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INDICATORS FOR ASSESSING THE EFFECTIVENESS OF MEASURES TAKEN UNDER THE CONVENTION

1. BACKGROUND

1. Article 25, paragraph 2 calls upon the SBSTTA to provide scientific and technical assessments of the status of biological diversity and to prepare scientific and technical as sessments of the effects of types of measures taken in accordance with the provisions of the Convention.

2. At its first meeting the SBSTTA proposed a mediu -term programme of work in recommendation I/2. Item 1.2.1 of this proposed mediu -term programme of work was:

> "Review and promotion of indicators of biological diversity to be used for assessment of effectiveness of measures taken in accordance with the provisions of th Convention."

3. Decision II/1 of the COP took note of the proposed mediu -term programme of work and requested the SBSTTA in considering its programme of work for 1996 to ensure that the programme is based on the priorities set in the programme of work for the COP for 1996 and 1997. The second meeting of the COP acknowledged the importance of developing indicators of biological diversity in th development of the Convention. For example, the COP in decision II/8 endorsed recommendation I/3, paragraph 4 which stated:

> "There is a need for each party to start assessing the effectiveness of easures taken under the Convention. However, methods for assessing the effectiveness of measures to conserve or sustainably use biological diversity should be reviewed. The use of

/...

> indicators of biological diversity and the status of its components is particularly time- and cost-effective. Several indicators are currently being used and developed. They should be reviewed and their use promoted".

4. Furthermore, the COP in its statement on biological diversity and forests to th Intergovernmental Panel on Forests noted:

> "The Intergovernmental Panel on Forests is currently taking steps to create a dialogu and achieve a degree of harmony among the numerous national and regional efforts in developing criteria and indicators of sustainable forest management. The biological diversity aspects of these efforts should be examined to ensure compatibility with Convention goals and requirements for reporting".

5. Given the current understanding of biological diversity the use of reliable indicators is essential to the development of measures designed to achieve the aims of the Convention. This is recognised in the Convention itself in several provisions. For example, Article 7 of the Convention calls on Parties to identify, monitor and assess the components of biological diversity as well as the processes and categories of activities which have or are likely to have significant adverse impact on the conservation and sustainable use of biological diversity. Clearly it is not realistic for any Party to report on all components of its biological diversity. This is implicitly acknowledged in that Annex I gives indicativ guidelines for the components of biological diversity to be considered. With finite resources and monitoring capabilities, indicators will play a vital part in allowing for the most effective and efficient monitoring of biological diversity. Indicators will also be essential if Parties are to be able to report on the effectiveness of measures taken in meeting the objectives of the Convention as required by Artic le 26.

6. This dependence on indicators is reflected in the other areas of the work programme of th COP and the SBSTTA. For example, the Secretariat observed in document UNEP/CBD/SBSTTA/2/2 that greater co-ordination at the international level, particularly between the various conventions concerned with biological diversity, would enhance the effectiveness of any assessments undertaken by the institutions of the Convention. An important avenue for increasing this co -ordination is th development and use of common key indicators for all these conventions.

7. The importance of developing indicators has also been raised frequently in the notes prepared by the Secretariat for many of the items of the provisional agenda of this meeting. The development of an effective response to the problems raised by the loss of biological diversity in agricultural systems, for example, is largely dependent on developing a set of indicators which will allow decision makers not only to assess the current status of and trends in agricultural biological diversity, but also to allow them to judge the effectiveness of the measures which they adopt.

8. This Note reviews the current status of indicators of biological diversity which can be used for assessing the effectiveness of measures taken in accordance with the provisions of the Convention. It then suggests some ways and means that these may be promoted and highlights a number of issues of particular relevance to the SBSTTA which it may wish to consider.

2. INTRODUCTION

9. Indicators can provide policy-relevant performance measures for a wide range of policy issues, particularly in national reporting. They can be used to summarise quantitative information on the status and trends of elements of biological diversity, as well as relevant socio-economic, cultural and other data, so as to be comparable across time and space. Because they lend context to data, and simplify sometimes complex processes and conflicting trends, indicators are useful tools for conveying reporting information to policy makers and other audiences.

10. Indicators such as the national unemployment rate and indices like the gross national product (GNP), are well-established tools for measuring national economic performance. National and international institutions have only recently begun to look at measures that might capture th environmental and social dimensions of development, and the progress (or lack of progress) towards visions of a sustainable society. The Dutch government, for example, now uses indicators ithin its national reporting systems to assess progress towards achieving a series of environmental "sustainability" targets. The World Bank recently ranked countries according to indicators of human resources, natural capital and produced assets. This exercise demonstrated that, when other measures of wealth are considered, traditional economic measures account for only a fifth of global assets.

11. Agenda 21, the Climate Change Convention and the Convention on Biological Diversity -- agreements that emerged from the 1992 United Nations Conference on the Environment and Development (UNCED) -- call on (in the case of the conventions, require) countries to monitor and assess progress towards environmental sustainability. As a result of these new information demands, there has been considerable work at both the national and international levels to define environmental indicators that are useful for reporting. The Scientific Committee on the Problems in the Environment (SCOPE) is one such effort underway in supp ort of the Commission on Sustainable Development (CSD).

2.1 Definitions

12. The term "indicator" is widely used both in ecology and in policy-making. The complexion put on it can understandably vary considerably with the perspective from which it is viewed. When ecologists, conservation biologists and natural resource managers use the term "indicators" in th context of biological diversity, they generally mean environmental attributes -- often species or groups of species -- that can be sampled and whos change either in space or in time is taken to reflect a change in biological diversity as a whole. In effect, therefore, indicators are measurable surrogates for larger measures of biological diversity. They are essentially monitoring tools used because it is simply not feasible to monitor the whole of biological diversity, even in a circumscribed area.

13. From a policy-making viewpoint, indicators are quantitative measures that "imply a metric (distance from a goal, target, threshold, benchmark, etc.) against which some aspects of public policy performance can be measured". As such, they differ from statistics (raw data) because they present information in a context that gives them meaning for a broad audience, and not just for technical experts. For example, "there are 10,000 hectares of protected wetlands in country X" is a statistic, while "five percent of country X's wetlands are protected" is an indicator (because it references protected wetland area to a benchmark -- in this case total wetland area). This indicator is policy-relevant in a number of ways: it can be used to look at progress made in protecting wetlands over time,

it can be used to assess the magnitude of change needed to meet a target, or goal (e.g., how much mor wetland area country X must protect in order to reach the IUCN's goal for nations to protect at least 10% of all ecosystem types), and it can be used to compare how well country X protects its wetlands relative to other countries.

14. Indicators in this sense are essentially us ed to convey often complex data in a simplified form. As such, they should be viewed in the context of the entire information chain, which includes:

15. Data/Reports: (disaggregated statistics → integrated data bases → indicators → indices → integrated reports) and;

16. Processes: (planning → surveys/inventories → data/information management → monitoring → evaluation (analysis and integration) → reporting).

2.2. Indicator objectives

17. As is evident from the above, indicators can serve a range of differ nt purposes and different audiences, and it is important to distinguish between them. This distinction is related to the all-important question of scale. Indicators for managers need to be operational at fine scales, both temporal and geographical. They must also be thoroughly tested and reliable, but may be reasonably complex or technical. Indicators for policy-making and public education must be easily understood and applicable over much broader scales, but should always be based on sound scientific principles in order to be defensible. They must also ultimately be derived from real data collected under monitoring programmes of various types and are therefore a use of, not a substitute for, data gathering.

18. When used at a national level by governments, environmental indicators can serve many, often overlapping, purposes:

(i) Public awareness

Past trends, conditions and future outlooks are simplified using high-level indicators that help to communicate to the public whether the environment is getting bet ter or worse.

(ii) Environmental policy performanc

Environmental progress and/or achievements are measured against national objectives and international commitments.

(iii) Sectoral policy development

Environmental indicators are applied in the context of a particular economic sector (e.g., forestry, fisheries, or agriculture).

(iv) Environmental accounting

Integrating environmental and natural-resource accounts is the focus of indicator development.

(v) Sustainable development decision-making

Indicators that link environmental and socio-economic information permit decision-makers to assess policy options, alter national programmes and steer a course towards sustainability.

2.3 Indicator criteria

19. Statistical data should meet certain criteria in order to be considered effective for indicator use. Good indicators should simplify information, be scientifically credible, relevant to policy or management, and be responsive to changes in time and/or space. In addition, indicators should be abl to show changes against a target or threshold, and be comprehensible to the intended audience.

2.4 Indices

20. Indicator information can be further aggregated into indices by combining several indicators (or different statistical datasets). These measures provide "bottom line" information -- summarising sometimes conflicting conditions and trends (for example, summarising data for changes in vegetation for all cover types within a country). While useful for painting broad-brush pictures of the status and changes in a particular environmental (or economic) sector, indices can be misleading because, through aggregation, they may mask or understate significant events.

2.5 Frameworks

21. Indicator frameworks organise indicators so as to present trends, processes and inter-relationships in one coherent picture (for example, to provide an overview of the conditions of and trends in biological diversity within a particular country). Various framework approaches have been developed for this purpose. For example, the edia approach presents environmental information by broad sector (air, water, land, and living resources). The pressur -state-response (P-S-R) framework relates pressures on the environment to the state of the resource or system in question, the impact thes pressures have on the resource and/or system, and management and policy responses to these impacts. Because it highlights relationships between actions and responses, the P-S-R framework is a particularly useful way of presenting indicator information to decision-makers.

22. Other more complex frameworks are also advocated, for example, the process -patter -evaluation framework, which is based on systems analysis. This approach attempts to take into account the evolutionary and adaptive characteristics of natural systems that mean that such systems often do not respond to pressures or responses in straightforward or even predictable ways.

2.6 Presentation formats

23. Indicators and indices can be presented through a variety of formats to depict changes o ver time and/or space: as tabular information (e.g., percentage of country X's vascular plant species that occur within publicly owned lands), as a graphic (e.g., as a bar chart depicting the percentage of vascular plant species occurring within publicly owned lands, by land use type), or as a map (e.g., a

map depicting the location of public land, colour-coded to depict the percentage range of vascular plant species found within a given map unit).

2.7 Indicator selection process

24. In choosing indicators of biological diversity, information managers should:

Define the indicator audience, and its information needs.

25. The audience to be reached, its level of technical expertise, and its information needs determin not only what kinds of data should be presented through indicators, but also:

(i) the number of indicators that are to be presented, and the degree to which indicator information should be aggregated;

(ii) the reporting units to be used. For example, managers generally require indicator results by management unit (by the watershed area, forest type, protected area they are working in). Policy analysts and policy makers, on the other hand, may prefer results by th administrative unit for which they are responsible (by state, or province, or country);

(iii) the spatial and temporal scale of measurement;

(iv) the thresholds, targets and benchmarks that are to be used in constructing indicators; and

(v) the presentation formats that can effectively communicate information to the target audience.

Articulate the criteria to be measured

26. Once the audiences and their general information needs have been defined, information managers should first work with these user groups to define the specific questions for which they need answers. The managers should then articulate criteria -- textual descriptions of the phenomena to b measured -- that might answer these questions. For example, in answering the question "are wild fisheries being managed sustainably?", information managers should work with scientist s to prepare series of criteria describing what a sustainable fisheries would look like, then define indicators that can measure whether these criteria have been achieved.

Select appropriate indicators for these criteria

27. Not all criteria will be measurable by indicators, and of those that are so measurable, not all can be measured directly. For example, in defining criteria to assess forest condition, some of thes criteria might best be answered qualitatively (e.g., whether forests are "pristine"), others can b captured directly through indicators (e.g., plantations as a percent of total forest cover, as a measure of naturalness), and others can only be measured indirectly (percent of forest cover in large blocks of roadless areas, as an indirect measure of human disturbance).

Critically test the indicators

28. Most environmental indicators have only recently been developed and should be considered as being in an experimental phase. It is important that indicators be tested against the wider phenomen a they are intended to represent or summarise so that they can be relied upon. As with any such process,

this testing can be expected to lead to modification, refinement, or even the abandoning of some indicators if they are found to be unreliable.

Establish appropriate targets, thresholds and/or benchmarks for these indicators

29. Indicators of use to policy makers provide context to data so they can be understood by non-technical audiences. Indicators do this by referencing targets, thresholds and/or benchmarks. Such references may include: change since a baseline year; benchmarks that describe a sub-component relative to the whole (e.g., the number of livestock breeds within a country relative to the total number of known extant plus extinct breeds); criterion benchmarks (e.g., the percentage of coral reef area threatened by pollution, where the criteria spell out ambient pollutant levels that might constitute a "threat"); and distance to a policy target, or goal (e.g., the ambient water pollution relative to the ambient level desired by year X).

"Field test" the indicators

30. Once the indicators have been developed, information managers should vet these indicators with individuals representing a sample of the target audience(s). The objective of this step is to ensure that these indicators effectively answer users' questions (and also that indicators are understood, that the reporting units are appropriate, that thresholds and benchmarks are intuitive, etc.).

3. ENVIRONMENTAL INDICATOR DEVELOPMENT AND USE

31. Research and operational programmes under the banner of "indicators" are being developed globally, nationally and sub-nationally. The goals, complexity and integration of indicator products in decision-making vary greatly among these activities. This should not be surprising, as indicator development is at a relatively young stage and the various research and operational methodologies are being developed on a number of fronts.

32. While environmental-indicator research for some sectors (such as forestry) has made some progress, far less has been made in developing indicators for biological diversity. This is due, in part, to scientific uncertainty, such as a poor understanding of ecosystem processes and functions, and to the wide range of policy-relevant issues that fall under the rubric of biological diversity.

3.1 Global indicator initiatives

33. One of the earliest environmental indicator initiatives is that begun by the OECD in 1989. It has developed indicators in four sectors (energy, transport, forestry and agriculture). The OECD has also worked on environment accounts for forestry and water, linking environment to the economy. With respect to reporting, a preliminary set of environmental indicators was published. Of the core set of 72 indicators, only 31 had adequate information, illustrating the need for the improved monitoring of primary data. This initiative also demonstrated how, where data are missing, surrogate indicators can be used to directly capture the phenomena to be measured. The OECD indicators included two biological-diversity measures.

34. A number of biological-diversity indicators of interest to policy-makers have been proposed. One summary list prepared by the World Resources Institute contains 22 indicators of the conservation of biological diversity *in situ*, *ex situ* and domesticated species diversity. Some indicators, such as on

for species richness, measure the natural endowment (condition or state) of biological diversity, whil others, such as that of the area protected, reflect policy responses to conservation. The coverage, completeness and quality of data were also ranked, demonstrating the gaps in the state of data supporting biological-diversity indicators. It should be noted, however, that the use of even secondary data can itself be useful to decision-makers in directing policies, research and monitoring activities to obtain the most desirable information, thus gradually improving the core set of indicators.

35. In response to chapter 40 of Agenda 21, the CSD is leading an initiative to develop indicators of sustainable development. It is working closely with national governments, UN organisations, intergovernmental organisations and NGOs. It attempts to be complementary to national reporting on the state of the environment. The approach is to use the pressur -state-response framework, develop candidate indicators of issues identified in the Agenda 21 chapters and build consensus among th agencies involved. Two indicators of biological diversity addressed under Chapt r 15 are included. However, other chapters -- such as oceans, freshwater, agriculture and forests -- also contain indicators relating to the sustainability of biological resources.

36. The process begun by the CSD might be one useful entry point to building the partnerships necessary to expand the suite of indicators of biological diversity to meet the requirements of this Convention.

37. A "bottom-up" approach to indicator development is being advanced through the UNEP's Global Environment Outlook, a programme designed to prepare integrated environmental assessments. The Dutch Ministry of Housing, Physical Planning and Environment, with the support of a feasibility study by the World Conservation Monitoring Centre (WCMC, 1996), has identified a preliminary cor set of six indicators of biological diversity and its use. Indicators are proposed for ecosystem and species levels. These are intended to be applied at regional and global levels using Udvardy's biogeographical zones within which to develop common suites of indicators.

38. The World Resources Institute is approaching indicators with an emphasis on the threats to ecosystems. Pressure indicators are particularly useful for influencing action because they point to those human activities that are detrimental to the condition of ecosystems and species. Those same pressure factors can be altered through changes in policy. In one example, a GIS -based ecosystem-indicators model has been advanced and preliminarily applied to assess pressures on coastal ecosystems. The WRI model incorporates measures of ecosystem sensitivity (resilience) and data on human activities to generate an index of potential pressure on ecosystems. Map -based indicators, such as the WRI approach, can be used to help define priorities for conservation. The maps are also useful tools for communicating complex issues to decision-makers and the public.

3.2 National and regional indicator initiatives

39. There is a growing number of national environmental indicator programmes that are providing tools and products to influence decision-making. The objective of Canada's national indicator progra is to develop a set of scientifically credible, understandable indicators relevant to decision-makers and the general public, that is representative of the state of Canada's environment and indicates trends towards sustainable development. The programme is also designed to provide an early warning and assist performance evaluation. Other strong national programmes are to be found in Australia, Denmark, Norway and the Netherlands.

40. The Centro Internacional de Agricultura Tropical (CIAT), based in Colombia, has embarke on an ambitious regional-indicator programme. The programme aims to develop a regional approach to environmental- and sustainability -indicator development and supporting information bases. Th programme integrates indicators on a national basis and by eighteen life zones. The programme maintains ties with other global and national efforts with the aim of learning about and harmonising approaches as much as possible.

SECTORAL INDICATORS

41. Forests are currently the subject of numerous indicator efforts at various scales. Generally, th aim of these efforts is to develop and monitor measures of sustainability, although the concept often remains undefined or very loosely defined. Indicators of biological diversity are an important aspect to most of these initiatives.

42. The OECD has identified and reported a national indicator relating productive capacity to annual harvest. Through the CSD process, several national indicators of pressure, state, and respons have been identified to address chapter 11 of Agenda 21 of UNCED, which calls for the development of scientifically sound criteria and guidelines for the management, conservation and sustainabl development of all types of forests.

43. Regional intergovernmental efforts such as ITTO (International Timber Trade Organisation) and the Helsinki, Montreal and Tarapoto Processes have developed national level criteria and suites of indicators for specific regional economic, ecological, social and cultural conditions. For example, through the Montreal process, countries sharing temperate forests have developed a series of six criteria, each with numerous proposed indicators of sustainability. The conservation of biological diversity is one criterion addressed through this process, although other criteria -- such as the maintenance of ecosystem health and vitality -- are also critical to the conservation of biological diversity.

44. The concept of F orest Resource Accounting (FRA) is being advanced by the International Institute for Environment and Development (IIED) and the WCMC. FRA accounts will link policy and institutional changes at a national level with physical changes at a forest -site level. The FRA process requires indicators to track numerous environmental and socio-economic aspects of sustainability.

45. The Centre for International Forestry Research (CIFOR) has conducted research that demonstrates the importance of linking indicators developed at a local level with national policy-level indicators. The purpose of the CIFOR programme is to identify and develop a minimum set of objective, cost-effective criteria and indicators applicable under different forest conditions. To accomplish this, the project is developing a methodology for the objective evaluation of criteria, and developing a system for evaluating the sustainability of forest management as a whole, based on th recommended criteria and indicators. The research is being undertaken in a number of countries with assorted forest conditions.

46. National efforts at forest indicators exist for many countries. In Canada, the Canadian Council of Forest Ministers has endorsed a comprehensive set of indicators of forest sustainability. The scheme proposes nine indicators related to ecosystem, species and genetic diversity, and many others that deal with other aspects of sustainability.

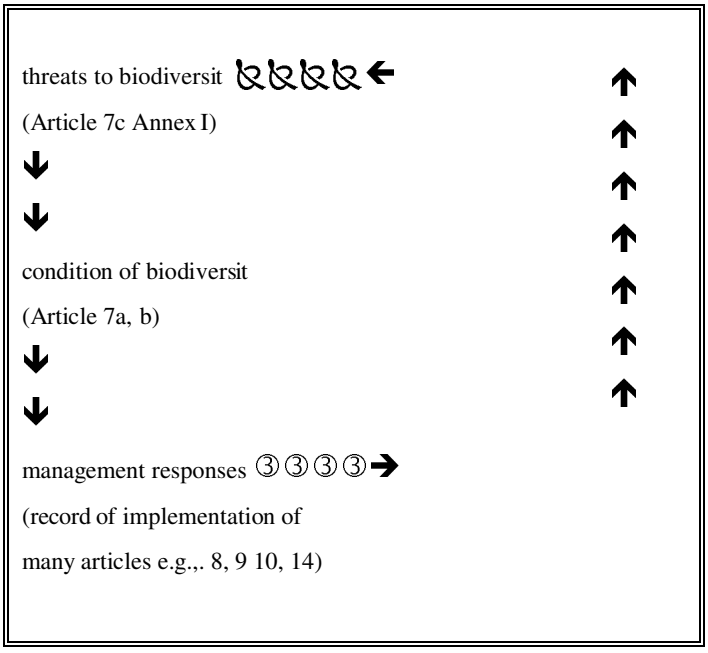
47. The WCMC is conducting research on habitat and biological-diversity indicator development, particularly for tropical forest countries. Attempts are being made to design and measure th effectiveness of indicators at different scales from global to forest-management unit.

48. There are also many other efforts under way to assess forest sustainability at the forest-management unit level in support of forest-certification schemes. The inclusion of biological-diversity criteria and indicators is an aspect of this work.

4. INDICATORS AND THE CONVENTION ON BIOLOGICAL DIVERSITY

49. The goals of the Convention are to ensure the conservation of biological diversity, th sustainable use of biological resources and the equitable sharing of the benefits of genetic resources. Indicators contributing to all three objectives will be required in order to track progress effectively.

50. Using the widely accepted pressur-state-response framework for indicators, the Convention can be viewed in the following manner:



Indicators for the condition of biological diversity

51. Within a pressure-state-response framework and in the context of the Convention, stat indicators of biological diversity are ultimately of greatest importance. Only by assessing the state of biological diversity and how this changes through time will it be possible to assess the effectiveness of measures taken in accordance with the provisions of the Convention. Such indicators may be subsets of biodiversity, usually species or groups of species (indicator taxa), or may be other parameters. Biodiversity state indicators may be essentially static, that is designed principally for geographical comparison (e.g., species richness or degree of endemism in a particular taxon), or may be dynamic, that is, intended to monitor change (e.g., percentage of species classified as threatened, area of habitat

remaining). Indicators used for assessing the effectiveness of measures taken to maintain biological diversity must, of necessity, have a dynamic component.

52. It is appropriate to consider indicators at the three commonly perceived levels of organisation of biological diversity, as set out in Annex I to the Convention: ecosystems and habitats, species, and genes and genomes. Because the three levels are interdependent, appropriate indicators for one level may actually be subsets of another level (e.g., species as indicators for assessing t he state of ecosystems). Indicators of the state of habitats and ecosystems are of particular importance, as th SBSTT 's recommendation I/3 suggests developing the ecosystems-level approach for the primary framework of actions to be taken under the Convention.

Habitat and ecosystem indicators

53. Indicators for habitats and ecosystems may conveniently be divided into those of extent (or area) and those of condition. In general, the former are more easily developed than the latter, at least for terrestrial ecosystems. Indicators of ecosystem or habitat extent require that a definition of th ecosystem or habitat in terms of measurable parameters be settled. For example, a forest is generally defined in terms of percentage canopy cover, where the canopy is some minimum height. For th purposes of developing indicators, the exact definitions can be fairly arbitrary (indeed, as discussed in document UNEP/CBD/SBSTTA/2/1, they will generally *have* to be arbitrary) as long as they ar applied consistently. The mor easily and widely measurable the parameters are, the better. For this reason, parameters that are measurable by remote-sensing or aerial photography are to be preferred. Indicators can be developed in a straightforward manner from original data simply by calculating th percentage changes in extent of habitat from some baseline.

54. Indicators of extent provide valuable information with respect to one major pressure on biological diversity, namely, that of the complete conversion or destruction of habitats or ecosystems. However, adverse impacts on biological diversity often fall short of this and rather affect what may b loosely termed habitat or ecosystem quality. These impacts may be as far-reaching in their effects as conversion. A lake may be rendered virtually abiotic by pollutants, but still remain a lake, or a species-rich grassland may have its diversity drastically reduced by input of nitrogenous fertiliser, but still remain a grassland. Developing indicators for these situations is generally far ore problematic, for both theoretical and practical reasons.

55. Because changes in habitat and ecosystem quality are essentially manifested in changes in th distribution and abundance of species, much attention has focused on developing the latter as indicators. Several sets of criteria have been established for indicator species, but very few such indicators have yet been made operational.

56. This is in large measure because the most basic attribute of indicators is that they must b correlated with some larger measure of biological diversity so that changes in the indicator over time or space mirror changes in biological diversity as a whole. Demonstrating this to be the case with species is problematic, for a range of theoretical and practical reasons. Although there is broad agreement that areas or ecosystems that are rich in one group of species are likely to be rich in others, this is by no means always the case and, indeed, at fine scales this relationship often breaks down, so that areas of richness in different taxonomic groups may be inversely correlated. Similarly, responses to environmental change, both natural and human-induced, may be very different in different subsets of biological diversity. For example, populations of generalist species, including many large mammals that would be widely considered as excellent indicators, often increase in logged -over or partially degraded forest, while populations of species dependent on undisturbed forest decrease.

57. A further assumption is that changes in chosen indicator species can be related directly to causes. Within a pressure -state-response framework this means that changes in state can be related directly to changes in pressures or responses. However, because natural ecosystems are highly dynamic at all spatial and temporal scales, this is often very difficult to demonstrate. The populations and ranges of all species vary for a number of reasons, including cyclical and non -cyclical environmental perturbations, through stochastic processes, and because of the impacts of humankind. Demonstrating that a change in the chosen indicator is the result of human actions, either beneficial (generally a response) or deleterious (a pressure), and not a product of other influences, is often not easy. Moreover, as noted above, because of the adaptive nature of natural systems, the responses of thes systems to human actions are often complex and sometimes counterintuitive.

58. Practical problems in developing species indicators for biological diversity lie in t he paucity of baseline data-sets in most parts of the world, and in the need for sustained monitoring programmes. Indicators of change by definition require monitoring through time, either continuously or periodically. Results obtained at different points in time have to be comparable, so methods for measuring or sampling must themselves remain consistent. However, in the vast majority of cases, monitoring th distribution and abundance of species is expensive and time-consuming, particularly if carried out over extensive areas, as is necessary if the indicators so developed are to have anything other than a very local application. As a result, few rigorous monitoring programmes have been sustained to date for any significant lengths of time.

59. Solutions to some of these methodological problems lie in: the use of sampling sites; th mobilising of large numbers of people, usually amateurs, as is done with annual wild bird counts in several countries; the use of aerial surveys to count large species, generally mammals and some birds in open ecosystems such as grasslands.

Other measures of ecosystem and habitat quality

60. Although, as noted above, changes in habitat or ecosystem quality are essentially changes in the distribution and abundance of species, these changes may manifest themselves in structural changes, particularly where species are structural components of the habitat, as in forests and coral reefs. Some of these may be easier to measure and develop indices for than direct measures of species abundance and distribution. Examples include fragmentation in forests, changes in density and height of vegetation cover in many terrestrial ecosystems and changes in plankton densities in aquatic ecosystems. Nevertheless, the challenge with these indicators remains one of linking them to the fate of species.

State indicators for species

61. Problems with monitoring and developing indicators for the state of species are discussed in general terms above. At national or global levels, however, species indicators do not necessarily have to be tied to particular habitats or ecosystems.

62. An important potential indicator of the state of species is the number or percentage of threatened species in a given area or country, as assessed under some standardised system such as that in use by the IUCN -- the World Conservation Union. However, assessing the threat status of species is very incomplete and very taxonomically skewed, so that only higher vertebrates (namely mammals and birds) and a few other smaller groups of organisms (e.g., conifers, cycads, swallowtail butterflies) hav been at all completely assessed. It is only feasible to attempt to derive indicators for these few groups.

63. Such indicators may provide a useful static picture of the state of biological diversity; that is, they may be useful for geographic comparisons, but are at present of limited use in tracking trends in time. This is because changes in listings unconnected to species status -- mainly taxonomic changes, improved information and changing classification criteria -- generally swamp genuine changes in status. With the establishment of new, more objective, listing criteria and a growing tendency to adopt standard classifications, the situation may improve, but it will be several years before useful indicators of change emerge.

State indicators for genes and genomes

64. Direct monitoring of the state of genes and genomes, particularly in wild populations, is generally not feasible at present. Presently, genetic diversity is of greatest importance in agricultural systems. Here, there are possibilities of developing indirect measures or indicators; for example, through assessing rates of loss of landraces or changes in the proportion of production from traditional as opposed to modern or improved varieties. The need for assessing biological diversity in agricultural systems is discussed in detail in UNEP/CBD/SBSTTA/2/10.

Pressure indicators

65. Pressure indicators are essentially indicators of the processes and categories of activities that have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity. These are discussed in document UNEP/CBD/SBSTTA/2/3. A number of pressur impacts can be measured, directly or indirectly, and can be used to generate indicators of threat. Of particular importance in predictions of future pressures on biological diversity is the development of indicators for the major socio-economic factors that lead to adverse impacts on biological diversity, identified in docu ent UNEP/CBD/SBSTTA/2/3 as land tenure, population change, cost-benefit imbalances, cultural factors and misdirected economic incentives.

66. Indicators of some aspects of pressure may be easier to develop than state indicators of biological diversity. Decreases or negative changes in pressure indicators will imply that measures taken to fulfil the aims of the Convention have, to some degree, been effective. Nevertheless, the crucial step will still be to link a decrease in pressure indicators to an amelioration in, or at least stabilisation of, the state of biological diversity. To achieve this, state indicators will ultimately have to b developed.

Response indicators

67. Responses to adverse impacts on biological diversity lie within the human domain and many of them are of a legal or formalised nature. The formal designation of protected areas is one obvious example. Such responses lend themselves well to the development of indicators because they ar measurable and can be translated into terms understood by a wider audience. Within the context of th Convention, this suggests defining a minimum core set of indicators on the implementation of various articles of the Convention, in particular Articles 8,9 and 10. Such an exercise will feed into national reports and global summaries such as th *Global Biodiversity Outlook*.

68. More generalised responses, such as changes in public attitudes and behaviour, are mor difficult to assess and develop indicators from. However, there are well-defined and tested methodologies for this outside the realm of biological diversity.

69. Again, as with pressure indicators, the challenge, and the principal subject of this Note, lies in relating such response indicators to state indicators, for it is only through this link that the effectiveness of these responses can be assessed.

4.2 Indicators of sustainability

70. The Convention defines "sustainable use" as: "the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations". This defines sustainability in terms of the effects of use on biological diversity. Indicators of sustainability can therefore effectively be seen as state indicators of biological diversity, discussed in detail above. Within a pressure-state-response framework, unregulated use is a pressure, while forms of regulation of use, including a wide range of traditional management systems, are responses.

71. Many of the sectoral indicator programmes, particularly those for forests outlined above, hav adopted wide interpretations of sustainability in which biological diversity is regarded as on component.

4.3 Indicators and other global conventions

72. It is expected that several other global conventions will be able to contribute significantly to meeting the goals of the Convention on Biological Diversity. These include CITES, the Ramsar Convention and the World Heritage Convention, all of which have well-developed reporting procedures and supporting databases.

73. The information bases supporting these conventions produce reports on topics such as trade in species and progress in *in situ* conservation. Key indicators derived from some of these measures, perhaps used in conjunction with complementary data sets, might be useful indicators of th implementation of the Convention.

5. CONCLUSION

74. Indicators should be viewed as series of tools that can support a range of activities and processes under the Convention. The Convention contains numerous articles requiring action by th Parties. Progress in those actions, or "policy performance", will require indicators of not only th policy and programme initiatives taken by the Parties, but also of the periodic assessments of th threats to and condition of biodiversity as evidence of the effectiveness of measures taken in maintaining biological diversity. In addition to being used as measures of policy performance, indicators that provide an early warning role will be useful. Indicators that signal changes in th condition of biological diversity and sustainable use, along with those that measure pressures on thes valued resources, can be powerful indicators for the Parties to use in order to revise policies or adopt new actions to address emerging threats to biological diversity.

75. The development and use of indicators can be a key focal point in capacity-building efforts, whereby the entire data and information infrastructure and decision-support mechanisms are energised to deliver policy-relevant information. Numerous indicator research and operational programmes will

need to be mined for approaches and information required the by Parties in order to support th Convention. A degree of consistency or harmony may be required.

76. The SBSTTA might like to consider reviewing existing indicator initiatives to determine which indicators discussed in these might be most appropriate for the purposes of the Convention. Th SBSTTA might like to be mind ful of the fact that most indicators cited in these initiatives are proposed or hypothetical, and might like to identify specifically those indicators that have been made operational.

77. The SBSTTA may like to consider whether the pressur -state-response framework is the most appropriate for the purposes of the Convention. If the SBSTTA considers that this is a useful framework, the SBSTTA might like to consider structuring any review it may decide to undertak along these lines.

Pressure Indicators

78. The SBSTTA might like to examine these in light of the proposed framework of processes and categories of activities likely to have significant adverse impacts on biological diversity set out in document UNEP/CBD/SBSTTA/2/3. It might like to determine whether useful indicators already exist for the different processes and categories of activities and, if so, might recommend their consideration for inclusion in national reports and other products, such as global and regional assessments, of relevance to the Convention. Where indicators have not been developed, the SBSTTA might like to propose promising indicators.

State Indicators

79. The SBSTTA may like to identify which ecosystems and habitats might be usefully described using indicators of area, paying particular attention to those identified in Annex I to the Convention and discussed in some detail in document UNEP/CBD/SBSTTA/2/3. It may wish to assess the availability of data to derive such indicators. The SBSTTA might also like to be mindful of the limit d success to date in identifying indicators of habitat quality, discussed at some length in this Note. It might wish to review current research efforts in this field, identifying the most promising approaches and proposing new ones in the form of a coherent research agenda.

Response Indicators

80. The SBSTTA might wish to review response indicators within the context of the Convention, and particularly Articles 8, 9 and 10, and recommend those which might be appropriate for inclusion in national reports, and in global and regional assessments.

81. As the most important use of indicators within the framework of the Convention is likely to b in national reports and assessments, the SBSTTA may wish to consider how indicators may best b used in a national context. It may wish to assess the possibility of developing a minimum core set of national indicators of biological diversity and determining where indicators should be tailored to national economic, environmental, social and cultural conditions. The SBSTT may also wish to consider how much harmonisation and standardisation is necessary or desirable in the development of national level indicators within the context of the Convention. It may also wish to assess the extent to which Parties will require additional capacity for collecting further data to support indicator development.

82. In cases where indicators are proposed, rather than operational, the SBSTTA might like to determine whether sufficient data already exist to allow for the development of the indicators. In cases where sufficient data do not exist, the SBSTTA may wish to advise on cost-effective methodologies for

gathering the data. The SBSTTA may wish to consider recommending priorities for the development of new indicators and may also wish to consider what the implications are in terms of capacity building and the increase in resources that might be required to establish and maintain monitoring programmes to gather the data to support such indicators.

83. The SBSTTA may also wish to assess th xtent to which Parties can make use of the data and indicators they have developed (or will develop) for their other reporting requirements, such as through other conventions, in meeting needs under the Convention.

84. The SBSTTA might like to consider recommending use of the clearing-house mechanism to make information on indicators more widely available. Such information could include, *inter alia,* a contact list of indicator programmes and initiatives, to assist Parties to draw on expertise in other countries; a review of current indicator use; a menu of currently available and proposed indicators; recommendations regarding scales of measurement, thresholds and benchmarks used, and presentation formats and other structural aspects of indicator development and use.

85. In view of the complexity of many of the issues surrounding indicator development and use, and the fact that much work on indicators is at present still at a preliminary stage, the SBSTTA might like to consider establishing an expert working group to carry out a detailed review of theory and practice in the use of indicators of biological diversity. Such a working group would report back to th next meeting of the SBSTTA with a view to making specific recommendations for COP IV.

86. The SBSTTA, or any working group which the SBSTTA might like to establish, may like to consider focusing its deliberations by considering indicator development specifically in one or other, or both of, two important thematic areas, namely agricultural biological div rsity and coastal and marin biological diversity, both of which are to be discussed under the provisional agenda to this meeting (s documents UNEP/CBD/SBSTTA/2/10 and UNEP/CBD/SBSTTA/2/14).