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Developing an early warning system for environmental degradation in Namibia

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Abstract

As in most arid countries, virtually all economically productive land in Namibia is rangeland, and subsistence and commercial agriculture contribute a steady 13% to its natural resource-based GDP. Extreme environmental variability, aridity, marginal soils and a 3.1% human population growth rate pose daunting hurdles for the future. The Biodiversity, Desertification and Climate Change Conventions together provide a reasonable framework for adaptive management and mitigation. In Namibia they are supported by well integrated national programmes tackling degradation, including biodiversity loss, at the interface of conservation and agriculture. Increasing integration has improved joint planning of monitoring efforts, indicator selection and mitigation. All three programmes must be informed by biophysical indicators of degradation, including disruption of ecosystem function.

Can useful bio-indicators of degradation in arid rangelands be identified and cost-effectively tracked in order to 'flag' severe degradation before it becomes economically irreversable? Pilot studies are focusing on soil invertebrates (termites, beetles) and soil processes as indicators of land use practices and intensity in communal farming areas of northwestern Namibia. Mycorrhizae and macrofungi will be assessed as indicators in the future. Two plants (*Acacia mellifera, Dichrostachys cinerea*) are established indicators of decreasing productivity through bush encroachment, a process regarded as economically irreversible which costs Namibia an estimated annual N$2 million (USD $400 000) per year.

Effective bio-indicators for rangeland health in Africa must be monitored easily and cheaply by rural people with little specialised training. Namibia's successful community-based natural resource management programmes have led the way in developing monitoring approaches and conservation management incentives.

Introduction

Despite considerable mineral and biological wealth, Namibia is an extremely arid African country with difficult environmental and economic challenges to face in the 21st century. Low and extremely variable rainfall, high evapotranspiration, marginal soils, a high human population growth rate of 3.1%, faltering economic growth, and historical public suspicion of conservation initiatives make sustainable development fraught with uncertainty. Namibia's biotic resources cannot be exploited intensely and continuously if it is to escape the environmental degradation and increasing poverty afflicting other arid developing countries. Most Namibians are subsistence farmers, and there is an urgent need to develop (or return to) land management practices which sustain productivity indefinitely. Biodiversity underpins both ecosystem function and the sustenance of livelihoods. Without well-functioning ecosystems, human development (as elsewhere) will be critically undermined.

National initiatives to combat desertification, conserve biodiversity, and mitigate climate change are increasingly integrated in Namibia. An immediate focus, led jointly by the National Biodiversity and Desertification Programmes, is to identify and assess biological and physical indicators of environmental degradation of common information value to all three programmes. This is a first step in developing an 'early warning system' for environmental change. Data on these indicators must be cost-effective, easily gathered by rural people, reliable, informative, and repeatable. They must also differentiate between natural variation and environmental degradation, which may be our most intractable problem. Namibia's scientific and management community is small and spread thinly on the ground. Yet this may prove advantageous, as it has been possible to gain consensus on the indicator development process, and there is good government support for sustainable development initiatives.

Progress so far

Namibia's Programme to Combat Desertification (NAPCOD) and the National Biodiversity Programme (NBP) began in 1994, although related activities were underway for many years. NAPCOD is steered by a committee of partners including four ministries (Environment; Agriculture; Lands; Regional Government), technical and grassroots NGOs (Desert Research Foundation of Namibia; Namibian NGO Forum and others), and farmers' unions. It is implemented largely by the Desert Research Foundation of Namibia. The NBP is steered by representatives of four somewhat different ministries (Environment; Agriculture; Marine Resources, Education), a host of technical and grassroots NGOs, and the country's two major tertiary institutions. Namibia's Climate Change Advisory Board represents five ministries (Environment; Energy; Agriculture; Works / Meteorological Office; Marine Resources), the two major tertiary institutions, and the Desert Research Foundation of Namibia which prepared the climate change country study. All three national programmes are run by the Directorate of Environmental Affairs, Ministry of Environment and Tourism.

NAPCOD, with assistance from the NBP, supports a pilot study of termite and beetle diversity and land use intensity at longterm research sites on five communal farms in northwestern Namibia and a site in the hyper-arid Namib-Naukluft Park (Zeidler, Hanrahan & Scholes, unpublished; Zeidler, Seely, Hanrahan & Scholes, unpublished). Potentially informative data from other taxa, including mycorrhizal and macrofungi, should be added in the next two years. This pilot study guides the development of an integrated national framework for terrestrial biological monitoring, both in terms of indicator selection and participatory data collection approaches. This national framework, when fully developed,

must serve the needs of a broad spectrum of environmental change monitoring needs, including those related to desertification, biodiversity, and climate change.

Results

Indicator selection

Termite species assemblages differ between farms in the communal farmlands, and diversity is generally higher at low land-use intensity sites than high ones. However, in highly arid areas this relationship is reversed (Zeidler, Hanrahan & Scholes, unpublished). A large-scale early study, the National Survey of the Isoptera of Southern Africa (1964-68), was recently mapped in the raster-based GIS package IDRISI (Clarke University, 1995). These historical Namibian data have two immediate uses: as a 30-year old baseline and as a basis for analysis of the environmental determinants of termite distributions. In Zeidler *et al.*'s analysis, generic richness increases with increasing rainfall. The distributions of four genera recorded from Namibia show a negative association with increasing rainfall, four appear not substantially influenced by rainfall, while distributions of 25 genera are positively associated. Current work is teasing apart the contributions of climate and land use in determining termite assemblages.

Index of biological integrity

The pilot NAPCOD study is developing a composite set of ecological indicators which act as an 'index of biological integrity' (IBI) of a system. The IBI is a tool for assessing range condition and ecosystem function based on ecological measures. These indicators include quantitative vegetation parameters, soil fertility, soil biota (termites and tenebrionid beetles) and their functional properties, land uses and indices of soil ecological processes (nutrient cycling, organic matter translocation, soil perturbation, Fig. 1). In principle, these results should reflect the degree to which critical ecosystem functions remain intact. In addition, the pilot study aims to determine a threshold IBI value at which ecosystem function is impaired and the range ecosystem is degraded (Fig. 2). Again, differentiating natural variation from anthropogenic degradation will be a major hurdle. ? not attached

Participatory data collection

Participatory rural assessment (PRA) of farmers' existing knowledge and rapid rural assessment (RRA) of natural resource levels and distribution are two important components of the Namibian pilot study, as well as two major established community-based management programmes (below). In the pilot study, sets of indicators of rangeland condition -- and possibly desertification -- commonly used by both communal and commercial farmers are being derived, tested and compared. Namibia will have to rely heavily on not only traditional knowledge and community perceptions in the future early warning system, but also on the skills and labour of farmers and other land users in basic data collection and sorting. PRA and RRA methods are presently combined with the IBI scientific data in a qualitative, comparative manner, but the integration of these two levels of data can be extremely powerful and needs further development (Fig. 2). This will be a focus of a national analysis of the biodiversity impacts of land tenure systems in Namibia, which began in 1998.

Discussion

Joint development of this national monitoring framework by NBP and NAPCOD started in 1998 and will accelerate in 1999. The process incorporates sites and information of other national projects, such as the Sustainable Animal and Range Development Project (SARDEP), Northern Regions Livestock Development Project (NOLIDEP), community forests, and the communal area conservancies of the Community-Based Natural Resource Management (CBNRM) Programme. It will also make use of data from projects initiated in Namibia by collaborating institutions, such as Cologne University's ~~BIOTA~~ Project, and intergovernmental programmes such as the International Geosphere-Biosphere Programme.

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References

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Figures

Fig. 1. Linkages that determine biological integrity in arid north-western Namibian rangelands

Fig. 2. The IBI provides a measure of biological integrity and is a tool to assess range and habitat condition.

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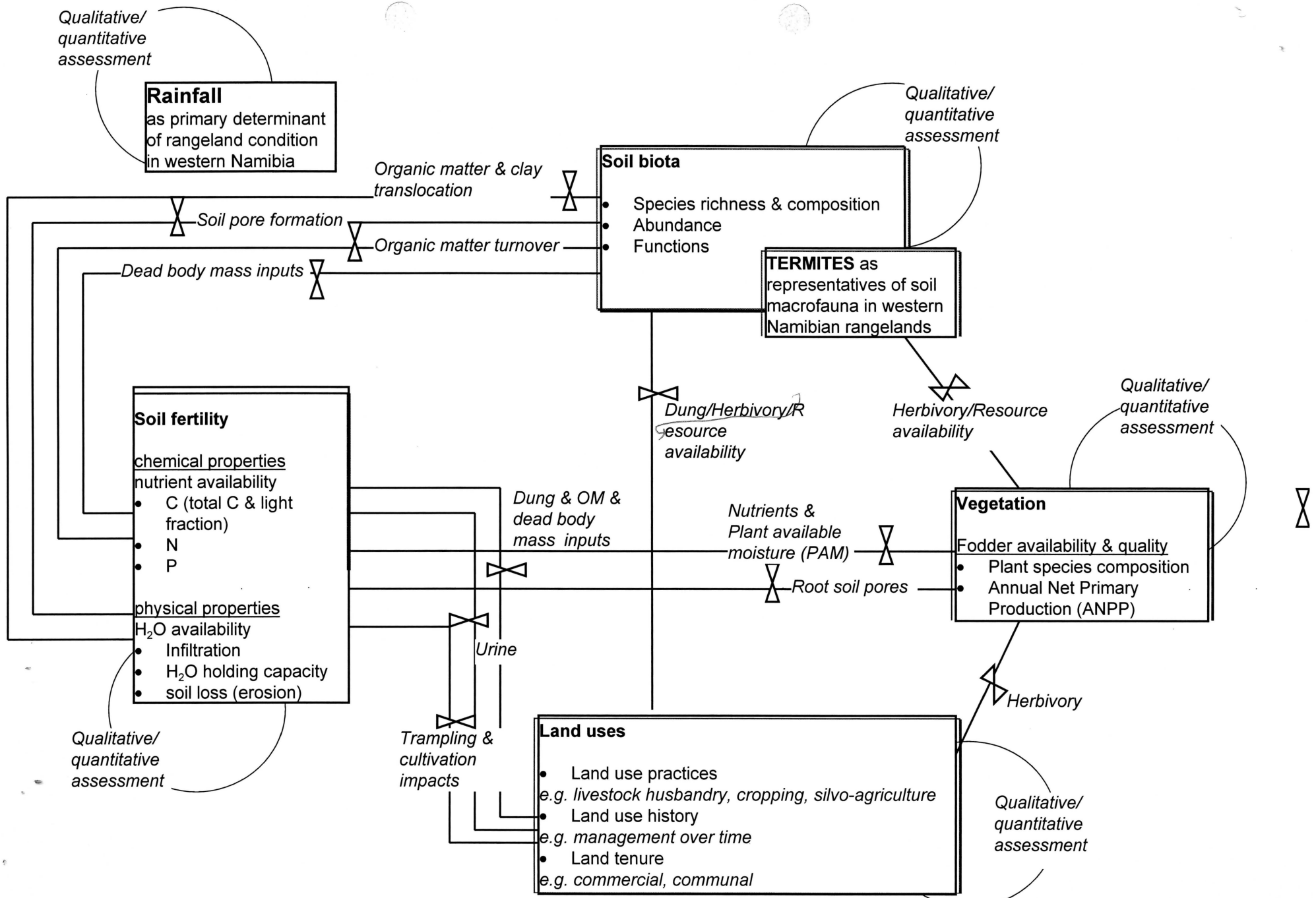

Figure 1: *Linkages that determine biological integrity in arid northwestern Namibian rangelands.*