the Convention. Its results should be a contribution to the global task of measuring the rate of loss of biodiversity as stipulated in the CBD Strategic Plan and the WSSD 2010 target. This type of monitoring provides information for state indicators.

[4] e.g. Articles of the Convention

[5] Standardization in this context relates to the methodology, not the standardization of results

11. The rationale for **assessing progress in the implementation of the Convention on Biological Diversity and/or the National Biodiversity Strategy and Action Plan** is to assess to what extent the programmes of work developed under the CBD have been implemented at the local, national, regional and global levels, respectively. This type of monitoring relates to all substantive Articles (6-20) of the Convention. In relation to the 2010 target, it contributes to assessing which actions are being taken to reduce the rate of loss of biodiversity. National and thematic reports prepared under the CBD are a key source of information. This type of monitoring provides information for response indicators.

12. The need to **assess the effectiveness of the measures taken within the framework of the Convention on Biological Diversity and/or the National Biodiversity Strategy and Action Plan** is fuelled by the urgency to sustain biodiversity as the basis for life. There is a need to analyse the costs and benefits of activities taken under the CBD and, if necessary, to adapt the strategies required to achieve a significant reduction in the rate of loss of biodiversity. The effectiveness of activities carried out as part of the CBD process can be assessed from the way in which these activities lead eventually to changes in the status of biodiversity. An assessment of the effectiveness of measures requires a combination of the above-mentioned state and response indicators.

13. A number of approaches have been used in developing and structuring indicators[6] [7]. One of the commonly used causal frameworks[8] for describing the interactions between society and the environment is the DPSIR (driver, pressure, state, impact, response) model. It is an elaboration of the PSR (pressure, state, response) model[9]. Although the DPSIR model is useful for conceptualizing the various parts in the chain of causes, effects and possible responses, it can complicate matters and frequently appears to cause confusion, especially when applied to biotic components. Depending on how a question is defined, the same factor can relate to different indicator categories. The distinction between driver and pressure indicators as well as that between state and impact can be difficult to establish. For example, biodiversity can be both an aspect of the 'state' of the ecosystem and the 'impact' which policies are intended to address. Therefore, this document is based on the less ambiguous PSR framework.

14. The PSR framework is particularly suited to address the first objective of the convention, the conservation of biological diversity. The indicator categories are defined as follows:

(a) **Pressure** includes indirect or direct human-induced pressures that affect biological diversity. Indirect pressures are related to demography, economy, technology, culture and governance. Direct pressures include *inter alia* land use, alien invasive species, climate change, emissions of nutrients and pollutants, fragmentation, exploitative human uses;

(b) **State** is the abiotic state of soil, air and water, as well as the state of the biological diversity at ecosystem/habitat, species/community and genetic level. State includes ecosystem goods and services, the direct benefits of biodiversity and the societal impacts of biodiversity loss;

(c) **Responses** are the measures taken to change the state, pressure or use. They include measures to protect and conserve biodiversity *in situ* and *ex situ*. They include measures to promote the equitable sharing of the monetary or non-monetary gains arising from the utilization of genetic resources. Responses also include steps taken to understand the causal chain and to develop data, knowledge, technologies, models, monitoring, human resources, institutions, legislation and budgets required to achieve the objectives of the Convention.

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[6] see for example IISD http://www.iisd.org/measure/compendium/searchinitiatives.aspx;

[7] Boyle (1998) prepared a literature review on monitoring, indicator frameworks and indicator design and selection http://ersserver.uwaterloo.ca/jjkay/grad/mboyle/references.pdf

[8] DPSIR is used, for example, by the European Environment Agency (EEA).

[9] PSR is used by the OECD and the CSD, as well as in previous CBD documents on indicators.

15. However, additional categories of 'use', 'benefit sharing' and the 'capacity' required to formulate and implement responses do not fit comfortably into the PSR framework. **Uses** are the various human uses of biodiversity. These include non-use functions, indirect uses and direct uses: provisioning (food, water, fibre, fuel and other biological products), regulating (climate, water, diseases), cultural (spiritual, aesthetic), and supporting (primary production, soil production, erosion control)[10]. Some uses are also pressures, especially the provisioning uses. Indicators for sustainable use are listed in annex 1 of the Addis Ababa Principles and Guidelines for sustainable use of biodiversity. They are complementary to those proposed in this document.

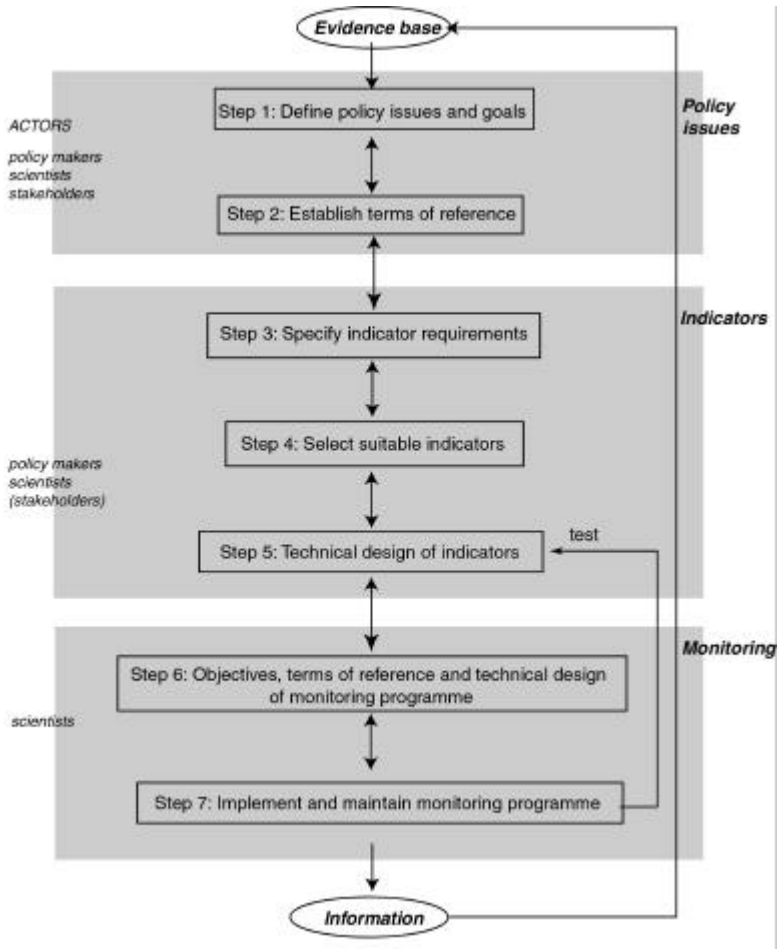
16. Biodiversity indicators must complement other sets of indicators designed to assess progress in other policy sectors, for example agriculture, forestry, poverty reduction, health, trade and sustainable development as well as those describing the abiotic environment. Various sets of indicators have already been developed at national levels for these sectors. In order to avoid duplication of effort, linkages should be made at national levels between these various initiatives. Indicators of relevance to biodiversity, especially pressure indicators, may be derived from work within other sectors. Likewise biodiversity indicators should be included in sets of indicators within other sectors. A list of sources of information on available indicators and ongoing international or national indicator initiatives is contained in appendix 2 of annex 2.

[10] The categories follow the document on "People and Ecosystems: A Framework for Assessment and Action" prepared by the Millennium Ecosystem Assessment.

B. Guidelines and principles for developing national-level monitoring programmes and indicators for biodiversity

17. The following section provides guidance on the steps to be taken from identifying the policy issues and goals towards the development of a suitable set of indicators and the corresponding monitoring programme. Various principles are incorporated through this process. Figure 2 provides a graphic presentation of the sequence of steps that are recommended. It should be noted that, while following the sequence of steps, a feedback – and possible adjustments – to previous steps should be planned.

Figure 2. Steps in indicator selection and design



18. This stepwise procedure provides a general framework for the process and choices involved. It may be necessary to adapt this procedure according to individual country's needs, institutional organization and capacities. A separate information document contains a preliminary indication of experience made with the practical application of the framework and guidelines within the countries participating in the GEF-funded project on "Biodiversity indicators in national use". Lessons learned from developing indicators and monitoring programmes are presented in appendix 1 of annex 2.

19. This document focuses on the conservation of biodiversity at ecosystem and species levels and elaborates to a limited extent aspects of sustainable use at ecosystem and species levels. Indicators for sustainable use are further elaborated in annex 1 of the Addis Ababa Principles and Guidelines for sustainable use of biodiversity (see UNEP/CBD/SBSTTA/9/9 and UNEP/CBD/SBSTTA/9/INF/8). Indicators for benefit sharing are not considered in this document.

Step 1: Define policy issues and goals

20. The first step is to choose the policy issues and policy goals to be covered by indicators. These issues will be guided by the provisions of the Convention and by its respective national implementation manifested in the National Biodiversity Strategy and Action Plans. Awareness of the issues will depend on the best available information, including scientific evidence, traditional knowledge and awareness of management and use.

21. The following standard questions can guide the selection of policy issues for which indicators are relevant tools. Does it concern pressures, state, response, use or capacity issues? In case of state, one would ideally like to know about all ecosystems and all species. This would give the most comprehensive overview of a country's biodiversity. However, apart from practical reasons (scientific and cost-benefit issues), some ecosystems or species might be considered more important than others, because they feature in specific policy plans, attract a lot of public attention, are economically important, or occupy large areas etc. Also one can choose to focus on rare, endemic, threatened ecosystems/species or species which are common and therefore play an important role in the functioning of the ecosystem in terms of energy or biomass flows. Such ecosystems and species can be selected as focal points (see also the categories as listed in annex 1 of the Convention).

22. Other standard questions are: Are you interested in past, current and future state? Past might be important as a reference to put current trends in perspective; current state serves to evaluate whether policies have been successful; future might be important to evaluate the effectiveness of possible measures (responses) being considered. Is it about national policy support or site management? Is detailed information or an overview required? For policy makers often overview information will be useful. For their assistants and scientist more details will be required, to better understand ongoing processes. So often, both will be required. And last, but not least, in which policy process does the indicator feed?

23. Not all policy issues will be amenable to the indicator approach. Therefore, the next standard question should be: does the issue necessitate quantitative, comparable, sensitive and reliable information to track changes over time? If not, indicators may not be appropriate for that issue. Below standard questions are summarized that may be considered in defining the issue.

Standard questions Step 1

- What are the **policy issues** for which information is needed?
  Does the issue concern pressure, **state** or response, or on use, capacity or benefit-sharing[11]
  If **state,** does it concern the abiotic environment, **biodiversity** or ecosystem goods & services?
  If **biodiversity**, does it concern:
  a specific **ecosystem type** ? Marine and coastal areas, inland waters, forests, drylands, agriculture etc.
  ecosystem **processes** or **structures**?
  the **ecosystem**, **species** or **genetic** level?
  If **ecosystem level,** does it concern:
  all ecosystems?
  ecosystems with high diversity?
  ecosystems with large number of endemic or threatened species or migratory species?
  ecosystems which are still wilderness?
  ecosystems of social, economic, cultural or scientific importance?
  ecosystems highly representative, unique or associated with key evolutionary biological processes?
  If **species level,** does it concern:
  species of a certain taxonomic group?
  threatened species?
  wild relatives of domesticated or cultivated species?
  species of medicinal, agricultural or other economic value?
  species of social, scientific or cultural importance?
  species of importance for research into the conservation and sustainable use, such as indicator species?
  If **genetic level,** does it concern
  described genomes and genes of social, scientific or economic importance?
  Does the issue concern:
  past, current and/or **future** status and trends?
  support of site **management** or national **policy making** (setting targets and measures)
  national, regional and **global overviews** , providing **detailed** or **overview** information?
  modelling of the causal effect chain?
  early warning, policy **evaluation** or **future projections (**scenario analysis)?
- Into which national **policy processes** do the indicators feed?
- Are indicators the most **useful** way to answer these policy questions?

24. A list of possible issues (phrased as key questions) for which indicators are suitable is included in section C of annex 2.

Step 2: Establish terms of reference

25. The purpose and audience of the indicators needs to be clarified because this will determine the overall number of indicators being considered and the level of detail required. In most cases, it will be better to start with a relatively small, manageable number of indicators in order to make rapid progress

[11] Given the focus of this document, only issues on the state of biodiversity are elaborated (in bold).

and develop capacity. Inevitably this means a selective approach to identify issues of high priority for policy (see Step 1) and good potential for rapid development of indicators (see Step 4).

26. The structure of the set of indicators as a whole will need to be considered. Many models are available, such as the PSR framework, the levels of biodiversity and the Convention objectives. Often an indicator set will have three components:

(a) A small number (10-15)[12] of 'headline' or 'aggregate' indicators which are intended to provide a high-level overview for the public and politicians. These will focus on issues of high public concern and provide simple messages about the status and trends in biodiversity and/or the implementation of Action Plans.

(b) A larger number (50-150) of 'core' indicators, which provide a more comprehensive picture across the range of policy issues included in Action Plans for policy makers.

(c) Secondary groups or 'satellite' indicators associated with the implementation of particular policies or entire policy sectors, for example agricultural biodiversity, especially for policy makers.

27. The selection process should consider whether indicators on pressure, state, response, use or capacity issues adequately cover the major policy needs and whether the balance reflects national priorities.

28. Aggregated indicators can summarize and simplify the presentation information for a wide audience. Additionally, or alternatively, a small number of headline indicators may be selected to represent priority issues of relevance to the target audience. A hierarchy of indicators and information is illustrated in section D of annex 2. Additional background information is contained in the relevant information document.

29. It is important to consider at an early stage how the work will be organized. The selection of participating institutes and individuals should take account of different policy sectors, research facilities, NGOs, and stakeholders, as well as their involvement in the successive steps. Policy makers guarantee the policy relevance of indicators; scientists guarantee their ecological relevance, technical feasibility and affordability. The involvement of stakeholders at all relevant levels will help to ensure that indicators have the widest possible impact and that they achieve broad acceptance. The specific structure and organization will have implications for budget requirements, time frames, decision and consultation procedures.

Standard questions Step 2:

- Is the set of issues as a whole coherent and incorporating the major policy issues?
- Who is the target-audience and what technical understanding do they have?
- Who should be involved and which is their role in the various stages?
- How can the process of indicator and monitoring development be most efficiently organized?
- What are the budget, timeframe and procedures?

[12] This number can be perceived by one person without being overwhelmed (see also Ministry of Agriculture and Forestry, The State of forestry in Finland, Criteria and Indicators, Publications 5a/2000, Helsinki).

Step 3: Specify indicator requirements

30. The first step in developing relevant and scientifically valid indicators is to clarify what are the underlying processes relating to the policy goals, which are to be assessed. Processes include both natural changes inherent to ecosystems and habitats as well as changes caused by human interventions and management activities affecting pressures and responses. In some cases, where processes are not adequately understood, further scientific research may be required before indicators can be specified. Understanding the underlying processes will help to determine the appropriate frequency and scale of the monitoring required.

31. Major ecosystem types[13] provide convenient spatial units corresponding with the thematic areas of the Convention. Adopting these spatial units for analysis facilitates coherent reporting to the Convention and also enables thematic, regional and global overviews[14]. However, countries will probably use more detailed sub-divisions of these major ecosystem types in national applications. Such a hierarchical system of ecosystem types allows for overviews at different levels within and between countries.

32. Indicators should be designed to track changes over time against a baseline. The baseline may be the earliest data within a time series of consistent observations or a scientific reconstruction of historical conditions, for example a pre-industrial or low impact state. Baseline data help to measure human impact in industrial times and viable population sizes so that the threat of extinction can be assessed. The role and function of baselines is described in more detail in a separate information document. The baseline provides a context for the assessment of change and gives meaning to the indicator. Establishing a common baseline can also provide an effective means of aggregating information at the national and international levels, wherever appropriate. It should be emphasized that the baseline is **not** the targeted state. If possible, indicators should be related to policy goals such that trends over time allow an assessment of progress towards the goal. If there is sufficient knowledge, it may be possible to define specific, time-limited outcomes or desired target values for indicators. Alternatively the direction of change (i.e. increase or decrease) may be sufficient to assess progress. Documents UNEP/SBSTTA/3/INF/13 and UNEP/SBSTTA/5/12 provide additional background on baselines.

Standard questions Step 3

- What is the actual underlying process relating to the policy issue?[15]
- What is the precise area of concern?[16]
- Which major ecosystem types and sub-types do you want to distinguish?
- What should be the minimum temporal and spatial scales of your indicator result?
- What will be the baseline?
- Are sufficient scientific data available for establishing the indicator (for monitoring, modelling, baseline)?

[13] Synonym to the world major habitat types and thematic areas in documents UNEP/CBD/SBSTTA/3/INF/13 and UNEP/CBD/SBSTTA/7/12. The main ecosystem types are: marine and coastal; forests; freshwater; tundra; dry and sub-humid lands; grassland; agricultural land; and built-up land.

[14] see UNEP/CBD/MYPOW/3 and the role of a Global Biodiversity Outlook

[15] For example, "species richness" is often used as an indicator to express the loss of biodiversity. But does this indicator really indicate this ongoing process? Often, biodiversity loss is characterized by common species getting more common and rare species more rare, because of human activities. This is also called the uniformity process. Extinction is just the last phase in a long degradation process. Species richness may even increase due to invasive or introduced species. The actual process to be indicated is not so much species richness but the decrease of the abundance and distribution of the original species.

[16] e.g. What are the boundaries of the area ? Does it concern a cross-boundary area

Step 4: Select suitable indicators

33. Indicator sets should recognize the different audiences for indicators. In general, indicators should be ecosystem and policy relevant, simple and easily understood[17], quantitative, scientifically credible, normative (allowing comparison with a baseline situation and policy target), responsive to changes in time and space, cost-effective and unambiguously, useable for scenarios for future projections, allowing aggregation at the level of ecosystem/habitat types or at national and possibly internationally level. The criteria are listed below.

Principles for choosing indicators

On individual indicators:

1. Policy relevant and meaningful
Indicators should send a clear message and provide information at a level appropriate for policy and management decision making by assessing changes in the status of biodiversity (or pressures, responses, use or capacity), related to baselines and agreed policy targets if possible.

2. Biodiversity relevant
Indicators should address key properties of biodiversity or related issues as state, pressures, responses, use or capacity.

3. Scientifically sound
Indicators must be based on clearly defined, verifiable and scientifically acceptable data, which are collected using standard methods with known accuracy and precision, or based on traditional knowledge that has been validated in an appropriate way.

4. Broad acceptance
The power of an indicator depends on its broad acceptance. Involvement of the policy makers, and major stakeholders and experts in the development of an indicator is crucial.

5. Affordable monitoring
Indicators should be measurable in an accurate and affordable way and part of a sustainable monitoring system, using determinable baselines and targets for the assessment of improvements and declines.

6. Affordable modelling
Information on cause-effect relationships should be achievable and quantifiable, in order to link pressures, state and response indicators. These relation models enable scenario analyses and are the basis of the ecosystem approach.

7. Sensitive
Indicators should be sensitive to show trends and, where possible, permit distinction between human-induced and natural changes. Indicators should thus be able to detect changes in systems in time frames and on the scales that are relevant to the decisions, but also be robust so that measuring errors do not affect the interpretation. It is important to detect changes before it is too late to correct the problems being detected.

[17] simple to interpret, easy to understand, easy to communicate, including through availability of local language versions and public awareness raising, clearly identify the extent of the issues they represent, and give a clear message on status and trends of biodiversity.

On the set of indicators:

8. Representative
The set of indicators provides a representative picture of the pressures, biodiversity state, responses, uses and capacity (coverage).

9. Small number
The smaller the total number of indicators, the more communicable they are to policy makers and the public and the lower the cost.

10. Aggregation and flexibility
Indicators should be designed in a manner that facilitates aggregation at a range of scales for different purposes. Aggregation of indicators at the level of ecosystem types (thematic areas) or the national or international levels requires the use of coherent indicators sets (see criteria 8) and consistent baselines. This also applies for pressure, response, use and capacity indicators.

34. The above criteria are not applied in the same way to all indicators. Detailed indicators – often single indicators – are generally used by technical audiences and do not have to be simple; headline indicators – often composite indicators – are generally used by non-technical audiences and should summarize data on complex environmental issues and processes in a simple and easily understood manner.

35. In consultation with stakeholders, a short list of candidate indicators should be selected from those considered relevant and available. Some desirable indicators may have to be eliminated because they cannot be measured reliably or at an affordable cost or fail to fulfil other principles. The chosen set of indicators should be reviewed as a whole with regard to the above principles 8-10, including the coverage of the main aspects relating to policy issues identified in Step 1. It is neither necessary nor possible to monitor all biodiversity, pressures, etc. A smart, representative cross-section of indicators is sufficient[18].

36. Realistically, most indicators cannot be expected to meet all criteria mentioned above. Therefore, indicators should be optimized for the purpose and audience using both scientific knowledge and intuition. Choosing indicators is the art of measuring as little as possible with the highest policy significance and sufficient scientific credibility.

37. Although indicators should ideally enable straightforward interpretation, it is obvious that the effectiveness of a measure or the sustainability of a use cannot be simply derived from the change of a state indicator assuming a direct relationship. Therefore, statistical and multivariate analyses can be helpful tools for the sound interpretation of an indicator's value.

38. It is useful to distinguish between more static ecosystem **characteristics** and **indicators**, i.e. *species richness* and *number of endemics* versus *trends of species abundance* or *area size*, respectively. Indicators are variable and sensitive to change, while ecosystem characteristics hardly change.

39. Indicators may be more or less suitable or desirable in one situation or country than in another. However, to provide guidance on indicators that have been found to work, a list of generally applicable indicators is provided in section D of annex 2.

[18] This selection problem is similar to that for economic indicators, such as the retail price index, in which a representative selection of products is monitored in a subset of stores -the so called 'shopping bag'- in order to measure inflation out of millions of products.

Principles on Step 4

- Make inventory of existing data
- Start with a list of existing and most promising candidate indicators
- Suitable indicators are those that match many of the above principles
- Some, but not all, principles are imperative such as 'affordable', 'monitorable' and 'sensitive'
- Adapt the indicator choice until a coherent and representative set is achieved

Step 5: Technical design of indicator(s)

40. The technical design of an indicator comprises a series of activities: definition of the exact units, including spatial and temporal scales, determination of the baseline value and of calculation procedures.[19]

41. Composite indices provide summaries across a range of indicators (e.g. species groups, habitats or pressures). This can be helpful in presenting a simple message. However, indices tend to obscure trends of individual components and there is need for transparency on how composite indices are calculated and what data are used.[20] It must be possible at all stages to assess each underlying indicator individually in case more specific questions need to be addressed.

42. **Indicator profiles** may be useful tools to describe and update an indicator in a transparent way. It may contain chapters on (i) why it is chosen; (ii) the exact units; (iii) calculation procedures; (iv) baseline value and underpinning; (v) current state values; (vi) cause-effect relationships; and (vii) ecology (in case of species indicators).

43. It may be necessary to refine and validate indicators through successive iterations to ensure that they are both scientifically robust and communicate effectively with the intended audience.

44. Under the UN Commission for Sustainable Development (CSD), guidelines have been prepared for the national testing of sustainable development indicators[21]. The same guidelines may be applied to the testing of biodiversity indicators. The Commission recognizes that the procedures and processes to be followed in the testing of the indicators may vary from country to country, depending on national objectives and targets, infrastructure, expertise and availability of data and other information for decision-making. CSD promotes a pragmatic approach to the testing of indicators because the whole process is resource intensive. Since the responsibility for indicators and data collection may lie with different institutions, CSD proposes the establishment of a coordination mechanism for the testing of indicators. The guidelines include sections on the implementation of the testing phase, assessment and evaluation, and on reporting.

[19] e.g. aggregating/averaging monitored (or modelled) data in time and space (measurements in various seasons and sample sites).

[20] In case of a composite indicator, the exact calculation procedure for aggregating/averaging the underlying indicators is determined (generally this results in indices). For this a common baseline is required. Sometimes underlying indicators have to be weighted by the area (or time) they represented before several single indicators are integrated into one composite indicator. Further information is provided in the State-of-the-art Report on Current Methodologies and Practices for Composite Indicator Development (http://www.jrc.cec.eu.int/uasa/prj-comp-ind.asp)

[21] http://www.un.org/esa/sustdev/natlinfo/indicators/indi8.htm

Principles on Step 5 (for each indicator of the set)

- The indicator is not defined until the exact units are determined (incl. spatial and temporal scales)
- The calculation procedure has to be determined unambiguously
- Baselines and target values should be established where appropriate
- An indicator profile is a systematic tool to describe exact units, calculation procedures, baseline values, current values and cause-effect relationships
- Does the indicator really match the principles of step 4?

Step 6: Objectives, terms of reference and technical design of monitoring programme

45. The **objectives** for monitoring programmes might be broader than the assessment of specified policy-related indicators in order to develop the evidence base. For example, it may be desirable to provide for early warning of new phenomena or pressures, for which indicators have not been devised. A major challenge when defining objectives for a monitoring programme is to make them robust to policy changes and to ensure continuity of funding. In many cases, the immediate cost of action may appear high; however, the long-term costs of inaction may be even higher. Political commitment is indispensable to guarantee the continuity of any long-term monitoring programme.

46. The **terms of reference** for the monitoring programme are derived from the previous steps. They will include the available budget, units of the chosen indicators, accuracy, minimum spatial and temporal scales to detect impact, and sensitivity. Sensitivity can be expressed as time and magnitude for change detection[22].

47. Monitoring is expensive. However, not all indicators require the collection of additional data. In many cases, some or all of the required information is already available, either from national statistics or from existing management and research data. It is critical, however, to assess the quality of the data and ensure that collection methods used are sound. Rigorous quality control and assurance is particularly important when data sets from different origins are used.

48. For some state indicators, it will be necessary to devise a cost-effective **sampling strategy**. The design should ensure that changes can be detected with statistical confidence, in appropriate time frames and that important change can be discriminated from background 'noise'. The monitoring frequency must be determined and whether the sampling is random or on selected sites (stratified). The exact location of the monitoring sites must be recorded[23]. This will not only allow repeated measurements at the same location, but also gives an overview of the total monitoring scheme and its representativeness. The sampling strategy is important to make sure that (a) when the monitoring system gives a signal, this signal is reliable (confidence); and (b) when some change occurs in the system, the monitoring indeed picks this up (detection power). Many manuals are available to assist in the selection of sensitive and cost-effective field methods. It is advisable to undertake pilot studies to test sampling approaches before full implementation.

49. Quantitative methods should be used wherever possible. Cost-effective methods of data collection should be used making use of existing facilities and staff, volunteers and earth observation as appropriate. Data should also be objective, reproducible and validated.

[22] For example, a change of 10% or more must be detectable in time periods of 4 or 10 years (frequency of monitoring)

[23] e.g. georeferenced within a Geographical Information System (GIS)

50. Monitoring schemes should also be **standardized** as much as possible between different ecosystem/habitat types and when measuring different variables. Consistent methods are needed across ecosystem types to address changes over time and across environmental gradients. Composite indicators (step 4) are made up from different underlying indicators, which may be based on different field methods.

51. Monitoring information can be effective only if it reaches the decision makers in time to take remedial action. It is therefore important that the data flow is clearly established from the field to the end user and that a procedure for regular[24] reporting is established (**data logistics**). Quality control should be incorporated in the data flow to ensure that data collection and analytical techniques are being performed correctly. Data treatment may be necessary to remove bias and gaps in space and time in the schemes.

52. Good data management is essential for long-term monitoring programmes. Experience has shown that the integrity of long-term programmes can be threatened significantly from (i) periodic institutional or personnel change; (ii) technological advances and obsolescence; (iii) inadequacy of data archives; and, (iv) poor technical documentation.

53. National reporting might require data collation in one location and agreements for data sharing between collecting institutions.

Principles on Step 6

- The monitoring objectives should be clear and unambiguous
- The monitoring terms of reference can be derived from the overall terms of reference in step 2
- A clear monitoring strategy is crucial (overall and per indicator)
- The data logistics from measurement to indicator production should be well-organized

Step 7: Implement and maintain monitoring programme

54. It is important to start with whatever information is available and gradually modify and improve the monitoring programme. This approach requires a feedback loop between the information produced in the programme and its usefulness in meeting the programme objectives. Pilot studies provide a cost-effective means of testing all elements of a monitoring programme before full implementation.

55. Long-term institutional responsibility, support in terms of capacity for the monitoring programme and a **strong sense of ownership** appear to be important criteria in the continuation of many monitoring programmes. Effective management programmes often depend on the coordinated contribution of a wide range of partners, including local community groups, management authorities, NGOs, research institutions, local and national government. Best practice guidance can be drawn from successful examples of biodiversity monitoring.

56. Once the monitoring programme provides information, it is necessary to verify whether the design of the indicator is appropriate or whether it requires adjustment. This is done through an evaluation of the programme's results (i.e. data) against the objectives and terms of reference (step 6). Frequent evaluation and adjustment are essential for programme development. The ultimate test of the performance of the monitoring programme is by the actual use of its output in the indicator protocol (step 5)

[24] e.g. annual, every 3 years etc.

Principles on Step 7 (for each indicator)

- Start and gradually improve monitoring
- Promote a strong ownership

57. In order to guide Parties in the establishment of biodiversity indicators for policy-making and monitoring, a stepwise procedure and a list of feasible indicators are provided. This facilitates a flexible approach in choosing the indicators to be monitored by countries based on their priorities, capabilities, and data availability, thereby taking fully into account national and regional differences. An energetic implementation is of crucial importance to timely evaluate the progress of the national NSBAP and objectives of the Convention as well as the 2010 targets.

C. Key questions that indicators may help to answer

58. The set of key questions addresses common concerns regarding the implementation of the Convention on Biological Diversity. They can be summarized in the following five core key questions:

(a) What is changing and to what extent? (state);

(b) Why is it changing? (pressure);

(c) Why is it important? (use);

(d) What are we doing about it? (response);

(e) Do we have the means to formulate and implement response measures? (capacity).

59. The set of key questions are organized according to indicator categories and the corresponding Article(s) of the Convention. Questions listed in previous CBD documents[25] for which indicators are less suitable as tools to answer them are **not** included.

Key questions on state (relates to Article 7)

60. What is the current state of biological diversity? What is the rate of biodiversity loss and how is it changing?

61. Is the status of biological diversity status stable or changing? What is the direction and extent of the change?

62. How many globally or regionally important species, populations and habitats are at risk of extinction?

63. What is the species abundance and/or distribution (evenness), species-richness, and ecosystem structure and complexity of important ecosystems?

64. How much biodiversity (landscape/ecosystem diversity, natural habitats, species and genetic resources) is being lost?

65. Are there early warning signs of problems that require early attention?

Key questions on pressure (relates to Article 7)

66. What is the possible impact of threats and what is their relative contribution?

67. What is the size of these threats, and are they stable, decreasing or growing? What is the threat status of known genetic resources, species, ecosystem types, and habitats of poorly known taxa?

68. What anthropogenic processes have the greatest influence on the current and near future status of biodiversity? Which social and economic root causes are responsible for the observed changes in human threats to biodiversity?

69. Are direct and/or underlying causes of biodiversity loss being addressed?

[25] UNEP/CBD/SBSTTA/3/INF/13, UNEP/CBD/SBSTTA/5/12; UNEP/CBD/SBSTTA/7/12

Key questions on response (relates to Articles 6, 8, 9, 10, 11)

70. Are management efforts targeted to the highest priority threats?

71. Is progress being made in achieving major targets and objectives set out in planning processes, in particular to reduce and prevent biodiversity loss?

72. Are there known perverse management activities, incentives and policies?

73. Is there a protected area network and how representative is it?

Key questions on effectiveness of measures
(combination of state and response; relates to Article 7)

74. How effective are/have been the measures taken to implement the Convention?

75. Are management efforts, including resource allocation, in relation to present and past threats sufficient to slow the rate of loss of biodiversity and prevent irreversible loss?

Key questions on use (relates to Article 7)

76. What is the current state of the goods and services provided by biological diversity?

77. What sustainable use practices are in place and how sustainable are they?

78. Are the benefits derived from consumptive and non-consumptive uses known?

Key questions on capacity (relates to Articles 12, 13, 14)

79. How much human and institutional capacity is available to implement the Convention?

80. How much support (financial resources, institutional support and incentives) from national and international sources is currently being provided to implement the Convention?

81. What additional means (including new and additional financial resources) are needed to address the threats?

82. What is the management capacity to quickly react to known (e.g. poaching, fires) or unforeseen (e.g. oil spills, new diseases) threats? What is needed to build the required capacity (according to national priorities)?

83. What is the capacity to effectively manage priority areas?

84. What is the national capacity to put expert (national or international) and traditional knowledge on status and trends of biodiversity to use for slowing down biodiversity loss?

85. What is the capacity to maintain information flow?

D. Indicative list of available and potential biodiversity indicators

86. Indicators may contain simple or highly aggregated information. **Single indicators** are single variables related to a reference value (e.g. number of storks compared to viable population). A reference might be a target (distance to target), a baseline (distance to baseline), a threshold value (distance to a collapse), or a reference year (change in time). **Composite indicators** aggregate various single indicators by transforming them into another common unit (like classifying apples and pears as fruit). One way is to transform single indicators into dimensionless indices by dividing them by a reference value (e.g. average population size of 10 species as % of undisturbed state). Another approach is the weighted transformation into a common unit (e.g. methane and CO_2 emissions transform into greenhouse gas equivalents). Subsequently these single indicators can be aggregated. Both calculation procedures and baseline values are required for data processing, which is in fact a form of **data compression** Site managers are usually interested in statistics and single-indicators; politicians at the national level are mostly interested in composite indicators.

87. Both the single and composite indicators listed below are **generic**; they can be applied to all countries and ecosystems. Parties can develop them according to their country-specific biodiversity, threats, pressures, policies and capacity. At this stage, the list focuses on indicators, which are feasible in the short or medium term (see also UNEP/CBD/SBSTTA/3/INF/13). As requested in decision VI/7-B, biodiversity state indicators are structured into indicators on ecosystem quality and those on ecosystem quantity. They relate to the following key questions from section C of the present note[26]:

(a) What is the current **state** of biological diversity[27]? Is it stable, improving or deteriorating? What is the extent of the change? How much is being lost? Are components threatened with extinction? The same questions apply to specific biodiversity components, such as those mentioned in annex 1 of the Convention.

(b) What are the major anthropogenic **pressures** on biodiversity? Are they stable, declining or increasing? What is their relative contribution to the impact on the current and future state of biodiversity? Do the combined pressures enhance or weaken the impact on biodiversity?

(c) What **responses** have been developed? What is the status of implementation of each provision of the Convention? How **effective** are the measures taken? Are the national and Johannesburg targets being achieved? Which area is protected? How representative are the protected areas? Are there known perverse management activities, incentives and policies?

(d) What are the current **uses** of biological diversity? Are they stable, declining or increasing? How sustainable are they?

(e) What **capacity** is available to establish and maintain an indicator and monitoring system, analyse its results and feed it into policy processes?

88. Additional guidance is contained in two appendices to the present note, which summarize the experience gained and lessons learned from several indicator development processes and present sources of web-based information on indicator initiatives and national monitoring programmes.

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[26] Indicators are not a suitable tool to answer all key questions from section C. Some can be simply answered by yes or no, or some require answers of a narrative character.

[27] at the level of species and ecosystems

I. Indicative list of suitable single indicators

category	type	Level	Indicator [28]	Meaning	Remarks
State	quantity	eco-system	Self-regenerating and man-made area as percentage of total country area	How much natural area remains, which part is agricultural, which built up land?	- Total country area is used as baseline. - Any further ecosystem sub-division is possible[29].
			Hot spots	Which ecosystems with high diversity of endemic species are threatened?[30]	here implicitely a natural baseline is applied;
	quality	species	Trends of set of species which is representative of the ecosystem [31]	- What is the quality of the remaining natural area and agricultural area, given the change in its components? - What are the trends at the species level?	1st track: baseline year as far back as possible 2nd track: postulated baseline set in pre-industrial times Consider what baseline to use[28]
			ditto of particular taxonomic group		
			exploited species		
			endemic species		
			species of cultural interest		
			migratory species		
			Waterfowl		
			red list species		
			any other species or species group (see also annex 1 to the Convention)		
			…….		
			Number of threatened and extinct species as a % of particular considered groups	Which species are threatened?	IUCN Red List categories
			……		
		structure variables	Trends of set of structure variables which is representative of the ecosystem (examples below)	- What is the quality of the remaining natural area and agricultural area? - What are the trends of ecosystem structures?	1st track: baseline year as far back as possible 2nd track: postulated baseline set in pre-industrial times
			canopy cover		
			percentage primary, secundary forest, plantations		
			ratio dead-living wood		
			% area vital coral reefs		
			% area (semi)natural elements in agricultural area		
			any other structure variable		
		genes	Number and share of livestock breeds and agricultural plant varieties	Which genetic resources are threatened?	Detailed information prepared by FAO[32]

[28] All indicators have a spatial scale of the major ecosystem types, subdivisions of these and/or the national level. The time scale may vary from 1 year, to 4 years or 10 years. All indicators have specific baselines such as: a specific baseline year, pre-industrial, natural background value, first year of monitoring, maximum sustainable yield, etc. Only the first indicator, on remaining area, has the country's total area as the baseline.

[29] A subdivision into the major ecosystem types similar to the Convention's thematic areas is preferable to enable national, regional and global evaluation of the Convention's objectives and the WSSD Plan of Implementation (document UNEP/CBD/MYPOW/3); see also step 3 of the procedure for indicator development. Man-made ecosystems may be subdivided into agricultural land and built-up area. The former into major agricultural types such as permanent crops, permanent grassland, arable land, rice paddies (see also OECD, 2003. Agriculture and Biodiversity – Developing Indicators for policy Analysis).

[30] Although the hot spots as such do not change (features) size and pressures may.

[31] Species trends can be expressed in various terms, e.g. density, extent of distribution, population numbers, presence, biomass, volume, breeding pairs, etc, what is most appropriate and feasible

			Number of varieties of livestock breeds and agricultural crops endangered		
			Share of major varieties in total production for individual crops		
			…….		
Pressure	physical[33]	direct	Annual conversion of self-generating area as % of remaining area	What is the size of a pressure? Is it increasing, stable or decreasing?	1st track: The size of individual pressures compared to a particular reference year and natural background value 2nd track: the size of individual pressures to their impact on biodiversity
			Change in mean temperature		
			Change in precipitation		
			disturbance		
			road density		
			m3 water extracted		
			fragmentation (size, isolation, connectivity)		
			fire		
			habitat alteration		
			damming and canalisation of rivers		
			any physical factor		
			…….		
	chemical[33]	direct	H+ deposition	What is the size of a pressure? Is it increasing, stable or decreasing?	1st track: The size of individual pressures compared to a particular baseline year or natural background value or critical value or standard 2nd track: the size of individual pressures to their impact on biodiversity
			P or N deposition		
			exceeding of soil, water and air standards of particular pollutants		
			…….		
	biological	direct	total number of invasive species as a % of particular groups	What is the size of a pressure? Is it increasing, stable or decreasing? What type of harvesting is applied,	1st track: The size of individual pressures compared to a particular baseline year or maximum
			total amount harvested per species per harvesting type		
			any human induced biological pressure factor		

[32] See FAO publications: "Review and development of indicators for genetic diversity, genetic erosion and genetic vulnerability" (2002) and "Indicators and reporting format for monitoring the implementation of the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture" as well as references in appendix 2.

[33] Several physical and chemical indicators have been worked out by the OECD. See also Adriaanse, A. 1993. Environmental policy performance indicators. Sdu, The Hague, ISBN 90 12 08099 1.

			…….	causing different impacts?	sustainable yield or total allowable catch 2nd track: the size of individual pressures to their impact on biodiversity
		indirect	human population density	these influence the direct pressures	
			GNP		
			……		
Use	provi-sioning		Total amount harvested per species or species group (tons or m3 or US$) Per capita wood consumption (m3 per year)	-what is the use? -is it sustainable? -how much people depend on the system? - what is the contribution to the GNP?	1st track: harvest compared to a particular baseline year, total allowable catch or unit effort, GNP 2nd track: harvest compared with the maximum sustainable yield
	regulating		Total and per km^2 carbon stored within forests per country (tons per year)		
	cultural		Total recreational revenues derived from ecotourisme (US$)		
	…..		…….		
Response	legislation		Total number of protected species as % of particular groups		
			% protected area by IUCN category		
	targets		NBSAP objectives met		
	expendi-ture		Expenditure of abatement and nature management measures (US$)		
	manage-ment		number of protected areas wih management plan		
			number of threatened and invasive species with management plan on total		
			effectiveness of protection measures in protected areas		this is a combination of a state and response
			.....		
Capacity	personnel		nature research capacity in number of people		compared to baseline year or total size natural area
			conservation policy capacity in number of people		
			nature site management capacity in number of people		
	legislation		number of physical and chemical standards		
	moni-toring		number of physical, chemical and biological variables measured		
			local site support groups (numbers, membership, activity) and number of volunteer monitors		
			…..		

II. Indicative list of suitable composite indicators [34]

State

General state

- Natural Capital Index[35]
- Wilderness[38]
- Living Planet Index[36]

Threat

- Red List Indicators on species groups[37]
- Hot spots[38]

Trends of components

- Species Assemblage Trend Indices[39]

Pressures

- Total Pressure Index[40]
- Habitat-species Matrix (agricultural practices)

or a few pressures on pressure-types such as

- Climate change
- Acidification
- Eutrophication

Uses

- Sustainability of total use

Responses

- Effectiveness of environmental measures
- Effectiveness of area protection
- Effectiveness of site management

89. A coherent overview at the national level is possible if similar baselines are used for the different habitat types. A short description of the indicators is given in the corresponding information document.

[34] Fact sheets with information on the meaning, design, calculation procedure, detailed reference and examples are provided in the corresponding information document.

[35] As described in UNEP/CBD/SBSTTA/3/9 and UNEP/CBD/SBSTTA/3/INF/13. A pressure based NCI has been applied in UNEP's Global Environment Outlooks.

[36] see WWF

[37] According to IUCN

[38] See Conservation International

[39] Examples of Species Assemblage Trend Indicators are the Living Planet Index, Bird Headline Indicator, or any annex 1 category of the Convention such as endemic species, species of economic or cultural interest, specific taxonomic groups such as birds, reptiles, etc.

[40] See pressure-index used in UNEP's Global Environment Outlooks.

Appendix 1

LESSONS LEARNED FROM DEVELOPING INDICATORS

1. Developing indicators and monitoring is not an easy task. Before starting this process, the following lessons and general notions may be of help; they have been compiled from experiences gathered in various processes of indicator development and should therefore not be considered as universally applicable.

On questions:

2. Start at the end. What are the aims of the policy makers?

3. A suitable indicator is based on an appropriate question. If the question is not well formulated, the corresponding indicator will not provide the intended answer. Because indicators and monitoring are costly, think twice before you choose.

4. Not all questions are to be answered by indicators. Actually many questions can be answered by one-off information (e.g. statistics) or are of narrative character (see also section C of annex 2). Besides, monitoring budgets are limited, so balance cost and benefits before deciding establishing an indicator.

On indicator developme nt:

5. Indicators are the "eyes and ears" of society, similar to a cockpit for a pilot. They are a prerequisite for adaptive and cost-effective policies.

6. The "keep it simple" principle should be applied; indicators need to be well understood by policy makers and the public.

7. A scientifically perfect indicator does not exist, a politically useful one does.

8. Indicators are not good or bad as such; the suitability of an indicator depends on the purpose it is used for.

9. Choosing indicators is the art of measuring as little as possible with the highest possible policy significance. It is not only a scientific exercise but also a matter of art.

10. Choosing indicators is a cooperative exercise between policy makers and scientists. This guarantees that indicators are policy relevant (targets, baseline choice), affordable, easy to monitor, ecosystem relevant, linkable with socio-economic scenarios (modelling response-pressures-effect relationships) and reliable.

11. Consultation with stakeholders enlists their participation and consequently increases the effectiveness of indicators as policy and management tool.

12. Biodiversity cannot be measured by a single variable or even a composite indicator. A multi-indicator approach consisting of a few complementary indicators is advisable in order to show the various aspects of biodiversity. Such an approach is also common practise in the socio-economic field. The same applies to pressures, uses and responses.

13. The number of suitable indicators is limited and therefore arbitrary choices are inevitable:

(a) Biodiversity is too extensive to allow measurement of all its components. Only a smart, representative subset of indicators in a limited number of sample areas can and needs to be measured.

(b) This selection problem is similar to that for economic indicators, such as the retail price index: out of millions of products only a representative selection is monitored in a subset of stores - the so called "shopping bag" - to measure inflation.

14. Choosing indicators is not just a matter of science but also a matter of experience and of weighting different factors. The number of indicators is a balance between costs and information needs. This is not a linear relationship. Furthermore, factors other than cost and benefit might play a role, e.g. existing monitoring schemes and institutional partnerships.

15. Be pragmatic:

(a) get started, learn by doing;

(b) do not get stuck on concepts like indicator value, key-stone species, habitat classification systems, etc. They are not goals but just a way of helping you to choose a representative set of indicators. Do not let them keep you from actually doing the work;

(c) do not complain about the lack of data but start with the information and indicators you already have;

(d) indicators do not have to meet all criteria;

(e) aim at a few, simple and feasible indicators in the short term (1-5 years); if possible undergo a gradual development and improvement in the long term (15 years); Rome was not built in one day either;

(f) aim at an accuracy that corresponds with the necessity of policy making (is money well spent?), not to write scientific articles;

(g) be problem-oriented; focus on human-caused changes, not on natural fluctuations;

(h) develop indicators which are flexible and can be used on different scales for multiple purposes, e.g. useful for national use, international reporting obligations, possibly site management, sustainability assessment, etc. However, indicators for national policy making tend to be of a different character and scale than those required for site management;

(i) although there are exceptions, common species tend to be easier and cheaper to monitor than rare species and may provide significant information;

16. Indicators can be single variable or highly aggregated composite indicators. They have different features and serve different users and goals:

(a) Single indicators provide detailed information, often useful for management questions. They may also represent the building bricks for composite indicators.

(b) Composite indicators provide general overviews often useful for policy making and communication with the public.

On indicator use:

17. The number of indicators one person can simultaneously perceive is around 15.

18. To underpin sector decisions, politicians are more interested in change than in the state of an entity.

19. Indicator values are just means, not the final goal. The final goal is to implement effective sector and conservation measures.

20. To assess improvement or deterioration of the status of biodiversity, a baseline and policy objectives are needed against which current and expected future state can be compared;

21. Assessments can be made from different points of view, e.g. (i) the more species the better; (ii) the less human-affected the better; (iii) the more self-organizing the better; (iv) the more productive the better; or (v) the lower the risk of extinction the better, etc.

22. If chosen carefully, indicators give suitable direction to monitoring and research programmes.

On monitoring:

23. Strong ownership is of great importance for the continuity and quality of monitoring.

24. There is need for co-operation and collaboration across a wide range of partners (local community groups, management authorities, NGOs, research institutions, local and national Government).

25. There is a potential role for volunteer effort and citizen science in collecting useful information.

26. Monitoring intervals and locations and the corresponding levels of confidence can be determined through statistical analyses.

27. Rules of thumb can sometimes provide an alternative to complex statistical solutions.

28. To be sustainable, monitoring systems must be simple and inexpensive enough to work in the long term.

Appendix 2

INDICATIVE LIST OF INDICATOR INITIATIVES AND SOURCES OF INFORMATION [41]

Organization	Title	Types of information	Address
International and regional organizations or information of international or regional scope			
Bird Life International	Indicators of avian biodiversity	Threatened species (global), Important Bird Areas (sites; currently limited to Africa and Europe but being extended to global) and common birds (habitats; Europe at present)	http://www.birdlife.org
European Commission, Joint Research Centre	Composite indicators of country performance	Background information on a workshop on composite indicators of country performance including a state-of-the-art report on current methodologies and practices for composite indicator development http://www.jrc.cec.eu.int/uasa/prj-comp-ind.asp	http://webfarm.jrc.cec.eu.int/uasa/index.asp?app=jrc&prj=frames&sec=home&dic=1&mode=6&swebSite=/uasa/&head=8&menuopen=1&start=yes&sHome=/uasa/events/oecd_12may03/index.htm
European Commission, European Statistical Laboratory	The Dashboard collection	Lists of indicators for the environment and sustainable development, various countries and Europe	http://esl.jrc.it/dc/index.htm
European Community	European Community Biodiversity Clearing-House Mechanism	Information on biodiversity monitoring and indicators: international and national initiatives with website links	http://biodiversity-chm.eea.eu.int/information/indicator
European Environment Agency (EEA)	Building agri-environmental indicators	The publication focuses on use of the Land Use/Cover Area Frame Statistical Survey (LUCAS) for building landscape and agri-environmental indicators. Analysis of independent and joint use of land cover information, administrative data and geo-referenced statistical surveys for providing information on fluxes, stocks and pressure indicators and data sets EU-wide. Topics range from bird diversity, to a complete land cover classification.	http://www.eea.eu.int/ http://agrienv.jrc.it/ publications/ECpubs/agri-ind/
European Environment Agency (EEA)	Fragmentation of ecosystems and habitats by transport infrastructure	Indicator fact sheet	http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/fragmentation/TERM_2002_06_EUAC_Fragmentation_final_draft_August_2002.pdf

[41] To be completed

Organization	Title	Types of information	Address
European Environment Agency (EEA)	Proximity of transport infrastructure to designated areas	Indicator fact sheet	http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/proximity/TERM_2002_07_EUAC_Proximity_to_designated_areas_final_draft_August_2002.pdf
European Environment Agency (EEA) and European Centre for Nature Conservation (ECNC)	A proposal for European Biodiversity Monitoring and Indicator Framework (EBMI-F)	List of ongoing international Biodiversity Monitoring Initiatives in Europe http://www.strategyguide.org/ebmi-f/monitoring_initiatives.html	http://www.strategyguide.org/ebmf.html
European Union (EU)	Environmental Assessment Report 2002	Core environmental indicators on the four themes of the EU Sixth Environment Action Programme	http://reports.eea.eu.int/environmental_assessment_report_2002_9/en/signals2002-chap08.pdf
Food and Agriculture Organization of the United Nations (FAO)	Forest biodiversity	Criteria and Indicators for Assessing the Sustainability of Forest Management: Conservation of Biological Diversity and Genetic Variation. Document prepared by G. Namkoong *et al.* Forest Genetic Resources Working Paper 37: http://www.fao.org/DOCREP/005/AC649E/AC649E00.HTM Status and Trends in Indicators for Forest Genetic Diversity. Document prepared by F.H. McKinnell. Forest Genetic Resources Working Paper 38: http://www.fao.org/DOCREP/005/AC786E/AC786E00.HTM Criteria and Indicators for Sustainable Forest Management: A Compendium. Paper compiled by Froylán Castañeda, Christel Palmberg-Lerche and Petteri Vuorinen, May 2001. Forest Management Working Papers, Working Paper 5. Forest Resources Development Service, Forest Resources Division. FAO, Rome (*unpublished*): http://www.fao.org/DOCREP/004/AC135E/AC135E00.HTM	http://www.fao.org

Organization	Title	Types of information	Address
Food and Agriculture Organization of the United Nations (FAO)	Agricultural biodiversity	Review and development of indicators for genetic diversity, genetic erosion and genetic vulnerability (GDEV): Summary report of a joint FAO/IPGRI workshop (Rome, 11-14 September, 2002): http://dad.fao.org/en/refer/library/reports/Ninth.htm Indicators and reporting format for monitoring the implementation of the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture: http://www.fao.org/waicent/FaoInfo/Agri cult/AGP/AGPS/pgr/itwg/pdf/P1Wad1E.pdf Report submitted by FAO for the OECD Expert Meeting on Soil Erosion and Soil Biodiversity Indicators (25-26 March 2003): http://www.fao.org/ag/agl/agll/soilbiod/docs/oecdpaper_final.doc	http://www.fao.org
Food and Agriculture Organization of the United Nations (FAO)	Fisheries	Indicators for sustainable development of fisheries: http://www.fao.org/docrep/W4745E/w4745e0f.htm The ecosystem approach to fisheries. *FAO Technical guidelines for responsible fisheries.* No. 4 Suppl.: ftp://ftp.fao.org/docrep/fao/005/y4470e/y4470e00.pdf	http://www.fao.org
Food and Agriculture Organization of the United Nations (FAO)	Land degradation assessment in drylands (LADA)	Some suggested indicators for Land Degradation Assessment of Drylands ftp://ftp.fao.org/agl/agll/ladadocs/paper_281102.doc containing biophysical ftp://ftp.fao.org/agl/agll/ladadocs/biophysicalindicators.doc socio-economic ftp://ftp.fao.org/agl/agll/ladadocs/socioeconomicindicators.doc and institutional ftp://ftp.fao.org/agl/agll/ladadocs/institutionalindicators.doc indicators	http://www.fao.org/ag/agl/agll/lada/emailconf.stm
Global Environment Facility	GEF Monitoring and Evaluation Unit	Measuring Results of the GEF Biodiversity Program Web link is the GEF website under Results and Impacts (but due to change)	http://www.gefweb.org
Institute for Environmental Research and Education (IERE)	Biodiversity Land use Indicators Workshop narrative	http://www.iere.org/documents/LanduseWorkshop.pdf Land use indicators	http://www.iere.org/landuse.html
International Institute for Sustainable Development (IISD)	Compendium of indicator initiatives	Web-based searchable database of indicator initiatives http://www.iisd.org/measure/compendium/searchinitiatives.aspx	http://www.iisd.org

Organization	Title	Types of information	Address
Intergovern-mental Panel on Climate Change (IPCC)	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories	Three volumes, each of which provides assistance to the analyst in the preparation of national GHG inventories. Directions for assembling, documenting and transmitting completed national inventory data consistently, compendium of information on methods for estimation of emissions for a broader range of greenhouse gases and a complete list of source types for each.	http://www.ipcc.ch/
Mediterranean Region	Plan Bleu	Description of a number of environmental performance indicators and of sustainable development indicators	http://www.planbleu.org/
Mediterranean Region	Système d'Information sur la Désertification d'aide à la planification dans la Région Méditerranéenne	Impact indicators for desertification including overview of international indicator frameworks relating to desertification and weblinks to: World Bank, FAO,UNDP, UNEP, CGIAR, UN Development Watch, UNEP, CSD, CIAT, ETCS, OECD, IDRC, GAIA, NRI, Redesert, NDMC, IISD, WRI, IALC, CIESIN & SEDAC	http://p-case.iata.fi.cnr.it/coopita/Marrakech/Indic1.htm
Organisation for Economic Co-operation and Development (OECD)	Agri-environmental indicators	Work in the OECD on agri-environmental indicators covers a range of issues, such as agricultural impacts on soil, water, air, biodiversity, habitats and landscape http://www.oecd.org/EN/home/0,,EN-home-150-nodirectorate-no-no-no-21,00.html	http://www.oecd.org
Organisation for Economic Co-operation and Development (OECD)	Environmental indicators	OECD core environmental indicators (CEI, i.e. the OECD Core Set), cover several environmental issues among which biodiversity and cultural landscapes. They are used to monitor environmental progress and performance in OECD countries.	http://www.oecd.org/env/ http://www.oecd.org/EN/documents/0,,EN-documents-567-14-no-4-no-567,00.html
Organisation for Economic Co-operation and Development (OECD)	Environmental data	The OECD regularly collects, jointly with Eurostat, environmental data from its Member and Partner countries, including data on wild life. Since 1984, these data have been published in the OECD Environmental Data Compendium.	http://www.oecd.org/env/ http://www.oecd.org/oecd/pages/home/displaygeneral/0,3380,EN-documents-476-14-no-4--no,00.html
Sustainable Cities Campaign	Measuring and monitoring sustainability: international, European, regional and local projects	Local sustainability indicators: a survey has been carried out by the Campaign Office. These pages contain information on important projects, publications and sources.	http://www.sustainable-cities.org/indics.html

Organization	Title	Types of information	Address
The World Conservation Union (IUCN)	2003 Annual Workplan	IUCN-WCPA-World Commission on Protected Areas: Developing and testing criteria and indicators for assessing management effectiveness of at least 10 World Heritage sites on a bio-geographic basis IUCN regional offices are developing tools, methods, criteria and indicators to assess the status (threats and management effectiveness) of ecosystems, habitats and species	http://www.iucn.org/wp2003/kra/5/1.htm
United Nations Commission on Sustainable Development (CSD)	Indicators of sustainable development	CSD Theme Indicator Framework containing social, environmental, economic and institutional indicators http://www.un.org/esa/sustdev/natlinfo/indicators/indisd/isdms2001/table_4.htm	http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm
United Nations Convention to Combat Desertification (UNCCD)	Committee on Science and Technology (CST)	Several documents on benchmarks and indicators, particularly those used to measure progress.	http://www.unccd.int/cop/officialdocs/menu.php
United Nations Educational, Scientific and Cultural Organization (UNESCO)	Observatoire du Sahara et du Sahel (OSS)	Description of the Indicators/Monitoring-Evaluation programme of OSS	http://www.unesco.org/oss/v_uk/programmes/programme_indicateursang.htm
United Nations Educational, Scientific and Cultural Organization (UNESCO)	World Water Development Report	The report is part of an ongoing assessment project to measure progress towards achieving the goal of sustainable development formulated at Rio in 1992, and the targets set down in the UN Millennium Declaration of 2000.	http://www.unesco.org
United Nations Environment Programme (UNEP)	United Nations system-wide Earthwatch	Contains information about indicator initiatives or organizations and at regional and national levels	http://www.unep.org http://www.unep.ch/earthw/indicat.htm
United Nations Environment Programme (UNEP)	Global Environment Outlook 3	The Living Planet Index: a global biodiversity indicator	http://www.unep.org/geo/geo3/english/221.htm

Organization	Title	Types of information	Address
World Bank	Environmental Economics and Indicators	List of ongoing environmental indicator initiatives http://lnweb18.worldbank.org/ESSD/essdext.nsf/44ByDocName/EnvironmentalIndicatorsCurrentInitiatives and key resources http://lnweb18.worldbank.org/ESSD/essdext.nsf/44ByDocName/EnvironmentalIndicatorsKeyResources	http://lnweb18.worldbank.org/ESSD/essdext.nsf/44ByDocName/EnvironmentalEconomicsandIndicators
World Conservation and Monitoring Centre (UNEP-WCMC)	Forest and Poverty Mapping in South Asia	Resources, resource use, poverty and population indicators. Indices have been determined using UNDP's methodology for the Human Development Index.	http://www.wcmc.org.uk/forest/poverty/indicators.htm
World Conservation and Monitoring Centre (UNEP-WCMC)	Natural Capital Indicators for OECD countries	(1) Report on biodiversity indicators describes the methods used and results obtained during a short feasibility study carried out by UNEP-WCMC for the National Institute of Public Health and the Environment (RIVM) in The Netherlands.	(1) http://www.unep-wcmc.org/index.html?http://www.unep-wcmc.org/species/reports/~main
World Health Organization (WHO)	Health in sustainable development planning: the role of indicators	Indicators on health, environment and sustainable development http://www.who.int/mediacentre/events/IndicatorsFrontpages.pdf and http://www.who.int/mediacentre/events/IndicatorsChapter1.pdf to http://www.who.int/mediacentre/events/IndicatorsChapter8.pdf	http://www.who.org
World Health Organization (WHO)	Environmental health indicators	http://www.who.int/environmental_information/Information_resources/documents/Indicators/EHIndicators.pdf	http://www.who.org
World Resources Institute (WRI)	Trends and indicators	Lists documentation which uses indicators to illustrate the state of the environment	http://www.wri.org/data/
National programmes and organizations			
Australia	National River Health Program	Australian River Assessment System: a rapid prediction system used to assess the biological health of Australian rivers	http://ausrivas.canberra.edu.au
Australia	National State of the Environment reporting: estuaries and the sea	Key set of 61 environmental indicators for estuaries and the sea; monitoring strategies and approaches to interpreting and analysing each of the indicators are discussed and possible sources of data are noted	http://www.amcs.org.au/news/reports/envind.htm

Organization	Title	Types of information	Address
Australia	Australian Bureau of Statistics	Measuring Australia's Progress 2002: Headline indicators for biodiversity	http://www.abs.gov.au/Ausstats/abs@.nsf/94713ad445ff1425ca25682000192af2/1c4c7a1ae2c7a1c7ca256bdc001223fd!OpenDocument
Australia – New South Wales	NSW State of the Environment 1997	Core indicators for atmosphere, land, water, biodiversity and towards sustainability	http://www.epa.nsw.gov.au/soe/97/listcore.htm
Canada	The ecological monitoring & assessment network	Forest Biodiversity Indicators - and Lessons learned in Implementation	(1) http://www.eman-rese.ca/eman/reports/publications/nm97_abstracts/part-8.htm
Canada	Special note on indicators	Recommended process for the selection of national (or indeed any) indicators in five steps	http://www.eman-rese.ca/eman/reports/publications/framework/context.html
Canada	Environment Canada National Environmental Indicator Series	Indicators of biodiversity and protected areas http://www.ec.gc.ca/soer-ree/English/Indicator_series/new_issues.cfm?issue_id=1&tech_id=1#bio_pic	http://www.ec.gc.ca/soer-ree/English/Indicators/default.cfm
Denmark	Danish Ministry for the Environment	Natur og miljø 1998: Udvalgte indikatorer (Danish only)	http://www.sns.dk/publikat/netpub/naturogm98/forside.htm
Estonia	Estonian National Biodiversity Strategy and Action Plan	Indicators of biodiversity of biocoenoses	http://www.envir.ee/euro/konventsioonid/biodiv.eng.pdf
Finland	Finland's indicators for sustainable development	Description of 20 ecological, economic and socio-cultural indicators, including five biodiversity indicators http://www.vyh.fi/eng/environ/sustdev/indicat/biodiv.htm	http://www.vyh.fi/eng/environ/sustdev/indicat/uhanala.htm
France	Institut français de l'environnement	Environmental performance indicators	http://www.ifen.fr/pages/2indic.htm
Germany	Umwelt-bundesamt	German Environmental Index (DUX)	http://www.umweltbundesamt.de/dux-e/index.htm
Ireland	The National Forest Biodiversity Plan	The Irish National Forest Standard outlines the basic criteria and indicators relating to the national implementation of SFM.	http://www.dcmnr.gov.ie/files/biodiv.doc
Japan	The "New Biodiversity Strategy"	Indicator of human influence on the natural vegetation	http://www.biodic.go.jp/cbd/outline/rev-unedited.pdf
Lithuania	Biodiversity of Lithuania	Indicators showing urbanization, transport, agriculture, forestry impact on biodiversity	http://www.grida.no/enrin/biodiv/biodiv/national/lithau/bp.htm

Organization	Title	Types of information	Address
Nepal	National Biodiversity Unit	Description of main components being assessed by the Ministry of Forests and Soil Conservation	http://www.biodiv-nepal.gov.np/nbuc.html
Netherlands	Netherlands Environmental Assessment Agency – RIVM	Environmental indicators including the Natural Capital Index (NCI) http://arch.rivm.nl/env/int/geo/data_geo3/nci/nci.html (GEO) and http://www.rivm.nl/bibliotheek/rapporten/402001014.html (OECD)	http://www.rivm.nl
New Zealand	Environmental performance indicators	Topics in biodiversity conservation ranging from indigenous vegetation to valued species	http://www.environment.govt.nz/indicators/biodiversity/
Norway	State of the Environment	Indicators for 11 environmental themes including biodiversity, natural and cultural landscapes, forest resources and fish resources with descriptions of the specific trend, pressure, state and response indicators used.	http://www.grida.no/soeno98/index.htm
Sweden	Effects on biodiversity of Sweden's new forest policy	Analysis by the National Board of Forestry and the Swedish Environmental Protection Agency	http://www.svo.se/eng/facts/biodiver.htm
Switzerland	Biodiversity Monitoring Switzerland	Comprehensive description of national biodiversity monitoring system including summary description of all indicators at http://www.biodiversitymonitoring.ch/english/daten/liste.php	http://www.biodiversitymonitoring.ch
United Kingdom	Sustainable Development - the UK Government's approach	This site covers the indicators that have been developed in the United Kingdom both at national, regional and local levels. It also includes links for reference to various key international initiatives and organizations.	http://www.sustainable-development.gov.uk/indicators/index.htm
United Kingdom	UK Biodiversity information group	Various working areas, including best practice and guidance for the establishment of biodiversity indicators, England, Northern Ireland, Scotland, Wales	http://www.ukbap.org.uk/Groups/bi_grp.htm
Vietnam	Sustainable Development in Vietnam: Environment sustainable indicators in Vietnam	List of economic, social and environmental indicators	http://www.sarcs.org/documents/tran%20paper.pdf

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