ARE THE POTENTIAL IMPACTS ON BIODIVERSITY ADEQUATELY ASSESSED IN SOUTHERN AFRICAN ENVIRONMENTAL IMPACT ASSESSMENTS?

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presented at a workshop on
Biodiversity and Impact Assessment
Christchurch, New Zealand
21-22 April 1998

This paper was presented in: Programme and Papers for the IAIAsa '97 Conference on "Integrated Environmental Management in Southern Africa: the state of the art and the lessons learnt" (Compiled by G. Kruger), pp 173-182, KwaMaritane, South Africa.

Overview. *The aim of the paper is to evaluates how adequately biodiversity has been assessed in reports on Environmental Impact Assessments. The analysis is based the reports available from a number of EIAs, including scoping reports, specialist studies and Environmental Impact Reports. References to biodiversity, and biodiversity related issues, were classified according to whether they addressed the species, community or landscape level and compositional, structural or functional components of biodiversity. The analysis showed that the impacts on biodiversity are not being adequately addressed and that functional biodiversity, in particular, is inadequately assessed. There are various possible causes, with the most important one being inadequate terms of reference for the specialist studies and a failure to co-ordinate and integrate specialist studies. Many interested and affected parties, and often the personnel leading environmental impact assessments, do not understand the full meaning of biodiversity, particularly the importance of functional biodiversity. The possible solutions include developing guidelines, similar to the existing lists of "environmental characteristics", to ensure that biodiversity assessments cover the important issues. The guidelines could be complemented by providing training courses on biodiversity for project managers, specialists and other interested parties. Environmental Impact Assessments are potentially an important tool for the conservation of biodiversity but this potential is not being realised at present.*

1. Introduction

The science and practice of Environmental Impact Assessment (EIA) has progressed significantly during the last decade and EIAs have become accepted practice for most large or controversial development projects in South Africa. The Green Paper on Biological Diversity emphasises the

need to: "Integrate biodiversity considerations into land-use planning procedures and environmental assessments" (DEA&T 1996). The primary aim of this analysis is to initiate debate on how to raise the standard of biodiversity impact assessments. We examine whether, and to what extent, biodiversity has been addressed in a number of the major EIA studies carried out in southern Africa, and analyse the possible causes to identify ways improving current practice.

1.2 Biodiversity and Impact Assessment

Ecological impact assessment is the process of identifying, quantifying and evaluating the potential impacts of particular actions on ecosystem components and their interactions (UNEP 1995; Eberhardt 1976; Westman 1985; Treweek 1995; Canter 1996). Biodiversity impact assessment, therefore, specifically addresses the nature and role of different biological components in the composition, structure and functioning of the different ecological units affected by a development.

Biodiversity is a difficult concept to define precisely (Noss 1990; UNEP 1995). It is derived from “biological diversity”, which means the diversity (variety and variability) of all living things (Wilson 1988). Biodiversity is expressed at different levels or scales of organisation (genes to landscapes Table 1) and has three different attributes or components (compositional, structural and functional) (Noss 1990; Franklin 1988).

Although there is no simple way to measure biodiversity, and it is not possible to measure it comprehensively, substantial progress has been made in identifying what needs to be measured and how (UNEP 1995). Often what is needed is a shift in perspective. For example a study may conclude that nutrient cycling will not be adversely affected, but fail to identify the fact that a key organism in the nutrient cycle will be affected because another organism vital to its life cycle will be lost for other reasons. The evidence that is emerging from recent research suggests that it is essential to assess as many aspects as possible, both because it is easy to overlook important aspects and because biodiversity is a sensitive indicator of the status of the processes that maintain natural systems (Noss 1990; Heywood & Baste 1995). Pragmatic solutions need to be found (Roberts 1988), one of these being to use indicators, i.e. species and variables which are sensitive to changes in the state and dynamics of natural systems (Noss 1990; Cairns & McCormick 1992; Stork & Samways 1995). In this analysis we use Noss’ (1990) framework (Table 1) to investigate how biodiversity is assessed, identify some of the weaknesses and suggest some guidelines that could enhance biodiversity assessment in future.

2. Methods

Reports were obtained from a wide variety of southern African EIAs. The terms of reference (TOR) for specialist studies, as given the Scoping Report, could be found for only nine of the EIA's we examined. Thirty-five specialist studies from seven EIA's were assessed and twenty-two executive summaries from various EIA's were assessed. The St Lucia EIA was examined in detail because of the thoroughness with which biodiversity issues were covered. The various issues raised or addressed in the EIA's were assessed and allocated to the most appropriate level and component of biodiversity, as defined by Noss (1990; Table 1).

3. Results

3.1 Scoping - terms of reference (TOR)

Biodiversity was raised as specific issue only in the St Lucia EIA. In the other eight EIA scoping reports aspects of biodiversity were identified as issues, but biodiversity *per se* was not raised as an issue. The TOR for specialist studies in all the EIA's were ambiguously phrased and open to interpretation. For example, statements such as "assess the impact of the development on terrestrial vertebrates" or "identify what could impact negatively on the species" are clearly open ended. The specialist could interpret this in many ways and there is no explicit directive to assess even basic aspects such as ecosystem function (e.g. nutrient cycling) and dynamics (e.g. succession). The final scope of the specialist studies therefore depends primarily on the experience of the specialists and their understanding of what needs to be addressed.

Some specialist study TOR were more explicit and addressed specific components of biodiversity. For example, St Lucia EIA TOR for the specialist study on vegetation and floristics required an assessment of: "successional changes due to natural events and man induced management controls" and "the effects of pine removal on habitat types and community dynamics". The wetlands study in the St Lucia EIA also required the specialist to collaborate with others in different fields to ensure that the assessment was comprehensive.

In the Eskom Nuclear Site Specific Investigation in the Southern Cape biodiversity issues were, at least implicitly, included in the TOR for the integrative report on terrestrial and wetland ecosystems. However, the companion report on marine ecosystems had no detailed TOR. In a similar investigation on the west coast the TOR for the specialist studies were provided in the form of a table of contents. Under the heading

"Conservation and resource value" the following aspects were specified: species of conservation importance, importance of sites for the component under discussion in a regional context, the role of the component in the functioning of the west coast ecosystem. In the Chevron EIA the scoping report identified several issues relating to biodiversity but provided only general TOR. Only one the twelve specialist studies (the one on birds) included the project brief and aims. Concerns about revegetation and rehabilitation were raised by the I&AP's in the EIA for the Namakwa Sands mine on the west coast but the TOR for the Conceptual Rehabilitation Plan only identified compositional biodiversity.

The second phase of the Saldanha Steel Project EIA provided detailed TOR in the scoping report. The TOR for specialist studies on vegetation and fauna emphasised compositional aspects of biodiversity. In the Frégate Island hotel and harbour development EIA, the conservation of habitats and species, vegetation dynamics (succession and dispersal) were identified as important areas of concern in the scoping phase. Again, only five of the ten specialist studies of biological components had TOR that referred to biodiversity related issues. Functional aspects of biodiversity were only included in the studies of landscaping and rehabilitation and of hydrogeology. Detailed TOR, including the functioning and dynamics, were provided by National Environment Commission in Maputo for Mosa Florestal afforestation EIA in Mocambique. Even so there were gaps, with the specialist studies on the biotic environment and the aquatic fauna having no terms of reference.

3.2 Investigation - specialist studies

Species composition received most attention in specialist studies (Figure 1), but usually just as species list which noted whether they were rare or endangered. Occasionally the lists included growth forms, habitats and distributions, but this was presented as bald facts and no information on the species roles in ecosystem dynamics and processes was provided. Functional diversity at the landscape level was generally neglected (Figure 1) and not viewed in the context of the role of different ecosystems in landscape processes. The fact that impacts cannot be adequately addressed without considering these aspects was not always appreciated. For example, the West Coast Nuclear Site Investigation identified the relationship between veld degradation, wind erosion and poor vegetation regrowth, but did not identify the roles of particular biodiversity components (species, communities) in these processes. Some studies were more specific, for example the mammal study in this EIA identified two mammals as indicators of ecosystem health. The possible disruption of the regulation of dassie population by leopards (functional role) was mentioned in the

Plettenberg Bay Marina EIA. The Mosa Florestal EIA specialist study on the biotic environment reviewed the potential impacts of changes in water-table levels on the viability of swamp forests (community function) and impacts on animal movement corridors (landscape function).

3.3 Executive summaries of reports

The executive summaries generally emphasised compositional rather than structural or functional components (Figure 2) while almost half addressed compositional, structural and functional biodiversity at the community level. The Frégate Island and Mosa Florestal studies were the only ones that addressed functional biodiversity at the level of species, communities and landscapes. Only the Alusaf and Mosa Florestal studies considered compositional biodiversity at the landscape level. Functional components were usually only addressed through recommendations for future research or indirectly via factors related to function (e.g. disturbance, rehabilitation) rather than by addressing ecosystem function as such. Landscape level function was discussed to a greater extent than in the specialist studies (Figures 1 and 2). This was mainly because of the broad scope and integrative nature of executive summaries and because landscape level issues were included in recommendations for future actions rather than in the EIAs themselves. For example, in the St Lucia EIA many of the deficiencies in the specialist studies (e.g. functional issues) were addressed in the reports on the key issues (Figure 3).

4. Discussion

This analysis provides clear evidence that biodiversity is not being adequately addressed in EIA studies undertaken in southern Africa. In many cases only the really basic components such as species lists are compiled. Few attempts have been made to assess the functional components of biodiversity. Many specialist studies did not clearly state their terms of reference or even give a clear set of objectives or aims. This made it very difficult to assess the extent to which they actually met their terms of reference, let alone whether aspects of biodiversity were adequately addressed.

In many of the EIAs even the basic requirements of an ecological impact assessment (identifying, quantifying and evaluating the potential impacts of particular actions on ecosystem components and their interactions) have not been met. This is a point of concern as there are clear guidelines on how to undertake ecological impact assessments and on the issues that should be addressed (Eberhardt 1976; Walker & Norton 1982; Beanlands & Duinker 1984; Westman 1985). Many of these are simply good scientific practice

and are not peculiar to environmental impact assessment, although meeting the demands for accurate predictions can be a significant problem (Walker & Norton 1982; Treweek 1995). The following sections explore some of the possible sources of these weaknesses.

4.1 Sources of the inadequate assessment of biodiversity

4.1.1 Scoping phase

As the scoping phase is the one which defines the EIA study it is clearly the critical one for determining how effectively an EIA addresses biodiversity. The modern approach is issues-based (DEA 1992; Preston *et al.*1992) and the specialist studies are identified and defined through consultation with the public, concerned parties and specialists (DEA 1992; Roberts 1995). Although this approach has important strengths it does have weaknesses. It places the onus on the I&APs to identify and raise issues which is potentially problematic as the public and even many specialists do not fully understand biodiversity and the impacts of developments on it (Heywood & Baste 1995). The need to address particular issues can easily result in a failure to integrate specialist studies at the outset, a prerequisite for addressing ill-defined problems (such as biodiversity) which, by nature, cross disciplinary boundaries (Weaver *et al.* 1996).

The EIA personnel who draft the "Terms of Reference" for the specialist studies may also not realise the importance of biodiversity, or may not biological training or experience. The IEM process provides for I&AP's to review the TOR but this, again, assumes that the reviewers, including the public, understand biodiversity and can identify the gaps.

4.1.2 Specialist studies

The findings of this study suggest that many of the specialist studies do not address biodiversity or fail to address aspects other than species composition. There could be several reasons for this, including a lack of data (e.g. the role of particular species in ecosystem function). Many of the impacts on ecosystem function may be indirect and these are very difficult to deal with even when intensive and medium to long-term studies are possible (Strauss 1991). Specialists may also not consider the different components and levels of biodiversity because of the nature of their training. Functional studies often consider only the process (e.g. nutrient cycling) and not the species involved or their other roles in the ecosystem. The inadequate assessment of biodiversity by the specialists, and the lack of integrated studies, means that the compilers of synthesis reports have to rely on their own understanding to address these issues. The fact that these issues are better addressed at this level (Figure 3) does imply that a degree of understanding does exist and that the issues could also be addressed by

the specialists. The problem of inadequate assessment is not confined to biodiversity. Reviews of ecological impact assessments have found that many fail to address basic aspects of ecology (Buckley 1991; Arquiaga et al. 1992; Treweek *et al.* 1993).

4.2 Improving the process by providing guidelines

Many of the causal factors implicated in this analysis have been identified as causes of poor assessments in other countries. These include inadequacies in the EIA process, institutional issues, and a lack of scientific data on, and poor understanding of, complex ecological processes (Treweek *et al.* 1993; Treweek 1996; Canter 1996). This problem has been recognised and some guidelines for biodiversity impact assessment are available (e.g. Sadler 1996) but have not yet been tested in South African situations.

In recent years there has been a shift in the emphasis of EIA from minimising impacts to assuring sustainability (Sadler 1996; Goodland & Daly 1995; Ortolano & Shepherd 1995). This was evident in the St. Lucia where sustainability had an impact on decisions that were made (Kruger *et al.* in press). This shift has many implications for ecological impact assessments (Treweek 1996), especially for those where biodiversity and biodiversity related issues are involved (DEA&T 1996). Application of the precautionary principle should also highlight gaps in knowledge that can be used to initiate and direct research.

5. Conclusion

We are not calling for a return to the impact matrix approach to EIA's or for comprehensive biodiversity assessment to become a prerequisite overnight. What is needed though is a protocol or guidelines that will ensure that key issues, such as functional biodiversity, are not neglected simply because they are not raised by the I&APs or understood by project managers or specialists. The place to address these issues is in the specialist studies as these provide the information needed for higher level synthesis. Thus the requirement for an examination of these issues has to be built into their TOR's. We believe that the tools required for an adequate assessment of the impacts of development on biodiversity are in place and hope that this paper will stimulate constructive debate which will turn that belief into reality.

References

Arquiaga MC, Canter LW & Nelson DI 1992. Risk assessment principles in environmental impact studies. *The Environmental Professional* 14: 204-219.

Beanlands GE & Duinker PN 1984. An ecological framework for environmental impact assessment. *Journal of Environmental Management* 18: 267-277.

Buckley R 1991. Auditing the precision and accuracy of environmental impact predictions in Australia. *Environmental Monitoring and Assessment* 18: 1-23.

Cairns J & McCormick V 1992. Developing an ecosystem-based capability for ecological risk assessments. *The Environmental Professional* 14: 186-196.

Canter LW 1996. *Environmental Impact Assessment.* 2nd Edition, McGraw-Hill Inc., New York.

DEA 1992. The integrated environmental management procedure. Guideline Document No. 1, Integrated Environmental Management Guideline Series, Department of Environment Affairs, Pretoria.

DEA&T 1996. Green paper on the conservation and sustainable use of South Africa's biological diversity. Department of Environmental Affairs and Tourism, Pretoria, October 1996.

Eberhardt, LL 1976. Quantitative ecology and impact assessment. *Journal of Environmental Management* 4: 27-70.

Franklin JF 1988. Structural and functional diversity in temperate forests. In: *Biodiversity,* ed. EO Wilson, pp. 166-175. National Academy Press, Washington.

Goodland R & Daly H 1995. Environmental sustainability. In: *Environmental and social impact assessment*, eds F Vanclay & DA Bronstein, pp 303-322. J Wiley & Sons Ltd, London.

Heywood VH & Baste I 1995. Introduction. In: *Global biodiversity assessment*, exec. ed. VH Heywood, pp 1-19. Published for the United Nations Environment Programme, Cambridge University Press, New York.

Kruger, FJ, van Wilgen, BW, Weaver, A vB Weaver & T Greyling in press. Sustainable development and the environment: lessons from the St Lucia Environmental Impact Assessment. *South African Journal of Science* 92.

Noss RF 1990. Indicators for monitoring biodiversity. *Conservation Biology* 4: 355-364.

Ortolano L & Shepherd A 1995. Environmental impact assessment. In: *Environmental and social impact assessment*, eds F Vanclay & DA Bronstein, pp. 3-30. J Wiley & Sons Ltd, London.

Preston GR, Robbins N & Fuggle RF 1992. Integrated environmental management. In: *Environmental Management in South Africa*, eds RF Fuggle and MA Rabie, pp. 748-761. 2nd edition, Juta, Cape Town.

Roberts L 1988. Hard choices ahead on biodiversity. *Science* 241: 1759-1761.

Roberts R 1995. Public involvement: from consultation to participation. In: *Environmental and social impact assessment*, eds F Vanclay and DA Bronstein, pp 221-246. J Wiley & Sons Ltd, London.

Sadler B 1996. Environmental assessment in a changing world: evaluating practice to improve performance. *Final Report, International Study of the Effectiveness of Environmental Assessment*. Canadian Environmental Assessment Agency, International Association for Impact Assessment. Catalogue Number EN106-37/1996E, Ministry of Supply and Services, Ottawa, Canada.

Stork NE & Samways MJ 1995. Inventorying and monitoring. In: *Global biodiversity assessment*, exec. ed. VH Heyward, pp 453-543. Published for the United Nations Environment Programme, Cambridge Press, New York.

Strauss SY 1991. Indirect effects in community ecology: their definition, study and importance. *Trends in Ecology and Evolution* 6: 206-210.

Treweek, J 1995. Ecological impact assessment. In: *Environmental and social impact assessment*, eds F Vanclay & DA Bronstein, pp 171-191. J Wiley & Sons Ltd, London.

Treweek J 1996. Ecology and environmental impact assessment. *Journal of Applied Ecology* 33: 191-199.

Treweek JR, Thompson S, Veitch N & Japp C 1993. Ecological assessment of proposed developments: a review of environmental

statements. *Journal of Environmental Planning and Management* 36: 295-307.

UNEP 1995. *Global biodiversity assessment*, exec. ed. VH Heyward, Published for the United Nations Environment Programme, Cambridge Press, New York.

Walker BH & Norton, GA 1982. Applied ecology: towards a positive approach. II. Applied ecological analysis. *Journal of Environmental Management* 14: 325-342.

Weaver A vB, Greyling T, van Wilgen BW & Kruger FJ 1996. Logistics and team management of a large environmental impact assessment: proposed dune mining at St Lucia, South Africa. *Environmental Impact Assessment Review* 16: 103-113.

Westman WE 1985. Ecology, impact assessment, and environmental planning. J Wiley & Sons, New York.

Wilson EO 1988. The current state of biodiversity. In: *Biodiversity,* pp 3-18. National Academy Press, Washington.