2. How to interpret biodiversity: the broad view.

This section provides an overview of the knowledge minimally required to address biodiversity within the broader context of impact assessment. It describes how parties to the conventions have defined biodiversity, what the objectives of biodiversity management are, and what approach should be taken to biodiversity management. It summarises the following, strongly related documents:

- Principles of the convention[1]
- Ecosystem approach[2]
- IAIA principles on Biodiversity inclusive impact assessment (in press)
- Conceptual framework to the Millennium Ecosystem Assessment[3]
- Biodiversity Assessment Framework for Corporate Social Responsibility[4]

The added subtitle, "the broad view" refers to the fact that many non-biodiversity experts in impact assessment may view the presented description of biodiversity as an all-encompassing concept, which includes many aspects of impact assessment that already are common practise without it necessarily being described as biodiversity. This chapter will show that biodiversity indeed is a broad concept. The next chapter will describe the implications of this broad view for impact assessment, how present-day impact assessment already effectively deals with many aspects of biodiversity, what elements in our existing tools and procedures can be improved, and how this can be done without creating a new family of impact assessment tools.

Definition. The Convention on Biological Diversity (CBD) defines biodiversity as "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 part; this includes diversity within species, between species and of ecosystems." In other words, it is the variety of life on earth at all levels, from genes to worldwide populations of the same species; from communities of species sharing the same small area of habitat to worldwide ecosystems.

Objectives. The CBD has three main objectives:

- the conservation of biological diversity (= maintaining earth's life support systems and maintaining future options for human development),

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[1] http://www.biodiv.org/convention/articles.asp

[2] Convention on Biological Diversity: Decision V/6 Ecosystem Approach (http://www.biodiv.org/decisions/default.aspx?m=COP-05&id=7148&lg=0) and Decision VII/11 Ecosystem Approach (http://www.biodiv.org/decisions/default.aspx?m=COP-07&id=7748&lg=0))

[3] Millennium Ecosystem Assessment (2003). Ecosystems and Human Well-being: A Framework for Assessment. Island Press. (http://www.millenniumassessment.org/en/products.ehwb.aspx)

[4] The Biodiversity Assessment Framework – Netherlands Ministry of Public Housing, Spatial Planning & Environment (2004).

- the sustainable use of its components (= providing livelihoods to people, without jeopardising future options), and
- the fair and equitable sharing of the benefits arising from the use of genetic resources.

Conservation. Guiding principles for conservation are that:

- Ecosystem, species and genetic diversity are conserved to ensure that they persist into the future, providing a range of values. Priority is given to ensuring the protection of threatened, declining or endemic ecosystems, ecosystems which play a key role in providing ecosystem services, unique habitats, endemic, threatened or declining species, species of known use or cultural value to society.
- Priorities and targets for biodiversity conservation at international, national, regional and local level are respected, and a positive contribution to achieving these targets is made.
- Some losses of biodiversity are irreversible; in these situations the "no net loss" principle is applied to protect biodiversity resources that cannot be replaced and that have unknown future values.
- The persistence of ecosystems and species is promoted by making provision for, and/or maintaining, natural corridors between fragments of a particular ecosystem, and between/along different gradients (eg altitude, climatic, landscape, watershed gradients).
- Habitats which play a vital role in supporting seasonal or migrant species are conserved.

Opportunities to enhance biodiversity through restoring, re-creating or rehabilitating natural habitat are used to optimum benefit. Unavoidable negative impacts on biodiversity are fully compensated by providing substitutes of at least similar biodiversity value.

Sustainable use. Guiding principles for sustainable use are that:

- Life support systems and ecosystem services such as water yield, water purification, breakdown of wastes, flood control, storm and coastal protection, soil formation and conservation, sedimentation processes, nutrient cycling, carbon storage and climatic regulation, amongst others, are maintained, thus safeguarding livelihoods and keeping future options open for human development.
- Use of living materials is such that yield or harvest can be maintained over time, supporting lives and livelihoods.

Equitable sharing. Guiding principles for equitable sharing of benefit accrued from biodiversity are that:

- Benefits from commercial use of natural resources are shared fairly, giving due consideration to those who have traditionally had access to, and/or knowledge about, those resources.
- The probable needs of future generations, as well as those of current generations, are taken into account (intergenerational needs). That is, natural capital is not 'traded in'

to meet short term needs, where this trading in could jeopardise the ability of future generations to meet their needs.

Ecosystem approach. The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. The application of the ecosystem approach will help to reach a balance of the three objectives of the Convention: conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources. In addition the ecosystem approach has been recognized by the World Summit on Sustainable Development as an important instrument for enhancing sustainable development and poverty alleviation (CBD Decision VII-11). Humans, with their cultural diversity, are an integral component of many ecosystems. People and biodiversity depend on healthily functioning ecosystems and processes; these have to be assessed in an integrated way, not constrained by artificial boundaries. The ecosystem approach is participative and requires a long-term perspective based on a biodiversity-based study area. It requires adaptive management to deal with the dynamic nature of ecosystems and the absence of complete understanding of their functioning.

Goods and services. Achieving the objectives of the convention, for example by applying the ecosystem approach, requires understanding of the goods and services provided by biodiversity as important contributors to human well-being. Although the terminology used to describe these goods and services show considerable differences, conceptually the differences are relatively small. The main text of COP Decision 6-VIIa refers to "use" and "non-use" functions of biodiversity. Appendix 3 of the same decision refers to the terminology elaborated in The Biodiversity Assessment Framework. The latter describes functions of the natural environment in four main categories: production, processing and regulation, carrier and significance functions. Recently, the Millennium Ecosystem Assessment (MA) provided an elaborate conceptual framework using the common denominator "ecosystem services". In order to create some uniformity in the use of terminology the MA terminology and definition is used.

Ecosystem services. The MA defines ecosystem services as "the benefits that people obtain from ecosystems". Four categories of services are distinguished:

- Provisioning services: harvestable goods such as fish, timber, bush meat, fruits, genetic material.
- Regulating services responsible for maintaining natural processes and dynamics, such as water purification, biological control mechanisms, carbon sequestration, pollination of commercially valuable crops, etc..
- Cultural services providing a source of artistic, aesthetic, spiritual, religious, recreational or scientific enrichment, or nonmaterial benefits.
- Supporting services necessary for the production of all other ecosystem services, such as soil formation, nutrients cycling and primary production.

Values of biodiversity. Ecosystem services influence human well-being, and thus represent a value for society. Values can be expressed, positively and negatively, in different terms:

- Economic values: (i) direct income, for example by selling of products; (ii) input to other activities by providing raw materials; (iii) indirect value by providing services that would require large investments if not present such as coastal protection by dunes or mangroves.
- Social values: employment, safety, health, quality of life, social security, appreciation of the presence of animal and plant life, etc.
- Ecological values, differentiated into (i) future values, saving biodiversity and its so far unrecognised potential for future use; and (ii) spatial values, relating to biodiversity on which biodiversity in other areas depend (e.g. birds depend on feeding areas along their migration routes).

Two different views exist in the expression of ecological values. In the anthropocentric or utilitarian view, ecological values are referred to as non-use or existence values; the non-utilitarian approach considers biodiversity as having a value in itself (intrinsic value), irrespective of its contribution to human well-being. Although using incomparable expressions of values, both views are used in political decision making.

Levels of biodiversity. Countries that have signed the CBD are required to implement policies to protect biodiversity at different levels:

- Ecosystems containing (i) rich biodiversity, (ii) large numbers of threatened or endemic species, with social, economic, cultural or scientific significance, or (iii) relevant for key processes such evolutionary processes, and (iv) ecosystems of relevance to migrating species;
- Species and communities of species that are (i) threatened in their existence, (ii) related to domesticated or cultivated species, and (iii) species with medicinal, agricultural, or other economic, social, cultural or scientific significance, and (iv) indicator species.
- Genotypes with social, scientific or economic significance.

Aspects of biodiversity. Signatory countries (= parties) must identify activities that are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects. Impacts at each level of diversity can be best assessed in terms of:

- Composition: what there is and how abundant it is; this is the most commonly known aspect of biodiversity. In practise impact analysis often does not go beyond the description of effects on species composition of higher plant and animal species.
- Structure (or pattern): how biological units are organised in time and space. A limited number of aspects are of disproportional influence on the maintenance of biodiversity:
    - *spatial structure and scale* of the ecosystem in relation to the scale of the human intervention. Ecological scale has spatial and temporal dimensions. Scale consists of grainsize (finest level at which something works) and extent (size and duration). Nature has fine grain and large extent. For example, local erosion has relatively little impact on the functioning of a river basin since the eroded material will be deposited somewhere else in the basin; contrary to this,

a change in river hydrology by construction of a dam will be noticeable in the entire basin and beyond.

- *foodweb structure and interactions* that shape the flow of energy and the distribution of biomass: changes in the foodweb has immediate repercussion for the functioning of the entire system. For example, the introduction of the predatory non-endemic Nile perch in lake Victoria has upset the entire ecosystem; dozens of specialised fish species feeding an algae have been eradicated, leading to a turbid and locally deoxygenised lake.
- *presence of keystone species*, a keystone species is one whose impacts on its community or ecosystem are large and greater than would be expected from its relative abundance or total biomass; a limited changes in numbers of individuals had disproportional effects on the entire system.

- Key processes: what physical and/or biological and/or human processes are of key importance for the creation and / or maintenance of ecosystems. For example, key physical processes are the sediment balance in a mangrove coast or a tidal mud flat, or the inundation regime of wetlands; a key biological process is the grazing pattern in savannahs, or predation of coral reefs by starfish. Note that key processes can be driven by external factors (climate, tidal regime, sediment flow), or by internal ecosystem processes (nutrient and energy flow, population dynamics, etc.). Also human processes can be of key importance; a number of ecosystems (better referred to as land-use systems) has been created by centuries of human management; examples are high altitude meadows, heather lands, nutrient-poor grasslands.

It is important to realise that potential significant impacts on biodiversity can be identified without having a complete description of the biodiversity. If an intervention is expected to result in changes of composition, structure or key process, there is a serious reason for concern and further studies can be focussed on this expected change. Especially for areas where available data on biodiversity is limited, this approach had the advantage of focussing costly data collection efforts on the relevant aspect of biodiversity (and thus avoiding lengthy descriptive studies of all biodiversity aspects in the intervention area).

Human activities: drivers of change. The Millennium Ecosystem Assessment states that understanding the factors that cause changes in ecosystems and ecosystem services is essential to the design of interventions that enhance positive and minimize negative impacts. Such factors are called drivers of change and can be natural or human-induced. Impact assessment is primarily concerned with human-induced drivers of change.

The design of the impact assessment process is such, that:

- The full range of factors that cause changes in biodiversity is considered:
  - direct drivers of change, which can be identified and measured, include the following groupings of physical and biological interventions: (i) land occupation and conversion, (ii) fragmentation and isolation, (iii) extraction, (iv) emissions, (v) disturbance, (vi) introduction of invasive, alien and genetically modified species, (vii) restoration).
  - indirect drivers of change which can in turn influence the direct drivers, include (i) demographic, (ii) economic, (iii) socio-political, (iv) cultural and (v) technological processes or interventions.

- Differentiation is made between those drivers that can be influenced by a decision-maker (endogenous driver), and others which may be beyond the control of a particular decision-maker (exogenous drivers).
- The temporal, spatial and organisational scales at which a driver of change can be addressed, are defined.

Information and precautionary principle. The precautionary principle asks for a risk-averse and cautious approach in cases where impacts cannot be predicted on a scientifically relevant level of detail or there is uncertainty on the effectiveness of mitigation measures. If the magnitude of impacts on important biodiversity resources cannot be established with sufficient certainty, the activity is halted as a precaution until enough information is available.

Local and indigenous knowledge is used, and views are exchanged with stakeholders and experts as valuable elements of any analysis in order to come to a complete overview of issues. Information on biodiversity is consolidated and effects are monitored.

Participation. Different groups or individuals in society have an interest (a stake) in the maintenance and/or use of biodiversity. Consequently, valuation of biodiversity and ecosystem services can only be done in negotiation with stakeholders. Stakeholder should consequently have a formal role in the impact assessment process.

Cumulative impacts and strategic decisions. In situations where there is a high risk of cumulative impacts on biodiversity, resulting either from repeated impacts of projects of the same or different nature over space and time, and/or from proposed plans, programmes or policies, a strategic level impact assessment is recommended.