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RECOMMENDATIONS ON SCIENTIFIC RESEARCH FROM A DIVERSITAS WORKING GROUP OF EXPERTS THAT SHOULD BE UNDERTAKEN FOR THE EFFECTIVE IMPLEMENTATION OF ARTICLES 7, 8, 9, 10 AND 14 OF THE CONVENTION ON BIOLOGICAL DIVERSITY

MEXICO CITY, MEXICO, 24-25 March 1998

A contribution of DIVERSITAS
to Agenda Items 4 and 13

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NOTE: This information document (No. 18) which will be of relevance to COP agenda items 4 (report of SBSTTA) and 13 (operations of the Convention and the long term programme of work), illustrates a very clear example of the comtribution provided by an international scientific programme in assisting the CBD and SBSTTA to identify the science that is required for the full and successful implementation of specific provisions within the Convention on Biological Diversity.

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Recommendations on Scientific Research from a DIVERSITAS working group of experts that should be undertaken for the effective implementation of Articles 7, 8, 9, 10 and 14 of the Convention on Biological Diversity

24-25 March 1998

Mexico City, Mexico

Introduction

DIVERSITAS is a programme established in 1991 to promote the science of biodiversity, including its origin, composition, ecosystem function, maintenance and conservation. It entered a new phase in 1995, expanding its activities, incorporating new sponsoring organisations and enlarging its administrative capacity. It is co-sponsored by IUBS, SCOPE, UNESCO, ICSU, IGBP-GCTE and IUMS. DIVERSITAS has ten Programme Elements each focused on a fundamental scientific question about biodiversity, which are outlined in an operational plan.

In its restructuring, the DIVERSITAS programme has endeavored to coordinate its activities in close cooperation with the Convention on Biological Diversity (CBD). A workshop held prior to the third meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA 3) in Montreal is an example of this cooperation, all of which led to the signing of the Memorandum of Cooperation between the CBD Secretariat and DIVERSITAS in 1997. In accord with the terms of reference of the Memorandum and the Article 24 (d), the Executive Secretary of the CBD Secretariat requested that DIVERSITAS carry out a scientific review of Articles 7, 8, 9, 10 and 14 of the CBD.

There is a growing need to enhance the ability of the Convention to draw on available scientific and technical knowledge to further the implementation of the Convention. This need became apparent following a preliminary review of the first 80 national reports submitted to the Secretariat of the Convention on its implementation at the national level.

Prior to the DIVERSITAS Convenors' (of the Programme Elements) Meeting held in Mexico City in March 1998, a Workshop of DIVERSITAS experts was convened to review Articles 7, 8, 9, 10, and 14 of the CBD. The agenda of this Workshop was prepared in close cooperation with the Convention Secretariat and other relevant agencies. The report which follows is the outcome of the Workshop and the attendees hope the recommendations will be of use to both the Conference of the Parties (COP) to the CBD and SBSTTA.

For each of the articles that were reviewed, the rationale and specific recommendations are provided. It is recognised that the implementation of these recommendations should be in accordance with national, regional, and global priorities and needs within the broader framework provided by the CBD.

General Recommendations

One of the key steps to be taken in implementing the Convention is to find new ways of linking different scientific disciplines and of breaking down artificial boundaries, especially between basic and applied science and socio-economic and cultural research. The need to continue to apply pure biological and ecological research in support of understanding and explaining the fundamental basis of biodiversity science is paramount. In addition, new integrated scientific programmes are needed that concentrate on the application of science in managing and sustainably using biodiversity in different societies.

The scientific community should work to ensure that both an ecosystem approach and a species-based approach are combined, using the best scientific and technical knowledge to enable biodiversity conservation, sustainable use and human welfare to be managed in an integrated way. The application of the ecosystem approach where conservation and sustainable use are seen in close context necessitates new approaches in development of management tools. Ecosystem modeling, in which socio-economic factors are included, needs to be further developed. Conservation and sustainable use practices outside protected areas need to be strengthened.

Article 7. Identification and Monitoring

Article 7(a)

Rationale

The characterisation and quantification of the world's biodiversity depends crucially on knowledge of its different components as well as of the magnitude of the interactions between them and the characteristic scales of space and time in which they operate.

Probably only 13% of species on Earth have been discovered and described (Global Biodiversity Assessment 1995), and the diversity of taxonomic groups such as bacteria, archaea, fungi, and protozoa is only beginning to be appreciated.

The lack of professionally trained taxonomists for many economically and socially important groups of organisms and the general decrease in the numbers of such taxonomists being trained, has been recognised by the COP of the CBD (Decision II-2) in the establishment of a concerted and sustained Global Taxonomy Initiative. Detailed actions and implementations relating to this need were explored in a recent meeting organised by the Smithsonian Institution and Environment

Australia, the results of which are published as the "Darwin Declaration". Those objectives outlined by the Declaration need to be achieved in the broad sense at the same time as the specific recommendations below are implemented. The value of taxonomy, as a means to predict the response and potentials of related organisms, is of considerable importance to agriculture, human health, fisheries and forestry.

The genetic variation within populations, between species, and at levels above the species is poorly understood, but is essential for understanding the origin and maintenance of biodiversity, ecosystems and their conservation and sustainable use.

Recommendations

1. Action should be taken to accelerate the inventory of the world's species diversity according to a set of well-defined priorities, including those mentioned in Annex 1 of the CBD.

2. The development of more efficient systems for the naming and registering the names of newly discovered organisms of all kinds should be promoted, in cooperation with the internationally mandated scientific bodies and the International Committee on Bionomenclature. The needs of countries with few taxonomists and limited literature resources should be taken into account, and name changes that do not arise from new knowledge should be further minimized.

3. Efforts should be made to accelerate the genetic characterisation of populations and species. Research should focus on, but not be restricted to, the needs of agriculture, including food security, human health, forestry and fisheries, economic development, sustainable use, ecosystem structure and function, and conservation, and as noted in Annex 1 of the CBD.

4. Agreement should be reached on common procedures for inventorying microorganisms and other poorly known taxonomic groups, with emphasis on those important for human health and biotechnology.

5. Efforts should be made to accelerate the production of national and regional Floras, Faunas and species surveys of Microbiota, field guides, and electronic interactive identification tools and other innovative approaches. These products should be readily accessible (free of charge whenever possible) to potential users.

6. Produce an electronic list of the worlds species that is as complete and reliable as possible. The Species 2000 project that is associated with DIVERSITAS, has been initiated to fill this need, and Parties may wish to endorse this initiative.

7. Accelerate the characterisation and classification of habitats, ecosystems, landscapes and seascapes according to national, regional and global needs and priorities.

8. Improve techniques to measure ecosystem structure and function and undertake experiments to clarify the relationships between biological diversity and ecosystem resilience.

9. Following established procedures such as those of IUCN, a "Red List" approach should be developed for the identification of threatened habitats and ecosystems in order to respond to human impacts and promote resource management and sustainable use.

10. Develop models and perform experiments to determine the effects of diversity at the level of genes, species and functional groups on basic ecosystem processes and ecosystem stability.

Article 7(b)

Rationale

SBSTTA has recognised the need for a global scheme for monitoring components of biodiversity to determine the extent to which the objectives of the Convention are being met. This is also reflected in the decision to produce a Global Biodiversity Outlook (GBO), which will largely be based on the individual Country Reports. Issues to be addressed include:

- developing agreement on the components to be measured and baseline protocols for sampling that allow changes in biodiversity in time and space to be determined,
- establishing means whereby all nations can take advantage of technological developments to implement comparable, affordable methodologies,
- developing agreements on means of access to data and in formats that can be readily compared,
- developing adequate means for assessing the status of ecosystems and species,
- developing adequate means for assessing the resources offering the greatest potential for sustainable use.

It should be noted that all the above require long-term commitments by the Parties.

Recommendations

1. A range of appropriate tools (including aerial photography, satellite imagery for surface temperature, height, and multi-spectral colour, multi-beam and side-scan sonar systems to measure aquatic bathymetry, and physical models to measure patterns of hydrodynamic processes) should be used to obtain land/water-use statistics and a broad overview of temporal changes in the extent and fragmentation of vegetation types and other land/seascape features and to design other monitoring schemes.

2. A network of long-term monitoring sites should be established and maintained in both terrestrial and marine realms to document temporal changes in components of biodiversity and associated processes. This should build on existing field stations, marine laboratories, monitoring schemes and sites such as biosphere reserves and other similar areas, and should address an increasing range of taxa.

3. Methods should be developed for standardising monitoring techniques and steps taken to coordinate and disseminate these.

4. Greatly increased efforts should be made to provide a more comprehensive assessment of the status of species, both in terms of taxonomic groups covered and geographic scale, following the Red List approach. Such Red Lists should be revised on a regular basis wherever possible.

5. Methods should be identified and selected among those already existing, or developed if necessary, to assess the status of ecosystems and habitats; the status of fragile (ecosystems easily subject to human destruction) should be monitored according to the Red List strategy proposed in recommendation 7a.

6. Efforts should be made to inventory those species that are being exploited by humans as food, fuel, fodder, timber, medicine and industrial uses.

7. Methods should be developed to determine which of the species identified in (5) are sustainably exploited by humans.

8. Rapid assessment and monitoring technologies (RAT) should be promoted and their use encouraged.

9. A review should be undertaken of the feasibility of applying the concepts of "indicator groups" or "indicator species" as a means of monitoring components of biodiversity. Indicators should not be used as a substitute for basic information on biodiversity.

10. Scientific criteria for monitoring should be applied to: a) evaluation of traditional use of resources, b) evaluation of sustainable use of species and ecosystems, c) development and evaluation of land and water use practices, and d) development of criteria for species and habitat protection (see Article 8).

11. The development of international programmes of an intermediate time scale should be stimulated to assess the impact on biodiversity of large-scale bioturbation phenomena such as El Nino, extensive and historically unusual fires, and river dynamics, by monitoring selected sites. The development of a biological diversity component should be undertaken within existing global monitoring programmes such as GOOS, GTOS, etc.

Article 7(c)

Rationale

Human activities impact on biodiversity and ecosystem functioning. Intensification in land use, environmental pollution, use of fire in deforestation and shifting cultivation, etc. adversely affect biodiversity at three levels of organisation: genetic, organismal and ecological. Human activities also affect biodiversity indirectly through the combustion of fossil fuels and the consequent alteration of the atmospheric composition and the climate; the burning of fuels and other activities influence the chemical composition of the environment as a whole, not only in the atmosphere, but also at the levels of the oceans (both the water column and sediments) and soils. The economic and social problems resulting from over-exploitation and loss of biodiversity can be prevented or ameliorated by understanding their causal relationships with biodiversity. Only a handful of the many services provided by biodiversity currently have a market value. This gap in our understanding leads to under-evaluation of natural ecosystems and over-exploitation. Consequently, a quantification and valuation of all the services that biodiversity provides to humans will be useful. A better understanding of the socio-economic determinants of over-exploitation will allow the identification of incentives to prevent over-exploitation.

Recommendations

1. A better understanding of the relationship between different activities and their direct and indirect effects on biodiversity is needed. These studies should encompass the major ecosystems of each biome, and use all available tools from manipulative experiments to descriptive studies and the analysis of long term data sets.

2. Research needs to be undertaken so as to identify thresholds in the response of biodiversity to intensification of land and water use. (Ecological systems often present a non-linear response to human intervention such as minor changes in biodiversity due to increasing levels of use, up to a point beyond which dramatic losses of biodiversity occur.)

3. Research should be carried out to assess the impact on biodiversity of all measures intended to improve environmental conditions. For example, it would be important to assess the effects of plantation forestry for carbon sequestration and "sustainable" timber production in areas of potentially species-rich forests.

4. Research on the impact of climatic change on biodiversity should be strengthened and integrated with research underpinning the implementation of the Climate Convention. One of the ways this can be carried out is through the utilisation of existing global and regional pollution programmes.

5. More research is needed to have a better understanding of natural *vs*. human-driven changes in biodiversity.

Article 7(d)

Rationale

The accessibility of data from systematic inventories and monitoring is essential for the conservation and sustainable use of biodiversity. Unfortunately, much of the information on the three billion specimens which reside in existing collections, and of the related literature, is not integrated or easily accessible. Furthermore, the fact that the vast majority of biological collections and systematic research centres are located in the developed world, whereas most biodiversity is to be found in developing nations, is an impediment that needs to be addressed. Detail on this is provided in the Darwin Declaration.

Recommendations

1. Priorities should be established for databasing the massive amount of information in existing taxonomic collections and associated literature, that is currently not readily accessible.

2. The electronic capture of the above data, in conjunction with the CBD Clearing House Mechanism, should be supported and accelerated.

3. More sophisticated biodiversity information systems, including innovative software and hardware advances, should be developed.

4. A major effort should be undertaken to establish electronic interchange within and between systematic research collections by providing free access on the Internet.

5. Systems for data and information exchange should be developed, or when applicable, reinforced, particularly in those countries where scientific libraries are scarce or absent.

Article 8. *In-Situ* Conservation

8 (a)-(e)

Rationale

A comprehensive and representative system of protected areas is critical to conserve biodiversity, but such a system will inevitably represent only a small proportion of land or ocean areas (9% for terrestrial areas). The largest fraction of the Earth's surface is subject to the impacts of low to medium human intervention, while a moderate but increasing fraction is heavily impacted by intensive agriculture, urbanisation and pollution. Areas where human intervention is present but at a low enough level to maintain a high level of diversity are likely to play an increasing role in the conservation and management of biodiversity on the world scale. Here new approaches for *in-situ* conservation combined with sustainable use practices should be developed.

At the core of such a new approach, a national protected area system should be established with the aim of:

- maximising the conservation of biodiversity;
- viewing protected areas as part of the landscape matrix, rather than as islands connected by nature-friendly corridors (the "bioregional approach") so as to create a "conservation matrix" which contributes to local economies and human welfare;
- putting into place an integrated management framework for those landscapes.

Recommendations

1. General criteria should be defined for establishing protected areas. These criteria should take into account the extent to which the major biomes are represented, diversity at the genetic, species and ecosystem levels, and uniqueness of species and ecosystems.

2. The special needs of extreme environments such as hot springs, soda and salt lakes, for microbial diversity should be recognised.

3. The UNESCO Man and the Biosphere programme, with its world network of biosphere reserves should be utilised, as it provides an important framework for experimentation in the field of protected areas and sustainable use of land- and seascapes. The IUCN World Commission on Protected Areas (WCPA) and UNESCO World Heritage Convention are specifically involved in protected area work. Cooperation with the CBD and SBSTTA should be encouraged, and particularly the use and evaluation of the IUCN Protected Area categories.

4. Criteria should be sought that favour the development of regional networks of protected areas, especially in the open-sea and deep-sea marine environments.

5. Protected areas should, whenever possible, be established across latitudinal or altitudinal gradients to conserve and manage biodiversity in the face of future climate changes. More

research is needed to develop the best scientific basis for the design and implementation of such networks.

6. New policies and measures should be developed that complement protected areas, particularly the reduction of negative human impacts in areas that are important for biodiversity. Favouring low-impact ecosystems, in particular those exploited using traditional practices (see 8(j)), may be an efficient and cost-effective way of preserving biodiversity.

Article 8(f)

Rationale

Ecosystems -

The rehabilitation and restoration of degraded ecosystems is an intervention into an ecological process which constantly varies due to internal and external factors, including human intervention, and which may have different successional paths leading to different states of equilibrium. A key question in restoration efforts is: to which state does one want to restore a given degraded natural system? Much of restoration ecology is based on empirical, locally derived experience, and a scientific background, that permits extrapolation of results and prediction of responses, still needs to be developed. There has been little evaluation of the success or failure of restoration programmes, and in particular there has been a failure to establish whether restoration has resulted in the successful establishment or re-establishment of specific ecosystem functions and values.

Species –

Recent experience suggests that the reintroduction and translocation of species is only likely to be a viable option for a small proportion of macroorganisms and some invertebrates. Very few successful examples have been recorded to date and their effectiveness is difficult to judge due to the short timescales involved and the need for subsequent monitoring. Various guidelines that exist are largely pragmatic rather than being based on sound scientific knowledge. While tools are now being developed to predict long-term demography and genetics, a better understanding is still required of population growth and extinction processes and the reasons why particular species are rare.

Recommendations

Ecosystems –

1. Clear goals with realistic objectives should be set prior to undertaking restoration and rehabilitation programmes using reference ecosystems.

2. Efforts should be made to understand the effectiveness of restoration and rehabilitation programmes on the recovery or establishment of ecosystem functioning and the overall species inventory.

3. Restoration and rehabilitation programmes should, where appropriate, be more scientifically based, and relevant theory should be developed to support the carrying out of such work.

4. Efforts should be made to assess the socio–economic viability and long–term effectiveness of restoration and rehabilitation programmes and develop guidelines as to how this should be achieved, especially in the context of sustainable development.

5. Further research should be developed on organisms and biogeochemical processes that can contribute to rehabilitate polluted ecosystems.

Species –

1. A detailed assessment should be made of those species introduction and recovery programmes which have already been undertaken, with a view to drawing on this experience.

2. Research should be undertaken aimed at predicting the demographic and evolutionary potential of re-introduced populations, that depend on parameters such as population size, life stage, and initial genetic variability.

3. Long–term monitoring should be complemented with both modeling and controlled experiments.

Article 8(h)

Rationale

Recognising the threats posed by invasive species to economic productivity, ecological stability and biodiversity in general, this clause of Article 8 prescribes that contracting parties should as far as possible prevent the introduction, control or eradicate alien species that threaten ecosystems, habitats or species. In fact, invasive species often represent the greatest threat to biodiversity after habitat destruction. Invasives are not only pervasive and potentially damaging, but because of limited data, practical expertise, and inadequate social and legal mechanisms, our capacity to deal with them is somewhat limited. Because this field of study has not until recently had an experimental base, our capacity to predict which species will be invasive is still limited. Knowledge of the receiving environment is needed as well as of the characteristics of the species themselves. We do not know why some systems are more invasible than others, or why invasibility may vary with time.

Recommendations

1. An assessment is needed of the changing nature of the vectors of invasives, particularly patterns of trade.

2. An evaluation should be made as to how far, and in what ways, global change, in its broadest extent, may exacerbate the problem of invasives.

3. An early warning system should be developed to enable nations to benefit from the knowledge of others. Emphasis should be on those microbes, plants and animals that are doing the greatest damage.

4. An examination should be made of which quarantine practices and legal instruments have been most successful in preventing the importation of potential invaders.

5. Knowledge of best practices in terms of the highest degree of control in the most environmentally benign manner must be made widely available, and ways of sharing both knowledge and expertise need to be developed.

6. Greater efforts should be devoted to developing biocontrol and integrated pest management techniques and the use of environmentally safe bioengineered organisms, and to devising better ways of assessing the success of any control effort. These efforts will assure that biocontrol efforts do not result in unwanted secondary consequences on biodiversity.

7. Actions to implement the above recommendations form part of the collaborative Global Invasive Species Programme (GISP), coordinated by SCOPE in conjunction with IUCN, UNEP and CABI, and a component of the DIVERSITAS programme, which COP is invited to endorse and support.

Article 8(j)

Rationale

Traditional communities which have developed a close relationship with the natural environment are particularly important to understanding and managing biological diversity. These relationships may change over time, but are presently under particular threat. In making decisions on the conservation, sustainable use and management of biodiversity at species and ecosystem levels both modern science and traditional knowledge systems have to be employed.

Recommendations

1. Within the SBSTTA framework, a forum should be provided whereby modern science and traditional knowledge can jointly define research projects regarding implementation of this clause of Article 8.

2. Research on the application of traditional use methods should be undertaken with the full participation of traditional communities.

3. Methodologies and procedures should be developed for recording and conserving traditional knowledge on the conservation and sustainable use of biological diversity.

4. Efforts should be made to identify those areas in which loss of traditional knowledge is occurring rapidly, so that appropriate steps can be taken to prevent this loss.

5. Research is needed into ways in which traditional practices for the use of biological diversity mimic natural processes and maintain the functioning of ecosystems and how these practices can continue to be used.

6. Research needs to be undertaken on providing options that will allow local communities to adapt to new lifestyles while at the same time retaining as far as possible their traditional

knowledge, procedures, and biological diversity.

7. The complex relationships between national legislation and traditional lifestyles and use of components of biodiversity need to be carefully explored in attempting to implement this clause of Article 8.

8. Provision should be made for the education and training of the younger generations of local communities in traditional knowledge and practices.

9. Full integration of traditional knowledge (particularly that of traditional sustainable practices) into the process of developing management plans and programmes should be assured, including through the development of appropriate institutional mechanisms.

Article 8 (k)

Rationale

Any legislation and regulatory provisions developed for threatened species and populations must take into account the different levels of knowledge available on those species and populations identified as threatened. In many cases little is known about the ecology and biology of many species included on national and regional Red Lists. For many organisms, especially plants, their survival may be dependent on obligately associated beneficial organisms (e.g. mycorrhizal fungi, nitrogen-fixing bacteria, pollinating birds or insects). Any measures introduced for their conservation should therefore recognise that species do not exist in isolation.

Recommendations

1. Legal or other instruments drawn up for the protection of threatened species and populations should, where appropriate, also take into account obligately associated beneficial species that are necessary for the survival of the targeted threatened species.

2. In drawing up legal or other regulatory protection for threatened species or populations, specialist advice should be sought to ensure that provisions are made to undertake research that might enhance the possibility of conserving them.

Article 8(m)

Rationale

Considerable experience in both traditional and modern approaches to biodiversity conservation and utilisation exists in both developed and developing countries. Despite the relatively long history of international programmes on this issue, there is still an urgent need to strengthen capacity in developing countries and for developed countries to benefit from knowledge of traditional biodiversity management systems.

Recommendations

1. Support for interaction, both south/south and north/south between biodiversity specialists should be increased, especially through the establishment of joint projects and capacity building networks.

2. The compilation of “best practice” manuals and training courses should be promoted for

application in both developed and developing countries, so as to address *in-situ* biodiversity management problems through bringing together experience gained in addressing similar problems in different countries.

3. Support should be given to increasing participation by developing country workers in scientific symposia, workshops and seminars.

Article 9. *Ex-Situ* Conservation

Rationale

Ex-situ conservation is an essential component of biodiversity management. The wide interpretation of the concept of genetic resources implied in the Convention will require a policy adjustment for both *ex-situ* and *in-situ* management. *Ex-situ* conservation activities are very diverse, covering seed banks, microbial culture collections, zoos, botanic gardens, tissue and cell culture, cryopreserved material and including whole organisms, seeds, pollen, spores, embryos, semen and DNA. Importantly, however, for the majority of organisms on earth, no *ex-situ* collections have been made and a there is a strong taxonomic bias in those which do exist (e.g. less than 10% of plants represented in gene banks, 18% of described microorganisms). The justification for *ex-situ* collections depends on the group of organisms, they may be essential for the identification and subsequent study of material (and biotechnological application in the case of microorganisms), to supply material for breeding programmes (crop plants), captive breeding (endangered animal species) and education. Reintroduction and translocation of *ex-situ* propagated organisms is only likely to be a viable option for a small proportion of cases.

Recommendations

1. A mechanism needs to be devised for the implementation of clauses (a) and (b) of this Article (adopting measures and establishing and maintaining facilities for *ex-situ* conservation), given that the vast majority of collections are not under direct governmental control. To be effective, this will need to take into account the diverse interest groups and coordination at a local level.

2. A long-term commitment, infrastructural support and training are required for the maintenance of *ex-situ* collections in the country of origin. The UNESCO MIRCENS are an important element for microbial collections.

3. A system of monitoring, control and protection needs to be put in place for the many *ex-situ* collections where no such agreements exist, such as the FAO undertaking on plant and animal genetic resources. A system is needed especially for all kinds of microbial genetic resources and botanic garden collections.

4. An in-depth assessment of the availability, location and status of *ex-situ* collections of all groups is urgently needed. The programmes of the WFCC and the WDCM have made considerable progress with respect to collections of microorganisms.

5. Evidence should be sought from the many well-documented examples of biological invasions as to which species are most likely to be successful candidates for reintroduction (see also Article 8 (f)).

6. Because the success of reintroductions cannot be judged in the short term, arrangements should be made for post-release monitoring of such attempts where nonesuch already exists.

7. Systems of control and regulation of reintroductions should be put in place, because of the potentially hazardous consequences for biodiversity (ref. Article 8(f)).

8. Close attention should be paid to traditional knowledge regarding *ex-situ* conservation of genetic resources at grass roots level (ref. Article 8(j)).

9. Methodologies and techniques need to be developed for sampling genetic diversity, especially when dealing with wild as opposed to domestic species (especially for plants), when establishing and maintaining *ex-situ* collections.

10. Much more effort is needed to identify accurately and characterise the material in *ex-situ* collections.

11. More research is needed on problems such as seed recalcitrance and germination, as yet uncultured microorganisms, poor breeding success in endangered animals, DNA handling and curation and the collection of environmental genetic samples.

12. A body needs to be established to help coordinate the activities of the different *ex-situ* constituencies listed in the rationale. Issues such as databasing, curation standards and commercial exploitation of genetic resources are common to some, if not all *ex-situ* activities, and it is highly likely that efforts are being needlessly duplicated due to lack of communication among different sectors of the *ex-situ* community.

Article 10. Sustainable Use of Components of Biological Diversity

Rationale

To ensure the sustainable use of components of biodiversity in a given area, the ecosystem approach should be applied. The ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organisation which encompass the essential processes and interactions amongst organisms and their environment. The ecosystem approach recognises that humans are an integral component of ecosystems. (This definition of "ecosystem approach" was developed at a Workshop co-hosted by the Governments of Malawi and the Netherlands, recently held in Lilongwe.)

If possible the precautionary principle should be applied whenever natural resources are utilised. The use of biological resources must be viewed in an integrated context that satisfies the needs of both long-term resource sustainability and environmental conservation.

More selective harvesting techniques that are less destructive of non-target species in any area that is exploited should be developed and applied, and lessons should be learned from effective traditional exploitation methods by local communities.

Recommendations

1. A network of co-ordinated databases on wild species that are being used by humans should be established (ref. Article 7 (b)) once an inventory has been made.

2. Criteria should be established for sustainable use, based on the population dynamics of the target species and on the effects of their use on the exploited system.

3. Complementary research is needed in population biology of target species and on how exploitation of some populations in a given ecosystem affects the functioning of the total system, for example its robustness and resilience. (i.e. the consequences of fisheries on the genetic diversity of the exploited populations and the functioning of aquatic systems to which they belong.)

4. Research is needed on the relationships between socio-economic factors, and the achievement of sustainable use should be promoted to demonstrate economic efficiency of sustainable practices.

5. The use of alien species in ecosystems should not occur unless a thorough scientific analysis of their possible negative effects on biodiversity has been carried out (ref. Article 8h).

Article 14. Impact Assessment and Minimizing Adverse Impacts

Rationale

Sound methods of assessing and communicating the impacts of factors potentially affecting the conservation of biodiversity as envisaged in Articles 14 (a) and 14 (d) must be developed and implemented. It is also important that the assessments focus more on providing early warnings of incipient problems rather than recording damage at a stage where it may be irreversible. Some adverse impacts may be wide-ranging and have effects beyond the limits of particular ecosystems or national boundaries. The use of comparable assessment systems over as wide a geographic area as possible is therefore advantageous.

Populations, or the status of single species or even groups of organisms may be affected by an array of diverse factors not necessarily indicative of more general changes. Thus, methods based on a wide range of organisms are more likely to be indicative of changes of general concern.

In view of the vast number and size of the areas requiring continuous impact analysis, it is imperative that assessment techniques be usable after minimal training by non-specialists, including conservation officers, reserve managers, and local communities.

It should be noted that some of the bioindication approaches developed in temperate regions, and which have been effectively employed by non-specialists and even school-children (e.g. in surveys of air and water pollution), can also be used in tropical countries, and that some progress to this end has already been made in UNEP/GEF sponsored discussions on how to establish a Tropical Areas Bioindicator System (TABS).

Recommendations

1. Environmental impact assessment procedures should be strengthened by techniques that enable users to access the appropriate knowledge base for impact prediction and conflict resolution.

2. The assessment methods employed should be based on a suite of organisms that respond to similar types of perturbations (whether environmentally or human-induced), and that provide early warnings of potential threats at the ecosystem level. These methods should be designed so that they can be employed over wide geographical areas by non-specialists, including local communities.

List of Acronyms and Abbreviations

CABI	Commonwealth Agriculture Bureau International
CBD	Convention on Biological Diversity
COP	Conference of the Parties (to the Convention on Biological Diversity)
FAO	Food and Agriculture Organisation of the United Nations
GBO	Global Biodiversity Outlook
GCTE/IGBP	Global Change and Terrestrial Ecosystems/International Geosphere-Biosphere Programme
GEF	Global Environment Facility
GISP	Global Invasive Species Programme (DIVERSITAS - SCOPE, IUCN, UNEP, CABI)
GOOS	Global Ocean Observing System (IOC, WMO, UNEP, ICSU)
GTOS	Global Terrestrial Observing System (FAO, WMO, UNESCO, UNEP, ICSU)
ICSU	International Council of Scientific Unions
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IUBS	International Union of Biological Sciences
IUCN	The World Conservation Union
IUMS	International Union of Microbiological Societies
MAB	Man and the Biosphere Programme (UNESCO)
MIRCENS	Microbial Resources Centres (UNESCO)
RAT	Rapid Assessment and Monitoring Technologies
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice (to the Conference of Parties of the Convention on Biological Diversity)
SCOPE	Scientific Committee on Problems of the Environment (ICSU)
TABS	Tropical Areas Bioindicator System
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WCPA	World Commission on Protected Areas (IUCN)
WDCM	World Data Centre on Microorganisms, Japan
WFCC	World Federation for Culture Collections
WMO	World Meteorological Organisation (United Nations)

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