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RECOMMENDATIONS FOR A CORE SET OF INDICATORS OF BIOLOGICAL DIVERSITY

Background paper prepared by the liaison group on indicators of biological diversity

A CORE SET OF INDICATORS OF BIOLOGICAL DIVERSITY

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1 Background

At its second meeting, the SBSTTA recognized the vital importance of monitoring and assessment of biological diversity, particularly with regard to Article 7 of the Convention, and further recognized that the primary responsibility for undertaking monitoring and assessment of biological diversity lies with individual Parties.

The SBSTTA advocated a two-track approach to assessment and indicator development. In the short term, actual assessment should be carried out of sectors and components of biological diversity which were already reasonably well-known and understood. Use should, in particular, be made of indicators known to be operational. Longer-term programmes involving research and capacity-building should be developed in areas needing advances in knowledge.

The SBSTTA recommended that the Executive Secretary be requested by the Conference of the Parties to produce, in consultation with a liaison or expert group, recommendations for a preliminary core set of indicators of biological diversity, particularly those related to threats.

This advice by the SBSTTA, contained in its recommendation II/1, was endorsed by the Conference of the Parties in decision III/10.

The Executive Secretary participated in the sixth Global Biodiversity Forum : 'Dialogue on Biodiversity Indicators and Implementation Targets', held at UN Headquarters on 3-4 April 1997. Through informal consultations the nucleus of a liaison group on indicators was constituted. It was agreed that the group would assist the Executive Secretary with the preparation of the pre-session documents needed for the consideration by the third meeting of the SBSTTA of the implementation of Article 7.

The liaison group subsequently held a working meeting in Wageningen, The Netherlands from 30 May to 2 June 1997, at the invitation of the Government of the Netherlands. The meeting considered an initial draft of a paper on a core set of indicators of biological diversity. In the course of the meeting the initial draft was discussed in detail and extensively redrafted. The present document represents the consolidation of the component texts drafted and agreed at the Wageningen meeting into a single document. This editing was undertaken by two members of the liaison group.

A synthesis of the present document has been prepared to assist the SBSTTA in its consideration of item 7.3 of the provisional agenda of its third meeting. The synthesis is contained in document UNEP/CBD/SBSTTA/3/9. The liaison group also assisted the Executive Secretary to prepare documents to assist the consideration of items 7.1 and 7.2 of the provisional agenda (documents UNEP/CBD/SBSTTA/3/7 and 8). The report of the meeting of the liaison group is contained in document UNEP/CBD/SBSTTA/3/Inf.11.

2 Introduction

2.1 The aim of this paper

The current paper provides background methodology and some initial proposals for a core set of biodiversity indicators suitable for use under the Convention on Biological Diversity. These indicators have been developed with a view to addressing the following major issues:

- indicators for managing biodiversity at all levels;
- indicators for identifying and monitoring underlying processes and evaluating the effectiveness

of measures taken to conserve biodiversity;

- indicators for identifying additional national capacity needs for implementing the Biodiversity Convention.

The core set of indicators are aimed at three potential users:

- the **Parties** for drawing up their national reports;

- **SBSTTA** for assessing the effects of the types of measures taken;

- the **Secretariat** of the CBD for preparing the *Global Biodiversity Outlook* report.

The core set of indicators should be relevant to the implementation of the three objectives of the Convention. However, this initial paper is, through pressure of time, limited to the first two objectives. It does not claim to provide a conclusive set of indicators; many detailed technical problems still remain to be solved before this can be accomplished.

Establishing indicators is neither an easy nor an entirely objective task, and sometimes value judgements have to be made. To help with understanding the paper, some of the background thoughts underlying the drafting of this document are listed in Appendix 1.

However this document does aim to provide a fairly comprehensive framework to direct Parties in the development of a core set of biodiversity indicators within a fairly short period of time. To help this process, a proposed timetable for action appears in Section 6.

2.2 Scope of the paper

Indicators are needed for monitoring and assessing different issues related to the implementation of the Convention on Biological Diversity.

The Convention text and the COP Decisions II/8 and III/10 explicitly require indicators to be selected or developed and applied, in order to monitor and assess:

- the status and trends of biological diversity and its components (CBD Articles 7(b) and 25(2a), COP Decisions II/8(SBSTTA Recommendation I/3(2 and 4) and III/10(1));

- the causes of biodiversity loss or the effects of processes and categories of activities which have or are likely to have significant adverse impacts on biological diversity (CBD Articles 7(c) and 14(a), and COP Decisions II/8 (SBSTTA Recommendation I/3(2, 2iii, 2vi, 3 and 4) and III/10 (SBSTTA Recommendation II/1(10, 16, 20vii, 22(vi) and 23 (iii));

- the effectiveness of the measures taken (CBD Articles 25(2b) and 26, and COP Decision II/8 (SBSTTA Recommendation I/3(4)).

More specifically, the COP has decided that a core set of indicators be developed and applied for a number of reasons:

- for National Reporting (Decision III/10 (SBSTTA Recommendation II/1(7, 18, 20(v) and 21)));

- in the Thematic Areas of the Convention (Decision III/10 (SBSTTA II/1 (12, 13, 14, 20(vi), 21

and 22(ii))); and

- through a two-track approach (Decision III/10 (SBSTTA Recommendation II/1 (9 and 19))).

These initiatives should in principle be applied in a holistic manner to all three objectives of the Convention (Decision I/xx), taking into account the three levels of biological organization and utilizing the ecosystem approach as the primary framework of action (Decision II/8 (1)). However, decision III/10 of COP urged Parties to identify indicators of biological diversity and to develop innovative methods for implementing Article 7 as a high priority. It also requested the Executive Secretary to produce for consideration of the next SBSTTA, and in consultation with a liaison or expert group, recommendations for a preliminary core set of indicators of biological diversity, particularly those related to threats (SBSTTA Recommendation II/1(23iii)).

It is proposed, therefore, that the *first track for immediate implementation* considers existing and tested indicators of state and pressure related to the conservation of biological diversity and to the sustainable use of its components. The *second track for longer term implementation* of biodiversity indicators should consider the identification, development and testing of response indicators for the three objectives of the Convention, along with state and pressure indicators of the sharing of benefits. The second track indicator should also aim at further improvement of the state and pressure indicators for the first two objectives of the Convention.

Box 1: Types of indicators proposed for the first track approach to indicators identification and implementation

Indicator types Objectives of CBD	Status and trends (State)	Processes of threat (Pressure)	Effectiveness of measures (Response)
Conservation of biological diversity			
Sustainable use of its components			
Fair and equitable sharing of benefits			

	First track		Second track

Such an arrangement should provide an optimum assessment of the status and trends of components of biological diversity, including both those components under threat and those components that might become threatened, along with negative trends on a national and international scale and identification of the main causes of biodiversity loss (COP Decision II/8).

The exercise should promote an enhanced public awareness of biodiversity loss and should also provide Parties with the means to produce a more focused set of priorities for action.

2.3 Key questions that a core set indicators might help answer

Many indicators already exist, on a variety of scales and for a range of different purposes. Some have specific scientific objectives while others are policy or management oriented. Within the framework of the CBD the current exercise aims to create a small, core set of universally applicable, quantitative indicators which allow the aggregation of local or national information for the purposes of regional or global comparison. The core set should answer a set of critical questions from the major topics listed

above. In the following section, some of the questions addressed by the core set are listed, along with the relevant Articles of the CBD.

A) Related to state

- **Initial questions (first track)**:
  - question a: How much is the status of biodiversity improving or declining as a result of human activities? (articles 7 and 25);
  - question b: How much landscape diversity and natural habitat is being lost? (articles 7 and 8);
  - question c: How much ecosystem diversity (quality) is being lost? (articles 7 and 8);
  - question d: How many globally or regionally unique populations, species and habitats are at risk of extinction? (article 7, 8 and 9).
- **Other questions (second track)**:
  - question e: How much are the biodiversity-mediated ecosystem functions improving or declining as a result of human activities? (articles 3, 7, 8, 10 and 14);
  - question f: How much are the biodiversity-mediated risks and impacts associated with natural and anthropogenic disasters increasing or decreasing as a result of human activities? (articles 3, 7, 9, 10, 14, 16 and 19);
  - question g: How much are the pools/stocks and fluxes (use and restoration) of valuable biodiversity components increasing or decreasing? (articles 7, 9 and 10);
  - question h: How differently are the diverse levels and components of biodiversity responding to the same key anthropogenic pressures? (articles 7, 10 and 14).

B) Related to pressure

- **Initial questions (first track)**:
  - question i: What anthropogenic processes have the greatest influence on the current and near future status of biodiversity? (articles 3, 7, 8, 10, 11, 14, 15, 16 and 19).
- **Other questions (second track)**:
  - question j: How has human pressure on biodiversity changed,has occurred and how much is it likely to change in the near future? (articles 6, 7, 10 and 14);
  - question k: Which social and economic root causes are most responsible for the observed changes in human threats to biodiversity? (articles 3, 6, 7, 13 and 14).

C) Related to response: C1) Capacity

- **Initial questions (first track)**:

- question l: How much capacity is available to implement the Convention? (articles 6, 11, 12, 14, 16, 17, 18, 19 and 20);

- question m: How much financial support and how many incentives are currently being provided by Parties to implement their commitments under the CBD?; (articles 11 and 20);

- question n: How much new and additional financial resources ares currently being provided by developed country Parties to developing country Parties? (articles 11 and 20);

- question o: What additional means are still needed to address the threats? (articles 6, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19 and 20).

- **Other questions (second track)**:

  - question p: How much is scientific and traditional knowledge of biodiversity increasing or decreasing? (articles 7, 8j, 10, 12, 17 and 18);

  - question q: To what extent is technology relevant to biodiversity conservation and sustainable resource use currently available to or being transferred to Parties? (articles 5, 16, 17, 18 and 20);

  - question r: How much cooperation between Parties is currently taking place to promote and facilitate the implementation of the Convention? (articles 5, 8, 9, 12, 13, 14, 15, 16, 17, 18, 19, 20);

  - question s: How much exchange of information is currently taking place? (articles 13, 14, 15, 16, 17, 18 and 19);

  - question t: How much capability is available for analysis of trade-offs between different management options to address the threats? (articles 3, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16 and 19).

C2) Effectiveness of measures

- **Initial questions (first track)**:

  - question u: How much has been done to address the threats to biodiversity? (articles 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 and 20);

  - question v: How effective are the measures taken to implement the Convention? (articles 3, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19 and 20).

- **Other questions (second track)**:

  - question w: How effective are the current efforts at *in situ* and *ex situ* conservation to maintain or restore diversity at the population, species and ecosystem levels? (articles 1, 3, 6, 8 and 9);

  - question x: How sustainable are the major harvesting systems/methods currently used in reference to biodiversity maintenance? (articles 1 and 10);

- question y: How much are the values attributed to biodiversity and its components increasing or decreasing? (articles 7, 13 and 15);

- question z: How fair are the current sharing of benefits associated with genetic resources use? (articles 1, 9, 15 and 17);

- question zz: How much access to genetic resources is currently avoidable, and how much is done with the prior informed consent of the source Party? (articles 5, 6, 9, 15 and 18).

In summary, these various questions address four major concerns regarding biodiversity:

- what is changing;

- why is it changing;

- why is it important; and

- what can be done about it?

The major challenge in the long term is to establish a highly aggregated Natural Capital Index next to the current Social Capital Indices and Economic Capital Indices to assure appropriate information in the national and supra-national decision-making process aiming at sustainable development. The establishment a core set of feasible and useful biodiversity indicators should be seen as a first step in this process. A similar process has been already evolved with respect to the establishment and harmonization of economic and social indicators over the last decades.

3. Why do we need a core set of indicators?

A core set of indicators is needed to address the three major topics and related key questions mentioned in section 2. Indicators are essential for effective management. In turn, effective management systems need three basic elements:

- Verifiable targets;

- Timely and sufficient knowledge about the current and projected state and a test to the objectives;

- Measures for making corrections.

If one element is lacking, rational and effective management is impeded. Indicators link the fields of policy making and science:

- policy makers set the targets and measures (elements 1 and 3);

- scientists determine relevant biodiversity variables, monitor current state, determine baselines and develop models to make projections of the likely future state given a range of possible policy options (element 2).

If chosen carefully, indicators can give direction to the monitoring and research programmes. Therefore, the choice of a core set of indicators should be a cooperative exercise between policy makers and scientists.

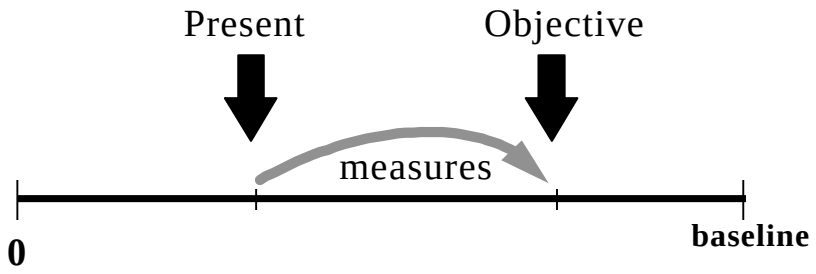


Figure 1: Indicators link monitoring, research and policy making.

- Scientists and policy makers work together to select a set of significant indicators from ecological and social perspectives.
- Subsequently, policy makers choose an appropriate baseline and set targets.
- Scientists the establish a monitoring programme, determine both the present and baseline states, and develop dose-effect relationships (models).

4. Biodiversity Indicators: definitions, hierarchies and frameworks

4.1 User definitions: tools for communicating properly

The following section provides some basic definitions which will help with understanding the rest of the paper.

Biodiversity indicators are information tools. They summarise data on complex and sometimes conflicting environmental issues to indicate the overall status and trends of biodiversity. In the context of implementation reports, they can be used to assess national performance and to signal key issues to be addressed through policy interventions and other actions.

Benchmarks include *thresholds*, *baselines* and *targets* provide reference points to lend political weight to data and are therefore a critical component of indicators. These are discussed below.

Indicators have been defined as quantitative measures which "imply a metric (i.e. distance from a goal, target, threshold, benchmark, etc.) against which some aspects of policy performance can be measured". It is the use of reference points, such as targets or benchmarks, that distinguish indicators from statistics. Use of a reference point allows the reader to gauge the significance of the statistic e.g. "the extent to which an objective is met" (see below).

Successful indicators:

- quantify information so that its significance is apparent;
- simplify information in order to help communicate complex phenomena;;
- are user-driven (ie summarise information of interest to the intended audience); and

- are policy relevant (in that they help guide decision making).

They should also be scientifically credible, responsive to changes in time and/or space, and be easily understood by the target audience. Presentation is an important aspect of communication; depending on the type of information to be conveyed, indicators can be represented as numbers within a text or table, as graphics, and as maps.

Box 2: Assessment methods and corresponding baselines

Figures on biodiversity (statistics) have no meaning without being placed into context. For example,, saying that there are currently a thousand dolphins in a particular sea area has very limited usefulness without an idea of the original population, the size of the sea, the nature of current threats etc. The type of reference and baseline determines the category of meaning (ie the so-called "policy signal"). For example, if the natural baseline state is a population of 9000-15000 dolphins, this tells us that only around 10 per cent of the original population is left. The "anthropogenic factor" is 90 per cent, with the population still being heavily deteriorated presumably by a combination of pollution, depletion of major fish stocks and drowning in fish nets.

However, there are a number of other possible measures to guide decision making.

1 *The year of ratification of the Convention could be another baseline. If this were, for example, 500 dolphins it would show that the population has doubled from a historical low, thus suggesting that policy makers may have done a good job in creating right conditions for increased survival. (However, as a result some groups such as fisherman might be concerned about the increase and propose, for example, to limit the population to 500.)*

2 *The minimum genetically viable population size could be another baseline. If this were set at, say, 500 dolphins, the thousand-strong population would be 100 above the critical level.*

3 *The Red List criterion is a fourth possible baseline. Say this were 750 dolphins it would mean that the dolphin could now be taken off the Red List, amidst congratulations for a great job done in dolphin conservation.*

4 *The number of endemic species can also be used as a slightly different baseline. In this case, suppose that the dolphin were not an endemic species. The population of a thousand dolphins is fine, but not particularly relevant because, even if they were to be extirpated, this would not affect the number of endemic species.*

5 *The species richness of mammals has also sometimes been used as a baseline. In the current example this would mean that the dolphin population of a thousand was fine, although again of little significance. Even if dolphins were extirpated it would not necessarily effect the species richness indicator if, for example, an alien seal species appears which compensates for the loss. Moreover, the species richness indicator is only affected when the population is zero.*

If no baseline is determined, policy-makers are reliant on guesswork and judgement. A thousand dolphins seems to be a lot, and the population appears to growing. Some people like fisherman state that they have become a plague which needs to be controlled. Others

believe that a thousand dolphins is not much at all and the population should increase up to several thousands to restore a healthy and balanced marine ecosystem.

Reference points (benchmarks, thresholds, targets): provide a means for distinguishing significant events that require policy attention, and for monitoring policy performance. They can be used in a variety of ways:

- **Baselines** are 'starting points", and can be used, for example, to measure change from a certain date or state. An example would be the For extent to which an ecosystem deviates from the natural state. Imagine that Country X enacted in 1996, as part of its National Biodiversity Strategy, the goal of "no net wetlands loss". The baseline for measuring policy performance would be total extent of wetlands, in hectares, as of 1996. One biodiversity indicator for measuring performance would be total areas in some future year as a percentage of that found in 1996.

- **Thresholds** are especially useful in developing indicators that serve an 'early warning' function - ie providing a signal that a problem requiring policy intervention is at hand. Thresholds may be formalised within laws and regulations, or be based on scientific consensus. For example, international and national agencies charged with monitoring capture fisheries use population number thresholds for assessing the status of fish stocks. One indicator of the status of a country's capture fisheries is the percentage of stocks that are "overfished".

- **Targets** often reflect tangible performance objectives, developed through policy-planning processes. For example, a country has established a target of protecting at least 5% of each ecosystem type. One indicator for measuring performance would be percent of total ecosystem type protected, relative to the 5% target. Another example is the restoration of specific species populations to a particular level. Targets include both those that measure pressure, state, response (whether mechanisms and actions have been put into place) and capacity (whether resources are available to do the job). The choice of baseline highly determines the meaning of the indicator value, as is shown in Appendix 2.

Assessment: the analysis of the gap between the current state and a reference state. The reference state might be for example a targeted state, a threshold value, or a particular baseline state. The analysis is a scientific activity, while the choice of the reference a subjective (political) activity.

Assessment frameworks: provide a systematic structure for organising indicators so that, collectively, they paint a broad picture of the status of biodiversity.

Pressure-State-Response assessment framework: an analytical framework which considers different stages in the causal chain:

- *Pressures* are the socio-economic factors or driving forces which affects biological diversity;

- *State* is the state of biological diversity as such;

- *Responses* are the measures which are taken in order to change the current of projected state.

Inventorying: determination of the present biodiversity at genetic, species and/or ecosystem level in a specific area.

Monitoring: periodic and standardised measurement of a limited and particular set of biodiversity variables in specific sample areas.

Biodiversity: the variability among living organisms from all sources including, *inter alia*, terrestrial marine, and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.

Biodiversity loss: the human caused biodiversity decrease relative to a particular baseline. Actually, biodiversity loss is usually a net figure resulting from a decrease of abundance and distribution of many species and the increase of a smaller number of other species.

Capacity: all human resources, expertise and institutional, legislative and financial means available to implement the CBD Index. This is usually a ratio between two values of the same variable, resulting in a factor without units. Two or more indicators with different units are usually aggregated by converting them first into similar ratios. Examples include distance to target, distance to baseline, or annual change

Data & statistics: raw data as a result of monitoring single variables, and statistical characteristics on trends, spatial distribution etc.

4.2 Hierarchies for organising indicators and proposed assessment framework

There are many ways of organising indicators, e.g.:

- CBD objectives: biodiversity conservation, sustainable use and benefit sharing (objective);
- by article of the CBD (issue) including
  - human made and self-regenerating ecosystems (different human function),
  - wild and domestic species (natural/artificial),
  - pressure, state, response (causal chain),
  - genes, species and ecosystems (level),
  - terrestrial and aquatic (media),
  - national and supra-national (spatial),
  - ecosystem type (e.g. vegetation types),
  - bio-geographical and geopolitical boundaries (spatial).

In this paper the objectives and articles of the Convention of Biological Diversity have been used as the main guiding principle. The pressure-state-response (PSR) framework is proposed in this draft as a useful and widely-accepted indicator framework in which the indicators for the Convention can be subdivided.

Although some indicators are used simply as a comparison over time (for example, the Dow Jones Index and the Price Index), biological indicators are far more effective if they are also measured against a baseline.
Setting such a baseline is a complex and often relatively arbitrary process. As shown in Appendix 2,

there are many alternative baselines possible. Each alternative generates different result and different policy information.

The working group recognised four relevant options for setting the baseline for the core set:

- at the time of the CBD's final agreement;
- before any human interference;
- before major interference by industrial society;
- as an agreed set of characteristics representing a similar cultural landscape with high biodiversity.

Parties may choose one or more of these options. Measurement against the conditions at the time of the ratification of the CBD is likely to be an attractive alternative as it is mentioned in existing CBD agreements. However, *only* using this baseline would raise some important questions: for example how should a change since 1993 be assessed as positive or negative, without a theoretical optimal baseline (see Box 2). Furthermore, assessing biodiversity only to its condition in 1993 would be perceived as a bias towards the developed countries, because these have been already achieved a high level of socio-economic development partly at the expense of their original biodiversity. Using the state before any human interference would be more appropriate in this respect but appears to be unfeasible because of lack of information.

Since there is no unambiguous natural baseline point in history, and all ecosystems are also transitory by nature, a baseline must be established at an arbitrary but practical point in time. Because it makes most sense to show the biodiversity change when the human influence was accelerating rapidly *a postulated baseline, set in pre-industrialised times*, referred to in short as the *postulated baseline* appears to be more appropriate (see Appendix 2).

A particular problem relates to the distinction between intensively managed, human-created areas and self-regenerating, possibly extensively-managed areas. Comparing for example an area of farmland with the original forest, savannah or wetland system it replaced is of little value, in that it will simply show that the majority of the original biodiversity has disappeared and not provide a very sensitive baseline for future changes. However, agricultural or other man-made ecosystems are sometimes highly valued because of their culture-historic values, landscape, and species richness, even if these are not all original species.

The above raises some important questions:

- the need to aggregate the state of biodiversity between countries up to the regional and global levels, and therefore to have an agreed and more scientifically-coherent baseline, in particular with respect to the core set of indicators;
- the importance of equality between countries and therefore of not setting baselines that favour some Parties over others;
- the need for baselines which take account of the particular biodiversity values in agricultural landscapes and other man-made habitats.

Bearing this in mind, it is suggested that in agricultural areas the usual pre-industrial baseline is interpreted as a *pre-industrial agricultural baseline* rather than being compared to the original

vegetation.

Habitat type	CBD agreement	Postulated baseline
grassland	1993	pre-industrial baseline
intensively-managed agricultural systems	1993	traditional, pre-industrial agriculture
tropical moist forest	1993	pre-industrial baseline
temperate and boreal forest	1993	pre-industrial baseline
tundra	1993	pre-industrial baseline
desert and semi-desert	1993	pre-industrial baseline
coastal marine	1993	pre-industrial baseline
freshwater	1993	pre-industrial baseline

4.3. The postulated baseline is no target

The postulated baseline for self-regenerating or man-made areas is not necessarily the desired state. Some degree of deviation from the postulated baseline is inevitable, or in many cases even desirable, from a socio-economic point of view. This is acknowledged by the UN Convention in the second main goal. Moreover, not every deviation from the postulated baseline is experienced as loss of biodiversity. Therefore, *in most cases, the policy objectives will not necessarily imply restoring the baseline state.* In practice, implicitly or explicitly, governments choose their objectives for biological diversity somewhere along the axis between zero (ecosystem completely deteriorated) and the baseline, depending on their interests in exploiting or converting an ecosystem and conserving biodiversity.

This implies a balancing act between economic, social and ecological values (see Appendix 2). Scientific research can support the decision-making process by providing information about the risks and degree of sustainability of different policy options.

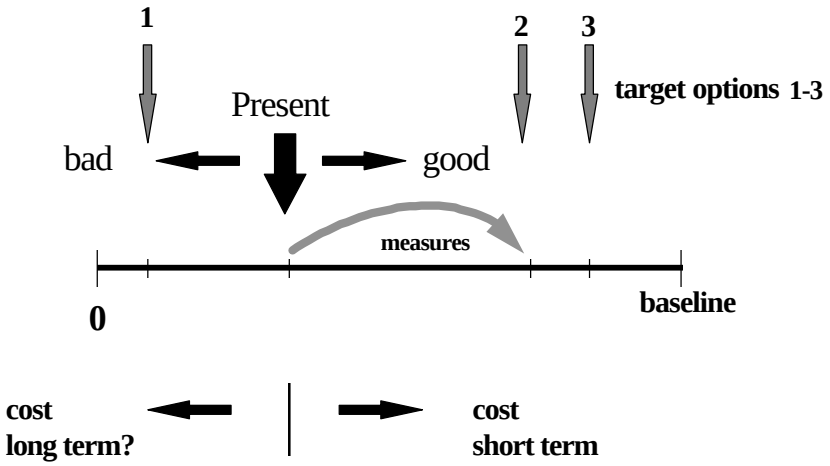


Figure 2:. Governments choose ecological objectives somewhere along the axis between zero and the postulated baseline state. This involves balancing socio-economic and ecological values.

Comparison of the current biodiversity state with the postulated baseline and policy objectives provides meaningful information for policy makers on:

- the state of biodiversity as such (respectively "anthropogenic change" in self-regenerating areas and species-richness in man-made areas, irrespective of whether the species are native or introduced)

- whether the state of biodiversity meets the policy objectives

5. Towards a core set of indicators

5.1 A core set of universal state indicators

In this chapter four sets of indicators will be elaborated: *state*, *pressure*, *use* and *response*. The proposed indicators are divided in 1st track and 2nd track indicators, thus providing an estimation of whether they could be applied in the short term or middle-long term. Ten criteria have been used to help choose indicators; these are listed in Appendix 4.

This section addresses a series of questions:

- question a: How much is the status of biodiversity improving or declining as a result of human activities? (articles 7 and 25)

- question b: How much landscape diversity and natural habitat is being lost? (articles 7 and 8)

- question c: How much ecosystem diversity (quality) is being lost? (articles 7 and 8)

- question d: How many globally or regionally unique populations, species and habitats are at risk of extinction? (article 7, 8 and 9)

The biggest challenge is how to deal with the almost infinite heterogeneity of the world's ecosystems and still meet the requirement of a limited number of universally applicable indicators.

To meet this, the following core set of 3 complementary, universal indicators has been proposed:

- i) ecosystem quantity;

- ii) ecosystem quality; and

- iii) the relative number of threatened and extinct species.

Together these provide a picture of the state of biological diversity.

5.1.1 Ecosystem quantity

This indicator provides an impression of the biodiversity losses or gains at the ecosystem level as a result of major causes: for example habitat loss by entire conversion and fragmentation for urban use, cropland, pasture for permanent livestock, infrastructure and industry. A specification for self-regenerating and man-made ecosystems is proposed in Appendix 3.

Several sub-indicators are proposed to capture the loss or gain and the fragmentation of the habitat.

- 1st track indicators:
  - 1a. Self-regenerating and man-made area as percentage of total area (units: percentage self-regenerating & percentage man-made area of total area).
- 2nd track indicators:
  - 1b. Self-regenerating area per habitat type as a percentage of the 1993 level and of postulated baseline set in pre-industrial times (units: percentage of self-regenerating habitat against 1993 level and the pre-industrial baseline);
  - 1c. Remaining self-regenerating area by size class category.

The proposed habitat types of indicator 1b are listed in Box 4. Indicator 1c would present the percentage distribution of remaining self-regenerating area found in blocks of habitat: 100-1,000 hectares, 1,000-10,000 hectares, 10,000-100,000 hectares, 100,000- 1 million hectares and over 1 million hectares. The last three size categories correspond roughly to minimum habitat requirements for maintaining viable populations of medium and large umbrella species, based on a partial literature review.

Box 3: Major habitat types

The remaining area per habitat type provides information on the loss of specific habitats. For the core set of indicators, the number of categories should be strictly limited - to no more than 10-20, to keep information simple and communicable to policy makers. Furthermore, the habitats types must be universally applicable to enable regional and global overviews. However, individual countries may choose to have much more specific habitat types to increase accuracy of national results. The starting point is the habitat types which are already identified by the CBD:

- *marine & coastal regions*
- *forests*
  - *temperate mixed and broadleaf forests*
  - *tropical wet forests*
  - *tropical dry forests*
  - *temperate needle leaf forests and boreal forests*
- *freshwater*
- *tundra*
- *desert and semi-desert*
- *grassland*
- *agricultural land*

The quantity of ecosystems does not, however, provide an impression of the state of the biological diversity within these areas: the *ecosystem quality*. Therefore indicator 2 is added.

5.1.2 Ecosystem quality (units: percentage of postulated baseline) This indicator measures the state of biological diversity within the areas relative to the expected state (postulated baseline). The Parties may develop an index that captured the quality by factoring in one or more variables that measure:

- i) species abundance and/or distribution (evenness),
- ii) species-richness,
- iii) ecosystem structure and complexity.

This indicator provide an average quality of areas as a percentage of the postulated baseline. The unit (0-100 per cent quality) makes this indicator simple to understand for policy makers and universally applicable (ie suitable for terrestrial and aquatic systems) and enables regional and global aggregation for overviews. The indicator is determined by the average quality of a representative set of underlying ecosystem-specific quality variables.

Species abundance related to the postulated baseline (evenness)
A valid measure of ecosystem diversity must be based on an unbiased, ecologically-meaningful subset of species, including not only dominant but also rare species, and should consider the different abundance of the species included relative to the postulated baseline (see for other criteria Appendix 4.

Human-caused changes in ecosystems generally result in a decrease of population sizes of many species, and an increase in populations of a few others. Both increases and decreases in comparison to the postulated baseline are significant and are sensitive measures for changes in the state of the biodiversity in a country, region or for a global comparison.

Species richness related to the postulated baseline
Species richness refers to the total number of a specific taxonomic group, or guilds of functional groups, associated with key ecosystem functions per site.

- 1st track quality variables for both species abundance and species-richness:
  - 2a. Distribution or abundance of a few selected species as the percentage of the postulated baseline per country (region, global);
  - 2b. Number of indigenous species of one or more selected groups as the percentage of the postulated baseline per country (region, global).

    Note: this could be all kinds of species, particularly those which are interesting from an ecological or socio-economic point of view such as game species, tree species, major fish stocks, whales, small cetaceans etc. It is recommended that the choice be harmonised as much as possible with the information needed in other conventions (see also 10 criteria for choosing indicators in Appendix 4).
- 2nd track quality variables:
  - 2c. As 2a and 2b, but an extended list of selected species, chosen both to illustrate species abundance and species-richness, thus providing a more detailed and representative picture of the change in biodiversity per country (region or global).

Ecosystem structure, complexity, heterogeneity related to the postulated baseline
Ecosystem structure variables are most promising because they can offer a lot of information on the state of ecosystems over large areas for relatively low effort. Many aspects of quality can be captured by identifying key-ecosystem structure variables which can indicate if the ecosystem is functioning correctly or not. For example, a crude measure of quality might be the total number of well-specified

habitat types observed within a sample area(s) relative to the postulated baseline number. Depending on the area and the available capacity they might be both 1st track and 2nd track measures. Remote sensing techniques will play a major role in this category.

- Possible 1st and 2nd track quality variables:
  - 2d. Various quality variables as the percentage of postulated baseline, for example:
    - examination of the structure of temperate needleleaf and boreal forests to capture old-growth characteristics and therefore a complete natural life-cycle;
    - the ratio between dead and living wood;
    - the percentage area of intact canopy cover;
    - the percentage area of intact understorey;
    - the percentage area of bio-reserve and primary forest;
    - the percentage area of sustainably managed forest;
    - the percentage area of secondary forest;
    - the percentage area of degraded forest;
    - the percentage area of tree plantation with and without endemics;
    - the percentage of major habitat qualifying as wilderness (self-regenerating terrestrial, freshwater and coastal ecosystems more than 20 km of a road, railroad or other point of access);
    - identification of remaining flood-plain characteristics from satellite images to show distribution of natural river systems;
    - the number of well defined habitat types as an indicator of agricultural diversity related to the postulated baseline (traditional agricultural ecosystems);
    - the percentage area of natural patches < 100 ha. in agricultural habitat;
    - the percentage area of vital reefs, mangrove and/or sea grass coverage in marine ecosystems

There are various characteristics related to species and ecosystem structure, abundance and distribution which might be characterised through a series of surrogate measures which, by comparing observed versus expected results in a range (but unavoidably limited number) of sample points, can indicate relative state of different major habitat types.

Each region can chose its own, appropriate, bio-geographic or ecosystem-specific and standardised core set of quality variables. The core set can be gradually established by starting with a basic set of easily affordable measurable quality variables, providing a rough picture of the overall national or regional

biodiversity state. Over time, new variables may be added or old ones replaced by better ones building up a more precise core set, providing a more accurate picture of the overall biodiversity.

When variables are added or adjusted, previous results of biodiversity assessments should be adapted simultaneously to avoid artificial discontinuities in trends.

The aim is to allow maximum national and regional flexibility in the choice and gradual development of the quality variables, with the eventual aim of crating an overall average *ecosystem quality index*.

Current monitored quality variables can be fitted into the core set. In addition to ecosystem quantity, ecosystem quality provides a general impression of the overall biodiversity losses or gains over time at the species or ecosystem level due to pressures other then habitat loss: over-exploitation, pollution, fragmentation, climate change and the introduction of exotic species.

However, this indicator does not provide detailed information on specific threatened species or ecosystem types for which political action is urgent. Therefore, indicator 3 is added.

5.1.3 Threatened and extinct species and habitat types

Article 8 (f) requires parties to "rehabilitate and restore degraded ecosystems and promote the recovery of threatened species..." Annex I identifies threatened species as a component of biodiversity to be monitored pursuant to the development of national strategies. Species and ecosystems categorised as threatened according to definitions relevant to the CBD will indicate a trend in biodiversity degradation and loss. The Convention does not provide a definition of threats, but through its Decision III/10 which endorsed SBSTTA recommendation II/I, indicated its general support for the proposed framework of processes and categories of activities that have or are likely to have significant adverse impacts on biological diversity as set out in paragraphs 39-41 of document UNEP/CBD/SBSTTA/2/3 and amended in paragraph 16 of SBSTTA recommendation II/I.

The IUCN Red List of Threatened Species, although not intended specifically for this use, provides useful definitions of specific categories of threat (see document UNEP/CBD/COP/XX/XXX). It also provides an important set of data concerning species falling under the specific categories of threat. This is not exhaustive for all categories, and contains significant gaps. For example, while the list of birds is relatively thorough, invertebrate and plant species listings are currently inadequate for use as biodiversity indicators. Even where assessment is more or less complete, as in the case of birds, care has to be taken in using changes in listing through time as the basis for indicator development. This is because such changes are as likely to be the result of improving knowledge or taxonomic changes as they are the result of changes in conservation status. Application of the criteria to species at the national level, for selected species for which surveys are adequate, will produce a useful core state indicator.

It is recommended that the Secretariat request additional information from IUCN on the calibration of categories of threat at the national level as biodiversity indicators.

- 1st track indicators:

  - 3a. Number of threatened and extinct species as he percentage of particular considered group per country (region or global);

    Number of threatened habitats as the percentage of the total per country (region or global).

- 2nd track indicators:
  - 3b. As 3a, but with an extended number of species groups;

Similar categories of threat are under development for habitats. The CBD Secretariat is recommended to seek additional guidance from relevant authorities for the application of categories of threat to habitats for use by countries. It is suggested that the number of habitat types be kept fairly small (10-20), see also Box 3.

Natural Capital Index

To facilitate communication, and to assure that natural capital can be incorporated into national accounts, it is recommended that a national index of natural capital (NCI) be used by each Party. The index would use a few or one single figure to express an aggregation of multiple "state" indicators. NCI is the product of quantity and quality of ecosystems, expressed by percentage (0-100 per cent), where quantity is expressed as percentage remaining area and quality is expressed as the average of many quality variables as percentage of the postulated baseline (see Figure 3).

NCI could be seen as the functional equivalent of Economic and Social Capital Indices used by UN and Bretton Woods institutions and by individual countries. This is an inspiring but nevertheless long term goal.

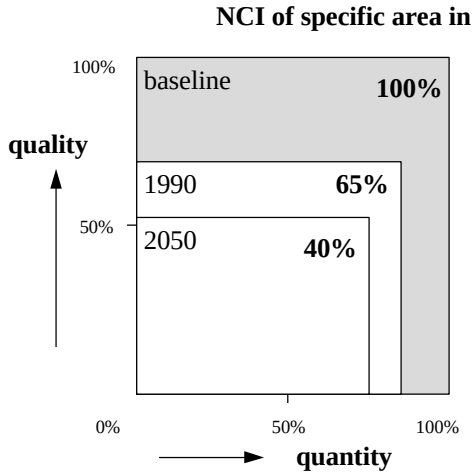


Figure 3: An illustration of the ecosystem quantity and ecosystem quality indicator combined in a Natural Capital Index.

This fictitious NCI is given for the postulated baseline, 1990 and a possible scenario for 2050. NCI can be worked out on every spatial scale. NCI would be expressed differently for man-made (for example agricultural) and self-regenerating (unused or extensively used) ecosystems for they have different baselines. If both NCIs are aggregated to one overall national, regional or global NCI, man-made ecosystems should be weighted by a factor of for example 0.5, 0.2 or 0.1 to express the difference between the two (see Figure 4).

Although the different figures could be combined, their aggregate total will not

exceed 100.

NCI would be expressed as:

- 2nd track indicators:
- 4a. NCI self-regenerating = percentage area x percentage quality;
- 4b. NCI human-made = percentage area x percentage quality.

Ecosystem quantity (indicator 1) can be calculated with relative precision on the basis of maps and spatial data derived from remote sensing.

Ecosystem quality (indicator 2) should be determined on the basis of the core set of quality variables measured in sample areas (see Figure 5).

A limited set of variables is drawn from the ecosystem-specific quality variables described in Section 5.1. The numeric value expressed as "percentage quality" is calculated by extrapolating the average quality per sample area for the whole country, which is common practice in the fields of economic and social assessments. Reducing the monitoring effort through use of a core set of indicators and a limited number of sample areas is a prerequisite to establishing a feasible and affordable assessment framework.

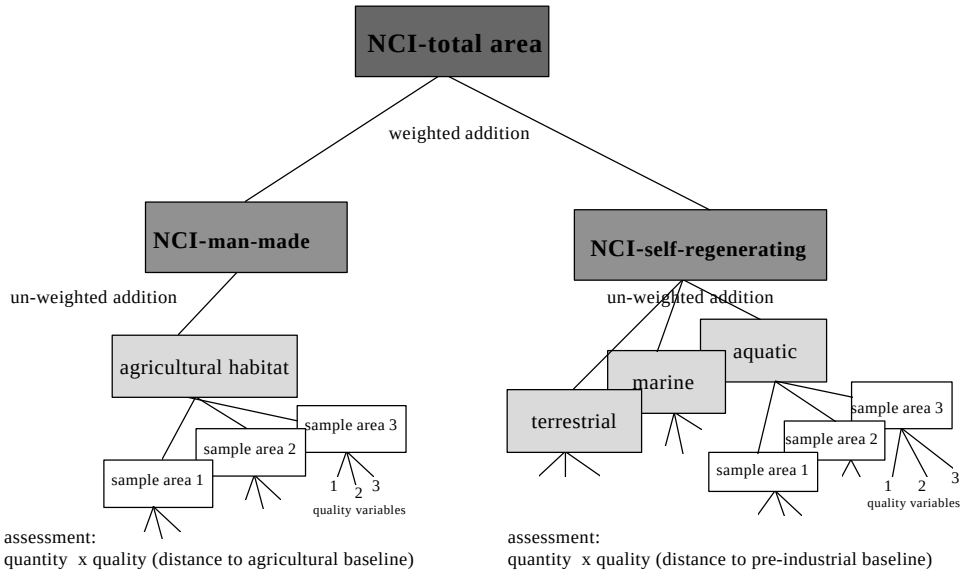
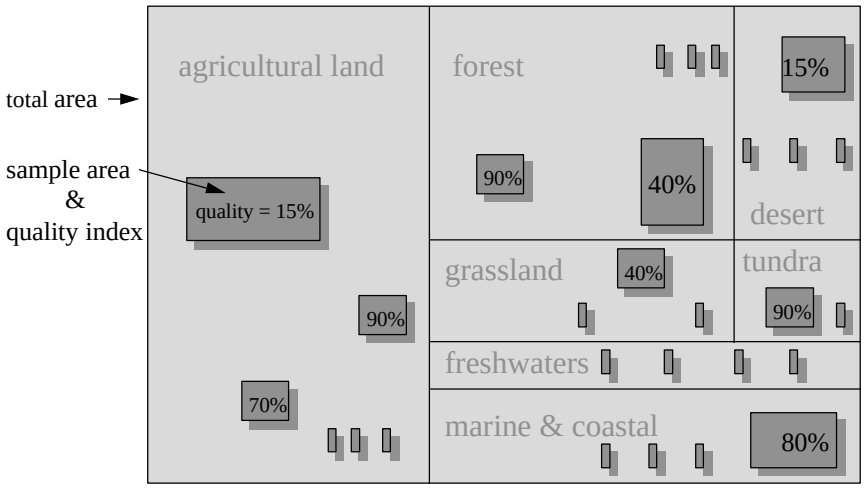


Figure 4: Natural Capital Index consists of two components: NCI self-regenerating and NCI man-made. They cannot be simply added because of their different character.

The NCI method could also be aggregated by habitat type to provide information on share of natural capital of a given habitat held by a particular state.It is recommended that the Secretariat explore the possibility of co-operation with bodies with relevant expertise, such as the World Bank, UNEP and IUCN to further elaborate and test a methodology as a pilot project.



NCI = quantity x quality

Figure 5: Schematic division of the considered area into habitat types, their relative area, sample areas (dark-grey areas), and the ecosystem quality index for some sample areas. ***Note****: The ecosystem quality index per habitat type is determined by extrapolating the ecosystem quality indices of its sample areas.*

5.2 A core set of universal pressure indicators

This section relates to the key question: question i: What anthropogenic processes are most affecting the current and near-future status of biodiversity? (articles 3, 7, 8, 10, 11, 14, 15, 16 and 19)

Five types of pressure indicators are proposed for this purpose. These correspond to those primary, direct threats most frequently cited in the literature as contributing to biodiversity loss:

- habitat loss;
- overharvesting;
- species introductions;
- pollution; and
- potential climate change.

On the middle term the pressure indicators should be related to pressure classes on biodiversity at risk and they could eventually be aggregated to an overall pressure indicator per country, region or global.

5.2.1 Habitat loss

- 1st track indicators:
  - 5a. Annual conversion of self-generating area and by habitat type as the percentage of the remaining area per country (region and global)
  - 5b. Annual land use change from self-regenerating area into agriculture, permanent pasture and built-up land in hectares per country (region and global) *Note*: this indicator is a first derivative from indicator 1. From this figure, it is impossible to

conclude unambiguously which factors or sectors cause loss of habitat. For this a more detailed analysis is needed, which could be a narrative supplement to the indicator.

- 5c. Share of riversheds dammed or channelized as the percent of the whole river per country (region and global).

  Note: this indicator can be used to assess the degree to which riverine habitats have been modified through damming, channelization and other activities. Although strictly speaking a measure of ecosystem condition, it can be used as a surrogate pressure indicator. The Sierra Club analysis of "wild rivers" within northern regions - these areas defined on the basis of absence of dams and decision rules on distance from roads and settlements - provides one example of its application. Data for such an indicator can be readily derived from land cover maps.

- 5d. Percent of coastal zone with a population density exceeding 100 inhabitants/km2;

- 5e. Percent of coastal zone within 30 km of a town or city > 100.000 inhabitants.

  Note: these two indicators provide a surrogate measure of pressures on coastal habitats, from a range of anthropogenic sources (habitat modification, over-harvest and pollution).

- 2nd track indicators: Several indices exist for gagging potential pressures on terrestrial and aquatic ecosystems. They incorporate a range of region-specific variables and decision rules.

Finally these pressure variables should together provide an accurate, aggregated pressure indicator for the degree to which biodiversity is "at risk" given existing infrastructure, population density, pollution, disturbance, exploitation, agricultural practices and other socio-economic, land use and demographic patterns.

5.2.2. Harvest

- 1st track Indicators:

  - 6b. Total amount harvested per unit effort (tons per unit effort, over time).

- 2nd track indicators:

  - 6c. Total amount harvested relative to estimate of sustainable off-take levels;

  - 6d. Average size/weight/age per unit of off-take of a given species relative to a baseline year;

  - 6e. Amount of agricultural area lost in 10 years due to erosion as percentage of agricultural area brought into agriculture in the same period, per country (region, global).

  Note: Ideally, indicators would show the relationship between current harvest levels and long term sustainability of the resource. Because maximum sustainable yield levels are still studied, many indicators belong to the 2nd track. Unfortunately, many of the current measuring systems are related more to maintaining a harvest than assessing impacts on biodiversity. Harvest level

and maximum sustained yield are therefore fairly coarse and partial indicators from the perspective of the CBD.

5.2.3 Species introductions

- 1st track indicators:
  - 7a. Total number of non-indigenous species as a percentage of a particular group per country (region, global).
- 2nd track indicators:
  - 7b. Relative abundance/biomass of non-indigenous species as a percentage of a particular group per country (region, global).

    Note: Indicators should track both introductions and spread of non-indigenous species (species number), as well as the relative abundance of populations of these species relative to native flora and fauna.

5.2.4 Pollution

Few countries collect comprehensive data on the state and loads of air, soil and water pollution which could be aggregated to national indicators. Nevertheless several standardised calculation principles exist regarding environmental themes such as eutrophication, acidification and dispersion of toxic substances. For climate change and depletion of the ozone layer, calculation principles have been established on emissions of gasses.

- 1st track indicators:
- 2nd track indicators:
  - 8a. Average exceedence of soil, water and air standards of a particular group of substances.

    Note: The most relevant groups of chemical substances relate to eutrophication, acidification and dispersion of toxic substances. In water turbidity is also important. In the future, better units of measurement are likely to become available

5.2.5 Climate change

- 1st track indicator:
  - 9a. Change in mean temperature per gridcell of 50 by 50 km, averaged per country (region, global) within a 20-year period.
- 2nd track indicators:
  - 9b. Change in maximum temperature, minimum temperature, and precipitation per gridcell of 50 by 50 km, averaged per country (region, global) within a 20-year period.

    Note: The temperature change should be related to different pressure classes. The pressure classes should be classified in terms of biodiversity at risk. This indicator is

preliminary applied in UNEP's 1st *Global Environment Outlook*. These more accurate indicators require better and more detailed climate models, and better understanding how the core set of indicators relate to these factors. The best use should be made of findings, recommendations and experiences of the IPCC and IGBP.

5.3 A core set of universal use indicators

This section relates to the key question: what is use of biodiversity for people and is it sustainable? Article 7 of the Convention on Biological Diversity requires Parties to identify and monitor elements of biodiversity important for sustainable use. Arguably much, or most of the utility value of biodiversity will be country-specific. However core indicators might be also used to track those elements of a country's biodiversity that -because they are traded on international markets, or because they, indirectly, provide life-support services to people living outside of a nation's borders - are of regional or global importance.

Two categories of indicators for assessing and tracking utility value of biodiversity are proposed:

- those useful for measuring ecosystem goods;
- those useful for measuring ecosystem services.

5.3.1 Ecosystem goods

These might include all renewable goods derived from man-made and self-regenerating ecosystems. For the purposes of this paper, we have only considered goods derived from "wild" species. One indicator of harvesting are also applicable here.

- 1st track indicators:
  - 6a. Total amount harvested per species and grand total over time (in tons, m3, $, percentage GNP, numbers), especially fish and timber products
  - 10a. Total recreational revenues derived ecotourism per country (region, global) in $, % GNP and % employment.
- 2nd track indicators:
  - 10b. Percent of wild species with known or potential medicinal uses, potential revenues in dollars.

    Note: estimates of the total value derived from wild products and the number of species with medicinal value may be taken from the grey literature, and or through expert opinion. Almost all countries track exports of wood products (although they may not desegregate production from natural as opposed to plantation forest), along with freshwater and marine catch.

These indicators present a simple, albeit indirect, measure of the importance of a country's biodiversity to consumers outside of its borders. However, the indicators do not capture the *potential* (unrealised) value of biological resources, nor their sustainability. Comparisons between countries is also made more difficult by variation in average earnings, value of money etc. Future use of this indicator will probably need some agreed system for standardisation, such as giving value of wild goods in terms of percentage of GDP, buying power of money earned compared to the US dollar etc.

5.3.2 Ecosystem services
These include ecological processes that provide "life support" services to humans, such as soil conservation and watershed protection.

- 1st track indicators:
  - 10c. Total and per km^2 carbon stored within forests per country (region, global) referenced to baseline year.
- 2nd track indicators:
  - 10d. Percent of transboundary watershed area assessed as under "low risk of erosion";
  - 10e. What is the people's perception of the value of biodiversity and its conservation in 5 classes and how does it rank in comparison to other common political issues?

    Note: one example of indicator 10d is under development. It uses a modified version of the universal soil loss equation and uses readily available data on climate, slope, and land use, to estimate the degree to which watersheds are at risk of erosion. Indicator 10e could provide an indication of what value people put on the conservation of biodiversity in comparison to other societal and political issues.

5.4 A core set of universal response/capacity indicators
This core set relates to the key questions:

- question l: How much capacity is available to implement the Convention? (articles 6, 11, 12, 14, 16, 17, 18, 19 and 20);
- question m: How much financial support and incentives are currently being provided by parties to implement their commitments under the CBD?; (articles 11 and 20);
- question n: How much new and additional financial resources is currently being provided by developed country Parties to developing country Parties? (articles 11 and 20);
- question o: What additional means are still needed to address the threats? (articles 6, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19 and 20).

Response indicators have many dimensions. As stated in Section 2.2, this area is not elaborated at this stage. A paper on Biodiversity Capacity Indicators (by J. Hough) is added in Appendix 5.

In the meantime, we recommend that the SBSTTA advise the COP that countries make use of standard checklists in determining major limiting factors in capacity.

Summary section : Preliminary list of 1st track indicators

- State:
  - Quantity: Self-regenerating and man-made area as percentage of total area
  - Quality: Distribution or abundance of a few selected species as a percentage of baseline per country (region, global)

- Number of indigenous species of one or more selected groups as a percentage of baseline per country (region, global)

- Various possible quality variables at ecosystem level:
  - examination of the structure of temperate needleleaf and boreal forest to capture old-growth characteristics and therefore a complete natural life-cycle;
  - the ratio between dead and living wood;
  - percentage area intact canopy cover;
  - percentage area intact understorey;
  - percentage area bio-reserve & primary forest;
  - percentage areas sustainable managed forest;
  - percentage area secondary forest;
  - percentage area degraded forest;
  - percentage area forest plantation with and % without endemics;
  - percentage of major habitat qualifying as wilderness (self-regenerating terrestrial, freshwater and coastal ecosystems more than 20 km of a road, railroad or other point of access);
  - identification of remaining flood-plain characteristics from satellite images to show distribution of natural river systems;
  - number of well defined habitat types as an indicator of agricultural diversity related to the postulated baseline (traditional agricultural ecosystems);
  - the percentage area of natural patches < 100 ha. in agricultural habitat;
  - the percentage area of vital reefs, mangrove and/or see grass coverage in marine ecosystems.

Threatened & extinct:

- Number of threatened and extinct species as % of particular considered group per country (region or global) & number of threatened habitats as % of total per country (region or global)

- Pressure & Uses:
  - Annual conversion of self-generating area and by habitat type as a percentage of the remaining area per country (region and global)
  - Annual land use change from self-regenerating area into agriculture, permanent pasture

and built-up land in hectares per country (region and global)

- Share of riversheds dammed or channelized as a percentage of the whole river per country (region and global)
- Percent of coastal zone with a population density exceeding 100 inhabitants/km^2
- Percent of coastal zone within 30 km of a town or city > 100.000 inhabitants
- Total amount harvested per unit effort (tons per unit effort, over time)
- Total number of non-indigenous species as a % of a particular group per country (region, global)
- Change in mean temperature per gridcell of 50 by 50 km, averaged per country (region, global) within a 20-year period.
- Total recreational revenues derived ecotourism per country (region, global) in $, percentage GNP and percentage employment.
- Total and per km^2 carbon stored within forests per country (region, global) referenced to baseline year

6. Implementation of a core set of indicators

The working group followed COP3's decision to work on a two-track approach to developing capacity for development and implementation of a core set of indicators. Furthermore, COP3 has decided that the CBD should co-ordinate an expert group to assist this process, drawn from the existing roster of experts. Preliminary dates are given below. Timing of some of these - such as publication date of the *Global Biodiversity Outlook*, the date of COP5 and the completion of the Second National Report - depends on decisions that have yet to be finalised, and therefore may have to be changed.

6.1 First track

Core set of indicators

Aim: to conclude development of pressure, state, response indicators for inclusion in the initial core set - specifically for:

- coastal and marine biodiversity;
- agro-biodiversity;
- forest biodiversity;
- freshwater biodiversity.

Rosters of experts on forests, agro-biodiversity and coastal marine area are already available to help in this development. The CBD may host a second liaison group meeting to include some specialists from each relevant area. Special attention have to paid to harmonise information of other conventions.

Timing: second meeting of either the core-set liaison group and/or the roster of experts should take

place soon after SBSTTA3 with completion of a core set of indicators by the end of 1997

Capacity assessment
Aim: early and rapid assessment of countries' capacity needs for determining and applying the core set of indicators, specifically by identifying training needs, through analysis of a questionnaire circulated by the secretariat.

Timing:

- questionnaire distributed early 1998;
- completed questionnaires returned to the secretariat by end March 1998;
- information available by COP4.

Training
Aim:

- i) preparation of methodology sheets/guidelines, manuals and public information on the core set of indicators;
- ii) development of global/regional training models for harmonisation of data collection, management and analysis (to avoid nations measuring biodiversity in incompatible ways - either regionally or internationally).

Timing:

- funding applications for training models to be started immediately;
- completion of a preliminary set of guidelines etc by COP4;
- training workshop following CoP.4, and before the end of 1998.

Implementation of core set
Aim: publication of the first results of a core set of indicators ready for inclusion within the Second National Report.

Timing:

- information collected by the end of July 1999;
- report released possibly by January 2000.

Global Biodiversity Outlook
Aim: data from the first core indicators available for inclusion in the second edition of the *Global Biodiversity Outlook*.

Timing:

- publication likely to be ready for COP5.

Contributions
Aim: following a decision at SBSTTA2, the Secretariat should encourage capable international

institutions to become involved in the core indicator process, both by helping countries fill in gaps in capacity and, if appropriate, by preparing complementary evaluations at regional level.

Timing: start immediately.

Roster of experts
Aim: Contact relevant people on the CBD's roster of experts to help with the process of developing a core set of indicators.

Timing:

- start immediately;
- include some experts in further liaison group meeting, tentatively scheduled for late 1997.

Support from GEF
Aim: Investigate with the GEF the possibilities for funding to support this process.

Timing:

- start making preliminary enquiries immediately;
- make applications after COP4

6.2 Second track

Research and development
Aim: developing relevant research activities.

Timing:

- proposal for research/development needs by the end of 1997;
- identify institutions and individuals as possible research partners by early 1998;
- approach international agencies for support for the programme, by May 1999 (or 4 months before SBSTTA-4);
- provide partial input to SBSTTA-4 by May 1999.

Indicators
Aim: development of additional core-set indicators for remaining habitat types

Timing:

- initial contacts with roster of experts etc. starts immediately;
- serious development beginning in 1998;
- first report of all core indicators ready for the 3rd National Reports.

Pilot programme for second track
Aim: to work with a series of international and regional institutions/countries to develop and implement

additional indicators, especially of response, as recommended by COP decision 3.10 item 6.

Timing:

- secretariat immediately contacts relevant institutions and Parties to volunteer for involvement in this process;

- partial report completed by May 1999 (or 4 months before SBSTTA.4) to provide input to this meeting, which will probably be in September 1999.

Activity	Details	Timescale
First track		
Indicators	Agreed core set of indicators for marine, forest, agro-biodiversity and freshwater systems.	By end 1997
Capacity assessment	Questionnaire distributed to countries following agreement of core set of indicators.	Questionnaire 1/1998, ready 3/1998, analysis by COP4
Training	Development of methodology sheets, guidelines and public information.	Guidelines by COP4
Training	Development of training systems for harmonisation of methods by national data analysts.	After COP4
First report of core set of indicators	For inclusion in the Second National Report.	Info collected by July 1999 Ready 2000
Global Biodiversity Outlook	Data from initial core indicators for inclusion in GBO report	Publication likely by COP5
Contributions	Contact institutions regarding their involvement of core indicators, capacity support etc	Start immediately
Roster of experts	Contact relevant experts regarding development of core indicators	Start now, some experts in next liaison group meetings
Support from GEF	Work with GEF in developing funding options for core indicator work	Start immediately, make applications after COP4
Second track		
Research and development	Develop research proposal	Proposal by 12/1997 To agencies by 5/1999
Second set of Indicators	Further development of core indicators	First report ready for 3rd national reports
Pilot programme	Set up pilot programmes to develop and test the secondary indicators	Completed by May 1999

Further recommendations

The CBD secretariat should approach UNDP to ask for GEF for funds for training and capacity building meetings early in 1998 and to work with the CBD to develop an international training programme and workshop for people involved in national collection of the core set.The CBD secretariat should contact the roster of experts to contribute to development of the core set. The secretariat should further investigate options for a second liaison group meeting to develop the core set of indicators before the end of 1997.

7. Discussion

Funding

There will be funding needs for many of these elements. Funding for indicators has proved difficult in

the past and the CBD secretariat should prioritise this issue, both at SBSTTA3 and COP4, and governments and agencies should also be invited to host further meetings to develop this process.

Data availability
The proposed indicators enable a periodic assessment of progress towards the conservation of biodiversity. They could support policy-makers in making key choices, setting priorities and adapting sectoral policy. Although the set of indicators meets most of the terms of reference, it is obvious that, to date, there is a shortage of data. This is a general problem, irrespective the choice of core set. It is not surprising, because loss of biodiversity has only become a serious and widespread political concern in recent years, so there was until recently little opportunity or political pressure to set up a universal data collecting system world-wide. And discussions are still continuing on defining, describing and assessing biodiversity.

Furthermore, monitoring and research are expensive. Partly because of this, various assessment systems have been set up by different research groups which address specific problems and have a range of aims in various countries. Consequently, the biodiversity issue is in a totally different stage of development in the policy life cycle compared to the more uniform descriptions and assessments of the socio-economic state of nations. If a more uniform information system on biodiversity is needed, as the COP recommended, then the conclusion has to be that this must be set up almost from new.

Such an information system could be efficiently based on the core set of biodiversity indicators to be developed in the first and second track approaches suggested above. Once the core set of indicators is chosen, it gives direction to systematic, standardised monitoring programmes, and to establishing effective research programmes into dose-effect relationships, ecology and baseline systems. This might also stimulate capacity building in the different regions.

Applicability
The core set of indicators appears to be universally applicable, from arctic to tropical ecosystems, from terrestrial to marine ecosystems, from lower to higher taxonomic groups, from pristine to highly modified or deteriorated ecosystems, and for geopolitical and bio-geographical areas. They can be used on all scales, and, if necessary, be aggregated to a few simple, easily visualised, and policy-significant figures:

- quality,
- quantity and
- combined in the Natural Capital Index.

They can thus function as a vehicle of communication between scientists and policy-makers. In addition, they provide the information for balancing different interests.

Flexibility
The regional choice of specific quality variables for biodiversity-state-indicator 2 makes the indicator framework flexible for local differences. This is also a prerequisite for getting sufficient acceptance and appeal. At the same time, with the aggregation into an "Ecosystem Quality Index" and a "Natural Capital Index", a universal measure can be achieved and will also be flexible for future improvements.

Spatial difference or temporal change?
The indicators focus on changes over time. They are not intended for setting a relative value on biodiversity between regions, nations or locations. They highlight the overall ecosystem effects of numerous human interventions occurring simultaneously. Spatial comparison is of less importance for

assessment of the state of biological diversity. Every region has its own, sovereign, responsibility for the conservation of biodiversity and its sustainable use. The contribution of each region is equally important, whether the region is originally species-rich or species-poor.

Meeting accuracy and policy needs

Different choices of quality variables lead to different results. The aim, however, is not so much to provide the ultimate scientific description of the state of biodiversity, but more to indicate the changes which occur over time, and to identify the most effective measures to address these. This is the information policy-makers need. Representativeness of the set of quality variables is worth pursuing in the long term, but should not stand in the way of providing policy-relevant information to date.

Wait for further research?

Use of indicators leads by definition to an simplification of the real state of biodiversity. To increase the accuracy, more quality variables (indicators) might be added. However, many countries will not posses the financial and technical means to study and monitor a large number of quality variables. One might start with quality variables which are: (i) most critical, (ii) easy to monitor, and (iii) reflect directly effects of the main human activities, for example the extent of self-regenerating area and population changes in some economically important species. Some well chosen indicators are generally better than none at all. In many cases, carefully chosen quality variables can provide a great deal of information at relatively low cost. Over time, variables can be complemented with new ones. When quality variables are added, previous results of the Ecosystem Quality Index and Natural Capital Index can be adapted simultaneously to avoid artificial discontinuities in trends. So the establishment of indicators can be gradually built up over time. Eventually, it may become possible to make biodiversity goals more tangible, when national governments set targets for the different indicators for their territory, as is common for sector policies.

A common baseline is a prerequisite for biodiversity assessment

Selecting and describing a baseline state is a prerequisite for describing and assessing biodiversity and the sustainability of its use. Baselines are also needed for aggregating many quality variables into one "Ecosystem Quality Index". Obtaining baseline values for man-made areas is less problematic than for pre-industrial values in self-regenerating systems. A great deal of data are available from 30 or 40 years ago or can be obtained from similar current, still-traditional agricultural areas. To obtain pre-industrial baseline values is, generally speaking, more problematic. For severely affected ecosystems it makes sense to go back as far in time as possible. In many tropical regions for example it may be necessary to go back several decades, while for many terrestrial ecosystems in Europe sometimes a baseline over a hundred years ago may be appropriate. However, in many cases, insufficient knowledge of the ecosystem makes this difficult. In all cases a pragmatic compromise has to be made between available knowledge and a relatively low level of human interference of pre-industrial times. It is important to choose ecosystem quality variables for which baseline data are available or relatively easy to reconstruct.

Three sources can be used to determine and reconstruct baseline values:

- old inventories and the memory of people (historical references);
- comparative research involving other, similar ecosystems (geographical references);
- and ecological theories.

Partly through expert judgement and partly through use of historical data, baseline values can be reconstructed step-by-step using individual components in much the same way as archaeologists reconstruct the past. Because ecosystems are not static but dynamic, baseline systems have to be determined in broad or even shifting ranges. Even with broad baseline ranges, the differences from the current or future degraded ecosystems will be large enough to provide a clear and significant signal for policy-makers and the public, as is the aim of the CBD.

An important complementary baseline is the year the Convention was signed, to see whether policy making is effective.

Why distinguish self-generating and man-made ecosystems?

The distinction that is applied between the assessment of "self regenerating" and "man-made" areas is rather a - necessarily - abrupt one. The avoidance of this arbitrary distinction leads to another problem: there is no (longer) information on habitat loss, which is one of the most important causes of biodiversity loss. Further the assessment of man-made ecosystems by comparison with the more natural, pre-industrial baseline state leads to a lot of effort without much political significance. It is up to individual nations or regions to categorise their areas into self-regenerating or man-made ecosystems. If a great deal of intensively used and actually "man-made" area is defined as "self-regenerating", this potential overestimation of the Natural Capital Index self-regenerating will be compensated for by a relatively low Ecosystem Quality Index (presumably < 10 5 per cent) of these included degraded ecosystems. Nevertheless harmonising definitions is a prerequisite in making figures comparable and provide overviews at the regional and global level. Even on the well established socio-economic figures harmonising national definitions is an ever ongoing process.

Appendix 1

Some background thoughts on a core set of biodiversity indicators

On the indicator framework:

- member states are not waiting for another theoretical framework, but a feasible and pragmatic approach with a concrete set of unambiguous indicators, incl. units;
- the "keep it simple" principle is applied (KIS);
- a scientifically perfect core set does not exist, a politically useful core set does;
- the core set must be demand-driven thus -
  - start at the end (with policy makers),
  - no longer be delayed by complaints about lack of knowledge, but approaches as learning by doing,
  - undergo a gradual development,
  - aim at a quantitative, feasible, simple and rough core set for everybody on the short term (1-3 years),
  - and an expanded, more sophisticated and inspiring core set on the long term (15 years);
- the SBD should avoid overloading Parties, by -
  - not proposing all indicators for all CBD articles at once;
  - harmonising with other conventions;
- there is a need for ecological indicators equivalent to economic and social indicators;
- the number of indicators is limited - biodiversity is too extensive to measure all its components and only a subset of variables in a subset of sample areas can be measured;
- arbitrary choices are inevitable -
  - choosing a core set is the art of measuring as little as possible with the highest policy significance as possible,
  - this subset should be as representative as possible for biodiversity as a whole;
- the extent of the core set is a balance between costs and information benefices and this is not a linear relationship;
- biodiversity cannot be simply measured by a single variable - a multi-variable approach is necessary;
- biodiversity loss has two main components: habitat loss and the loss of biodiversity in the remaining habitat;
- in essence biodiversity loss results in a decrease in numbers and distribution of many species

and the increase of some others.

On the policy relevance

- politicians are more interested in biodiversity change than in the state as such, to legitimise sector decisions;
- politicians are not interested in details of the state of biodiversity, but in headlines - is it improving or declining, how much, what they can do about it to which costs?;
- the core set should aim at an accuracy of indicators that corresponds with the necessity of policy making, not for scientifically-described assessments of biodiversity;
- energy should not be wasted on details or fragments;
- the indicator values are not the final goal but the resulting sector and conservation policy measures;
- the paper is dealing with human-caused changes;
- to assess improvement or decline a universal baseline is needed against which current and expected future state can be compared;
- assessments can be made from different points of view (e.g. the more species the better, the less human-affected the better, the more self-organising the better, the more productive the better, ...);
- low managed, extensively used areas are valued differently from intensively managed, dominantly man-made areas and therefore need to be assessed differently with consequently different baselines;
- all regions' contribution to global biodiversity is equally important for example tundra is of no more or less value than rainforest, irrespective their difference in species-richness;
- the core set must be linked to socio-economic indicators to enable integrated policy making;
- the P-S-R model is a suitable and moreover the most widely accepted indicator framework;
- the species and ecosystem level are currently the most feasible levels for measurement;
- the core set should be problem-oriented.

On the lay out of the paper:

- the paper should focus on a tangible;
- be straight-forward and appealing;
- be as short as possible;
- use appendices, boxes, figures and examples.

Appendix 2: Defining a baseline for self-regenerating and man-made habitats

The definition and determination of a baseline corresponding to a more natural, pre-industrial state is the most challenging part of the framework. Nevertheless, to omit it from the framework would create new problems. The use of a less modified, pre-industrial baseline" has three major advantages.

First, it provides a fair and common calibration point to compare the current biodiversity, so policy-makers and the public can get a notion of the major (predominantly anthropogenic) changes which have already taken place in modern, industrial times. This point in time will be different from place to place, from state to state, but is a comparable point for all nations in their socio-economic development and the resulting high modification of "natural" ecosystems and traditional, highly diverse agricultural landscapes.

Second, it provides the possibility of assessing whether any change in biological diversity since the CBD-agreement is a good or bad one from the biodiversity conservation point of view, as is shown in Box 2. This is achievable despite the possible absence of verifiable ecological objectives.

The third reason is that a baseline point enables us to remove the units of the many different biodiversity variables and make indices: distance to reference (dtr). This allows us to aggregate many different biodiversity parameters to a few, or perhaps a single, more-or-less representative biodiversity (quality) index for entire ecosystems. This is analogous to the GNP and Price Index as highly aggregated indicators for the state of the entire economy, consisting of figures from many different economic activities and price changes. Also the health of a person is assessed by several health variables related to baseline values.

Assuming that a more natural baseline state has a crucial function in the assessment of biodiversity, the question arises of how to deal with the theoretical and practical difficulties? Pristine or non-human affected ecosystems no longer exist, because humans have been part of most ecosystems for the last 100,000 years. We know today that, even in prehistoric times, humans had a considerable impact. Many large animals and forest systems have been exploited to extinction. Man's impact (per time unit) was low in early times, and has gradually increased with growing technology, population, production and consumption rates in modern times. Biodiversity is currently decreasing at an unprecedented high rate (see the *Global Biodiversity Assessment*, 1995). It is this unprecedented rapid change in modern times that we want (and are obliged) to show quantitatively in national, regional and global assessment reports. Since there is no unambiguous natural reference point in history, and all ecosystems are also transitory by nature, a baseline point must be established at an arbitrary but practical point in time. There is nothing wrong in this, provided the arbitrariness of the baseline is acknowledged, and commonly applied. The best way to acknowledge this is to give this baseline point a specific name, referring to this arbitrary choice.

Because it makes most sense to show the biodiversity change when the human influence was accelerating rapidly, the baseline should preferably be just before modern times: the pre-industrial state. This choice means that pre-industrial human influences are part of the baseline. For every region, nation or location this point in time may be different. Also the availability or reconstructability of data will play a role in this choice. Data availability will generally increase in more recent and thus more modern times, so in some cases the baseline must be set in (early) industrial times. It is up to nations to choose this point. Once the baseline has been chosen, it has to be used consistently over time, so that trends can be quantified unambiguously. Given the above, it is proposed using the concept "postulated baseline, set in pre-industrial times", or in short, the "postulated baseline". For heavily modified, man-made agricultural ecosystems the often biodiversity-rich traditional agricultural ecosystem is applied as a baseline.

Parties will most probably identify baseline ranges for the different variables/indicators utilised. These ranges are subject to revision pending availability of new data and insights. This requires also adjustment of the assessment figures in the past to enable comparison over time. To enable aggregation of data up to regions and globally, these baselines should be internationally discussed. Major differences which are initially inevitable between countries could be harmonised on the longer term, as has also been the case (and still is) with economic indicators.

Appendix 3:
Specification of self-regenerating and man-made ecosystems

Man-made ecosystems: Heavily modified areas intensively used by humans such as:

- built-up areas;
- cropland;
- planted pasture for permanent livestock;
- infrastructure;
- industrial and mining area;
- planted forest with exotic species;
- channels, ditches, man-made reservoirs & mariculture ponds;
- self- regenerating patches < 100 ha.

Self-regenerating ecosystems: All other primarily natural and semi-natural areas, possibly extensively used ecosystems, irrespective of its ecological quality, larger than 100 ha, such as:

- nature areas;
- extensively used areas, such as shifting cultivation areas, areas with nomadic livestock and areas with indigenous people living in traditional way
- all forests (including production forests, except for planted forests with exotic species);
- rangelands of native pastures;
- all freshwater, except for channels, ditches, man-made reservoirs & mariculture ponds;
- marine areas.

Appendix 4:
Vetting criteria for choosing state indicators of biological diversity
Except for the above terms of reference in section 2.1, indicators should also meet the following technical requirements:

Each indicator/variable should:

1. have achievable quantitative data;

2. be policy and ecosystem relevant; meaningful and scientifically sound, and address key properties of diversity;

3. be accessible to accurate and affordable monitoring;

4. be sensitive to pressures including -

   - having some knowledge available on dose-effect relationships,

   - be interlinkable to socio-economic & environmental models for making projections;

5. have indicative value

6. where possible be stable - and have natural fluctuations distinguishable from anthropogenic,

7. be useful as an indicator for at least a 30-50 years.

The set of indicators/variables should:

8. provide a reasonable representative picture of the state and especially changes in biological diversity -

   - key properties of diversity, different levels and groups of diversity;

9. reflect effects of the main pressures causing biodiversity change;

10. have as small a total number as possible, be scientifically credible and simple to communicate

Appendix 5

Biodiversity Capacity Indicators and Targets

by Dr. John L. Hough,

Draft for Global Biodiversity Forum on
Biodiversity Indicators and Implementation Targets
3-4 April, New York

What is Capacity?

Capacity relates to the ability to do something. Specifically: the ability of individuals and organizations to perform functions - effectively, efficiently, and sustainably. Capacity development involves an improvement in that ability. The term "capacity development" is preferred to capacity building in order to emphasize the need to retain, or retrieve, capacity and to ensure that improvements in the way that existing capacity is utilized are also included.

Five dimensions of capacity are generally identified:

i. the overall societal context including the economic, social, cultural and political environment in which individuals and organizations operate, and the extent to which these facilitate or constrain functional capacity;

ii. the legal, regulatory, policy, and normative context in which individuals and institutions operate;

iii. information flow, communication - including networking, and linkages and coordination across individuals and organizations;

iv. organizational structures, management, processes, functions, and resources;

v. the human resource base of managerial, professional and technical people - including their skills and behaviour.

Developing capacity involves enhancing ability to do something by improving the functioning of one or more of these dimensions, or the way that they interact. However, it is important to note that "capacity development" alone is meaningless, unless the "something" that is to be done is specified.

Capacity to do What?

In this forum I think we are concerned about ability, or capacity, to do three tasks:

- change the state of biodiversity
- respond to pressures on biodiversity
- meet the objectives of the CBD

For ease of use in this discussion I will use the term "biodiversity conservation" to collectively include all of these.

Setting Targets and Measuring Progress

If we are to set targets, and measure progress, for "capacity" it has to be done in relation to these activities. Hence, reflecting back on our five dimensions of capacity the questions that must be applied to each task associated with biodiversity conservation become

How do we measure:

- the extent to which the societal context facilitates or inhibits biodiversity conservation
- the extent to which legal, regulatory and policy frameworks facilitate or inhibit biodiversity conservation
- whether information is flowing and effective coordination is taking place
- how effective the institutional structures and relationships that are in place are
- how effective the organizations themselves are
- how effective the people are
- how effective is the interaction of all of the above.

Impact Indicators

Ultimately we measure the ability to do things by assessing whether the tasks themselves are being accomplished. In this case we measure the impact of capacity development by measuring whether the state of biodiversity is changing, pressures on biodiversity are being reduced, and the objectives of the CBD are being met. Interestingly this means that there are no separate impact indicators for capacity. Indicators of impact with respect to capacity are the same indicators that are used to measure whatever it is the capacity is for. If we are developing capacity for in-situ conservation, the impact indicator for capacity development is an improvement in in-situ conservation. No special impact indicators for capacity are required.

Process Indicators

Since we need to know whether progress is being made in the right direction we generally cannot wait for the measurement of "impact indicators" to tell us whether we are getting it right. Consequently we must also have "Process Indicators", and associated with these some defineable targets. These are more problematic. Capacity requirements are highly specific and dependent on the nature of the problem being addressed. For example, to solve a particular biodiversity problem in one country it may be that 27 botanists are required. In another, the problem is that the 27 botanists need to have had particular training. In another the same problem may not require botanists but a policy change. In yet another country the problem may be that although the right policy is in place, as are the 27 suitably trained botanists, the problem is that neither the policy nor the 27 botanists are effective. Consequently setting generalizable capacity targets and indicators is difficult. Instead targets and indicators must be set on a case by case basis.

The implication of this is that all biodiversity strategies, action plans, reports, etc should contain an assessment of capacity, in terms of each of the capacity dimensions as well as the interactions between them. The assessments should define the specific targets for improvement and the measurable indicators of each of these. The ability to do this might in itself be taken as a qualitative indicator of capacity.

The task before this forum is then not to define specific indicators, rather it is to develop an indicative list of some of the kinds of indicators that might be used and parameters for measurement.

Some Examples

Societal Context
- extent to which the general public understands the term "biodiversity"
- extent to which subsidies encourage or discourage biodiversity considerations in economic decision making
- number, size and age of NGO's dealing specifically with biodiversity

Legal and Policy Context
- how recently the national laws on access to ownership of genetic materials were revised
- importance assigned to biodiversity in National Environmental Action/Management Plans
- comparative levels of budgetary commitments to biodiversity institutions

Institutional relationships
- clarity of mandates to different organizations to deal with particular aspects of biodiversity
- effectiveness of communication between organizations
- degree of cooperation between organizations dealing with biodiversity

Organizational Structures and Resources
- clarity of organizational mission statement
- clarity in lines of accountability
- adequacy of physical environment, resources, materials

Human Resources
- extent to which skills and tasks are matched
- regularity and seriousness of performance monitoring and review
- degree of job satisfaction and motivation

Interactions between Components
- percentage of university applicants indicating wish to study biodiversity
- number of court cases successfully prosecuted in which biodiversity regulations were contravened
- level of use of biodiversity themes in product advertising

Scale of Indicators

It is important to note that capacity indicators will be applied at different scales:
- global
- regional
- national
- sub-national

Since we are a global forum perhaps we should work our way through the attached chart identifying some indicators that we can use to establish our global scale biodiversity capacity baseline status as of now.

Indicative List of Capacity Indicators

Capacity Dimension / Task	Societal Context	Legal & Policy Context	Institutional relationships	Organizational Structures & Resources	Human Resources	Interactions between Components
Change the state of biodiversity						
Respond to pressures on biodiversity						
Meet the objectives of the CBD - Is the task to meet the objectives (impact) or to implement the articles (process), or both?						
Conservation						
Sustainable Use						
Equitable Sharing						
Article 5: Cooperation						
Article 6: General Measures						
Article 7: Identification and Monitoring						
Article 8: In-situ Conservation						
Article 9: Ex-situ Conservation						
Article 10: Sustainable Use						
Article 11: Incentive Measures						
Article 12:						

Capacity Dimension Task	Societal Context	Legal & Policy Context	Institutional relationships	Organizational Structures & Resources	Human Resources	Interactions between Components
Research & Training						
Article 13: Public Education & Awareness						
Article 14: Impact Assessment						
Article 15: Access to Genetic Resources						
Article 16: Access to & transfer of Technology						
Article 17: Exchange of Information						
Article 18: Technical & Scientific Cooperation						
Article 19: Biotechnology						
Article 20: Financial Resources						