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Management and Research in Relation to Ecosystems of the Kruger National Park

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In contrast to the study of the individual components of ecosystems, the management and research strategies of the Kruger National Park are designed to take cognisance of all the complex dynamic entities of ecosystems simultaneously. The point is also made that the preservation of intact ecosystems is essential for the maintenance of the qualities of life for human societies.

Key words: Kruger National Park, ecosystems, management, research, pollution, water quality.

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Introduction

Even with a cursory knowledge of nature and its processes, one is bound to be impressed by the orderliness of nature and by the diversity of shapes, colours and adaptations which are evident in the abiotic and biotic components. In addition, man tends to compartmentalise natural phenomena, a concept which usually results in a loss of the perception that all the intertwining attributes of the two major components are specifically designed to augment each other, resulting in a unified and integrated system of inanimate and animate matter.

The concept of ecosystems is of the utmost importance in modern scientific thought but is also often interpreted in a fragmented fashion (*i.e.* compartmentalised). The management and research strategies of the Kruger National Park (KNP) are designed to take cognisance of the complex, dynamic nature of ecosystems (Pienaar 1982). This fact prompts many questions. For instance, is it desirable or even necessary to preserve intact ecosystems?

Where the emphasis throughout this volume is focused predominantly on the

geology of the KNP, some attention should be given to the concept of ecosystems, and how ecosystems, geology and geomorphology within the area are interrelated.

The Preservation of Ecosystems

The basic approach towards management in national parks is clearly outlined in the National Parks Act of South Africa (No. 57 of 1976, as amended). The Act states that "The object of the constitution of a park is the establishment, preservation and study therein of wild animal, marine and plant life and objects of geological, archaeological, historical, ethnological, oceanographic, educational and other scientific interest and objects relating to the said life or the first-mentioned objects or to events in or the history of the park, in such a manner that the area which constitutes the park shall, as far as may be and for the benefit and enjoyment of visitors, be retained in its natural state". The fundamental principle underlying this definition is the preservation of representative natural areas in which the intrinsic natural attributes are conserved in their pristine state for their scientific and educational value.

It is evident that the National Parks Board of Trustees is committed to the preservation and perpetuation of ecosystems. Why such an approach is necessary and of what benefit it can be to *Homo sapiens*, remain to be clarified.

In the context of this paper ecosystems may be defined as identifiable ecological entities resulting from the interactions and interdependencies within and between biotic communities and their abiotic environment. In somewhat different phraseology Joubert *(in prep.)* has defined living organisms as the "... sum total of a number of interacting and interdependent processes that relate to one another in a spontaneously dynamic fashion, with the inherent capability of reproducing and perpetuating their specific form of life". It is clear that the two definitions imply the same phenomenon and could, therefore, be regarded as interchangeable. From this point of view ecosystems can be interpreted as living organisms, and on ethical and aesthetic grounds, can make as much demand on protection and preservation as any other form of life.

One may ponder over what value life, on the individual or ecosystem level, may have for modern day technological man. It would appear as if material welfare and economic values have eroded the sensitivities of modern society to the extent that it has become ostensibly indifferent to life. Be this as it may, the records prove differently.

The upsurge in industrial and other developments over especially the last two decades have resulted in an affluence that could hardly have been foreseen in the aftermath of the devastation of the Second World War. Unprecedented technological advances also resulted in the exploitation of natural resources on a scale that soon revealed the limitations of non-renewable resources, and the accelerated impoverishment of renewable resources through excessive demands. The insatiable greed for material wealth, together with poor and inadequate planning for the future, left in its wake levels of pollution and abuse that not only seriously jeopardised the very resources required to sustain the acquired affluence, but also 'high-tech' societies riddled with social disorders and imbalances.

On the other hand, the progressive depletion of natural resources also led to an upsurge in the cry for the protection of what was left intact, and an increase in the demand for areas and facilities to satisfy the need for contact with, and/or involvement in the natural heritage. The increasing public support for nature conservation projects, and the spate of private, municipal and higher order conservation areas that have been proclaimed in recent years are sufficient manifestation of the close bond that still exists between man and his natural surroundings (on which he is, in fact, ultimately dependent). Amongst a considerable segment of the public the desire to conserve natural areas is largely – if not entirely – based on aesthetic values, and not on the idea of nature as a life-supporting entity. In support of this attitude, it is the ultimate responsibility of the National Parks Board of Trustees to further convince the public of their dependence on natural resources, and to promote the acceptance of a conservation code of ethics in addition to mere aesthetics.

There is no problem in convincing the public of the need to preserve selected life forms which are of direct benefit to man – for medicinal, economic or whatever other use. Synthetic substitutes could easily replace such life forms and deny them the justification for further perpetuation. It is more than merely direct 'benefit to man' that is at stake in the preservation of ecosystems. Human societies are unquestionably dependent on natural renewable resources for their existence. The management of such resources to retain their full potential is, in turn, dependent on an understanding of the dynamic and functional aspects of the systems involved. There are no substitutes for intact natural ecosystems to provide the essential data and insight for the formulation of managerial strategies suitable for agricultural use, or as basis for the long term planning of industrial, urban or technological ventures. It may not readily be acceded to, but there can be no doubt that the preservation of natural ecosystems – and the benefits that may be derived from a study of those ecosystems – is a prerequisite for the future existence of man.

Management Rationale

The KNP comprises some 1 948 500 ha and represents one of the largest national parks in the world. Prior to its proclamation as a national park it was only sparsely inhabited. With the advent of Europeans towards the mid-1800s it became a favoured hunting area during the mild winter months, and towards the end of the 19th century many of the large mammal populations were severely reduced in number, and in some cases – notably black rhino *Diceros bicornis,* and white rhino *Ceratotherium simum* – even extirpated to the point of local extinction. In spite of heavy hunting pressure, the ecosystems and all their constituent parts, represented within the KNP were intact at the time of proclamation in 1926. The KNP, therefore, provided an unsurpassed opportunity for the preservation, study and interpretation of pristine ecosystems.

Though the KNP represents a particularly large area by any landuse standard, a number of important factors and incidents played a significant role in the development of the management strategy applied in the area. Most important of these were that: (i) the KNP did not represent an entire

ecological unit; (ii) immediately prior to its proclamation a large and particularly important area to the west of its predecessor, the Sabi Game Reserve, was excised; and (iii) the western boundary was fenced during the early 1960s, thereby imposing a further restriction on habitat/animal interactions. In view of these restrictions and disturbances there was no other feasible alternative but to adopt a pragmatic policy of adaptive management (*cf.* Pienaar 1982).

In exercising management options the accepted guiding principle has been management by "minimum intervention" (Joubert 1983a; Pienaar 1983). In the application of this principle an ecosystem-orientated approach has been taken, in which the perpetuation of diversity and species richness has played a decisive role, and in which the dynamic functional aspects of ecosystems (*i.e.* the interactions and interdependencies of the components) are acknowledged. Management by 'minimum intervention', therefore, implies the restoration of disrupted natural processes by simulating the natural state of affairs.

In order to retain the full spectrum of the natural attributes of an area the intensity of management is directly related to its size with management inputs declining in large areas. On the other hand, the effects of managerial strategies are more readily discernible in a small area, and deviations from the anticipated objectives could be rectified earlier in its development than is possible in a large area. In accordance with these principles even management by 'minimum intervention' can only be applied successfully when objectives are clearly defined, when due consideration is given to the available data, and when its effects are recorded by means of a sound monitoring programme.

Research Priorities

To manage the KNP according to ecosystem principles obviously implies a knowledge of the individual components, their dynamics and the inter-relationships between them. The role of research is, therefore, to gain insight into and interpret the cause-and-effect relationships governing the dynamics of ecosystems (Pienaar 1977). On the basis of this information the necessity and nature of managerial measures to be applied, may be determined.

In ecosystem-orientated research the emphasis falls on monitoring (Joubert 1975, 1983b). Recording events as they occur, and identifying changes and associated responses amongst the various components of the ecosystem is the most important consideration once the individual components have been identified and described. Furthermore, management demands almost invariably revolve around short and medium term changes to the ecosystem. Consequently such phenomena should have high priority in any research programme. From this point of view abiotic components, such as soils, geological formations and other geomorphological components are subject to a lower rate of change, and would inevitably be of lesser importance than components such as climate (particularly rainfall), vegetation and animal communities.

Management is not the sole consideration in determining research priorities. In acknowledgement of ecosystems representing integrated units in which all constituent parts are essential in monitoring the integrity of the whole, the necessity to include all the components of the ecosystem in a comprehensive research and monitoring programme is evident.

To comply with the demands of understanding and managing ecosystems a research programme was instituted in the KNP which essentially provided for the following: (i) monitoring of various parameters of climate (Gertenbach 1980); (ii) identification and mapping of geological formations and soil types (Bristow 1980; Schutte 1972, 1982; Schutte & Clubley-Armstrong 1982; Venter 1981); (iii) large-scale mapping of the topographical features; (iv) identification of plant communities (Coetzee 1983; Gertenbach 1983), their distribution, and relationships to their abiotic environment, and subsequently a project to monitor vegetation dynamics; (v) the annual recording of animal population trends and distribution patterns (Joubert 1976); and (vi) recording of environmental variables, such as surface water and various parameters of the field layer and woody vegetation on an annual basis (Joubert 1976).

Research hitherto undertaken on the geology and geomorphology (including soils) of the KNP has almost exclusively been of an analytical nature involving mapping of major geological units, and geochemical analyses of representative rock specimens. This type of research differs from research done on other ecosystems, since geological systems are, within the time scale of human life, inanimate. Consequently considerable time scales are generally required to observe significant, or even detectable geological changes. Coupled to this is the fact that the KNP is located in a particularly stable geological region. This does not in any way detract from the importance of these components in the ecosystem, as is evident from the fact that every biotic community is determined and structured by the interaction between those communities and their geo-physical environment.

Threats to the Kruger National Park Ecosystems

In spite of the stated objective of managing the KNP in such a way that the natural attributes and dynamic properties are preserved intact, several inevitable developments which constitute a threat to the natural pristinity have been imposed on the area. The Transvaal Lowveld ecological unit extends from the Drakensberg escarpment in the west to the Moçambique coast in the east, and from the northern areas of Natal in the south to beyond the Limpopo River in the north, thus representing an area considerably in excess of 203 000 square kilometres. In this respect even the 19 500 km^2 of the KNP represent only a fraction of the entire ecosystem. Furthermore, a major complicating factor is the fact that the KNP is situated almost in the centre of the larger Lowveld ecosystem, and is on the receiving end of a number of adverse influences.

The perennial rivers which form an integral part of the KNP ecosystems, all flow from west to east. To the west of the KNP major developments have

taken place, including urbanisation, agricultural, forestry and industrial developments, as well as large scale exploitation of the mineral deposits by means of open cast and underground mining. Increased demands have been placed on the renewable natural resources, and have inevitably led to a degradation in quality and quantity of water in the perennial rivers, increased siltation of the rivers, the introduction of alien plant encroachers that threaten certain habitats, and, more recently, increased air pollution and the possibility of 'acid' rain.

The increase in agricultural activity to the west of the KNP, and the resultant danger of transmitting contagious diseases between wild animals and livestock eventually led to the fencing of the southern and western boundaries of the Kruger National Park. This, and other considerations, finally resulted in fencing the boundaries of the entire Kruger National Park. These artificial barriers inevitably curtailed the natural migration and dispersion patterns of various large mammal species

The above factors have all played a part in necessitating readjustments in certain established ecological patterns, and have also led to the adoption of a pragmatic approach towards wildlife management – in which the preservation of the full spectrum of natural attributes of the area receives the highest priority, and management strategies are formulated in accordance with the principle of minimum intervention.

Conclusions

Geology and geomorphology are as much part of an ecosystem as any organ or limb is part of an individual organism. The study and interpretation of the composition, structure and dynamics of geology and geomorphology not only form an integral part of an ecosystem-orientated research and management programme but are essential in gaining insight into, and understanding of the complexities of ecosystems.

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