CERTIFICATION STANDARDS FOR SUSTAINABLE GAME RANCHING IN THE NORTHERN PROVINCE, SOUTH AFRICA

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Thesis presented in partial fulfilment of the requirements for the degree of Master of Science at the University of Stellenbosch.

Promoter:

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March 2000

Declaration:

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

SUMMARY

Formal systems of environmental management and certification for activities associated with extensive land use, relate mainly to forestry. The emergence of forest certification largely originates from the issue of tropical deforestation and the associated boycott campaigns against tropical timber. At the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, a new set of international norms were set in the form of Forest Principles. These were non-binding and together with international initiatives, such as the Tropical Forestry Action Programme and the International Tropical Timber Organisation have failed to decrease deforestation. New efforts to encourage sustainable forestry through forest certification were made by Non Governmental Organisations which collaborated with the private sector in developing new policy instruments. They followed the trend of eco-labelling in an attempt to link green consumers to producers whose aim it is to improve management practices. The Forest Stewardship Council (FSC) was established. The FSC system relies on forest management principles and criteria approved by itself and is based on performance standards. The International Standards Organisation (ISO) also developed a management standard based on the principle of continuous improvement. ISO developed the ISO 14001 standard for the certification of Environmental Management Systems which is applicable to any industry concerned with the environment. From questionnaire surveys carried out among a sample of private game ranch owners/managers in the Northern Province, current standards of management were established. It was found that private owners/managers rely mostly on their own experience and knowledge. Information about management on game ranches is rarely available and only major concerns and most visible problems are attended to. Guidelines with standards for an Environmental Management System (EMS) according to the ISO 14000 series were drawn up from the results of the surveys and a literature review. A checklist of principles and criteria which could be used for the certification process was also developed. The final objective is to attain quality game ranch management which is environmentally sensitive, socially aware/beneficial and economically viable. This is crucial for the conservation and preservation of the natural systems in South Africa in which private land owners play a major role.

OPSOMMING

Formele omgewingsbestuursisteme en sertifisering vir aktiwiteite wat geassosieer word met ekstensiewe grondbenutting, word hoofsaaklik gekoppel met bosbou. Die konsep van sertifisering het tot stand gekom as gevolg van die omstredenheid rondom ontbossing en die gassosieerde sanksies teen tropiese hout. By die Verenigde Nasies Konferensie oor Omgewing en Ontwikkeling in Rio de Janeiro in 1992 is 'n nuwe stel internasionale norme daargestel in die vorm van Bosbeginsels. Hierdie was nie-bindend en saam met internasionale inisiatiewe soos die Tropiese Bos Aksie Program en die Internasionale Tropiese Hout Organisasie het hulle gefaal om ontbossing te verminder. Nuwe pogings om volhoubare bosboupraktyke aan te moedig is aangewend nadat Nie-Regering Organisasies en die privaatsektor saamgewerk het om nuwe beleidsinstrumente te ontwikkel. Hulle het die neiging vir die "eko-etiket" nagevolg in 'n poging om omgewingsbewuste verbruikers in kontak te bring met produseerders wat gemoeid is met verbeterde bestuurspraktyke. Die Forest Stewardship Council (FSC) het tot stand gekom en hulle sisteem sluit bosbestuursbeginsels en kriteria in wat deur hulleself goedgekeur is en gebaseer is op werkverrigtingstandaarde. Die Internasionale Standaarde Organisasie (ISO) het ook 'n bosbestuurstandaard opgestel gebaseer op die beginsel van kontinue verbetering. ISO het die ISO 14001 standaard opgestel vir Omgewingsbestuursisteme wat van toepassing gemaak kan word op enige industrie wat gemoeid is met die omgewing. Na afhandeling van vraelys opnames onder privaat wildsplaas eienaars/bestuurders, is daar vasgestel wat die standaard van bestuur tans in die Noordelike Provinsie is. Privaat eienaars/bestuurders maak meestal staat op hulle eie ondervinding en kennis. Inligting oor die bestuur van die wildsplase is nie geredelik beskikbaar nie en slegs die mees sigbare en grootste probleme word bestuur. 'n Riglyn met standaarde vir 'n Omgewingsbestuursisteem volgens ISO is opgestel vanaf resultate van die opnames en 'n literatuurstudie asook 'n "Checklist" wat beginsels en kriteria insluit wat gebruik kan word in die sertifiseringsproses is ook ontwerp. Die finale doel is om kwaliteit bestuur te bewerkstellig wat omgewingsensitief, sosiaal bewus/voordelig en ekonomies lewensvatbaar is. Laasgenoemde is uiters belangrik aangesien privaat grondeienaars 'n sleutelrol speel in die bewaring en preservering van die natuurlike sisteme in Suid-Afrika.

Acknowledgements:

I would like to thank the following people for their support and assistance whom without this thesis wouldn't have seen the light.

Dr. H.J. Van Hensbergen: Thank you for giving me this project which you initiated, your guidance and the privilege to gain from your experience and knowledge.

Dr. N. Fairall: Thank you for two years of tutoring, guidance and for making my field of thought wider.

Prof. R.C. Bigalke: Thank you professor for your help right at the beginning and most importantly right in the end when I needed help and guidance the most.

Forestry Faculty, University of Stellenbosch: Without the bursaries granted to me by the Forestry faculty I would not have been able to do this M.Sc.

My sincere thanks to the Conservation officials in the Northern and North West Provinces who have been most helpful regarding the surveys.

Also, the study would not have been possible without the co-operation of the game ranch owners/managers that participated in the surveys.

Anton Kunneke: map of study area and weather data,

Konrad Buchler: analysis of the survey data,

Loren Gibbs: editing and tremendous support,

Holger Vogt: editing of pictures and diagrams - you are a genius,

Tom Van den Berckt: editing and everything else,

Ulrike Kussing: editing in the beginning stage, you are the best friend anyone could ever wish for.

Jaco and Thys: your prayers meant more to me than you know,

My parents: thank you, is all I can say.

Gloria in excelsis Deo!

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ABBREVIATIONS:

ASA	-Advertising Standards Authority
EAS	-Ecological Aerial Survey
EIA	-Environmental Impact Assessment
EMS	-Environmental Management System
EMSi	-Environmental Management Systems international
FSC	-Forest Stewardship Council
GIS	-Geographic Information Systems
ISO	-International Organisation for Standardisation
ITTO	-International Tropical Timber Organisation
KHCA	-KwaZulu-Natal Hunting and Conservation Association
NGO	-Non-Governmental Organisation
PDCA	-Plan, Do, Check and Act
PHASA	-Professional Hunters Association of South Africa
SA	-South Africa
SABS	-South African Bureau of Standards
SAF	-South American Foresters
TFAP	-Tropical Forestry Action Programme
TWINSPAN	-Two Way Indicator Species Analysis
UNCED	-United Nations Conference on Environment and Development

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1. INTRODUCTION

1.1 CODE OF PRACTICE

In all walks of life we live according to some code or standard set by society that has been passed on for generations. However, every individual makes his/her own choice of whether to accept and live according to these codes or standards. It is human nature to give structure to everything we encounter, plan or venture into and to set standards by which progress can be measured and compared in order to be competitive. In South Africa (SA) the South African Bureau of Standards (SABS) is the institution that determines, and thereby ensures uniformity in, standards for products and practices. One of its responsibilities is to administer the Environmental Management System standards in the ISO 14000 series, drawn up by the International Standards Organisation (ISO). To date little attention has been paid to formal environmental management systems for wildlife based enterprises. The first step in developing such a system is to establish a code of practice and a set of guidelines that will encourage a standardised approach to the sustainable management of these natural resources.

1.2 RESEARCH AND AIM OF STUDY

It is hypothesised here that the standard of game ranch management in the Northern Province is not very high. The research for this study comprised a questionnaire survey designed to test this hypothesis. It took the form of informal interviews with a sample of private game ranch owners to assess their attitudes and opinions and establish and evaluate current management practices. A further aim of the study is to set up performance standards for sustainable game ranching practices in the form of quantifiable guidelines that can be practically implemented. These could be used to develop an Environmental Management System (EMS) complying with ISO 14001 requirements and against which an operation could be certified. Certification, as a market-based incentive, can be applied to products or activities, which are sold in environmentally conscious markets.

Existence of such a possibility should stimulate game ranch managers and/or owners to become more conscious of the impact of their actions on the environment and to strive for ecologically sound land management.

2. BACKGROUND

2.1. STANDARDS

The definition of a standard according to the Oxford English Dictionary is a quality or measure serving as a basis or example or principle to which others conform or should conform or which judges the accuracy or quality of others. According to the International Organisation for Standardisation (ISO) standards are documented agreements containing technical specifications or other precise criteria to be used consistently, or rules, guidelines or definitions of characteristics to ensure that materials, products, processes and services are fit for their purpose (Upton & Bass, 1995). ISO is a Swiss-based non-governmental organisation that was founded in 1946 to develop world wide standards and reduce the possibility that national standards would function as trade barriers (McCreary, 1996). In the late 1980s, ISO 9000 was developed and was aimed at improving management quality. It deals largely with management systems and plant operations. This quality standard is implemented for a business or product line (Stauffer, 1997).

The ISO 14000 framework has been growing, since 1992, out of the, now well established, ISO 9000 effort and has been developed in the form of internationally applicable standards for environmental management (Begley, 1996). The principles of management for both ISO 9000 and ISO 14000 are the same, while differences may be manifested in a shift of approach or emphasis on certain requirements (Van Rensburg, 1996). The objective has been to focus on instituting environmental management systems that, over time, will change corporate conduct by motivating better environmental performance and by ensuring that environmental aspects are taken into account in all areas of decision making (McCreary, 1996).

Under the chairmanship of the SABS, environmental standards, compatible with ISO 9000 and applicable to South African conditions, have been published in two documents: SABS 0251 (1993), *Environmental management systems*, and ARP 036 (1995), *Guide to environmental management systems requirements* (Van Rensburg, 1996). In this study a set of standards is developed for the sustainable and ethical management of private game ranches which could be applied in the framework of ISO 14000 to ensure better environmental performance.

2.2 MANAGEMENT TOOLS

Game ranch management is an all encompassing subject and ranges from veld and game management to managing tourists and hunters and labour as well as general environmental conservation. These components are all linked and cannot be separated because they influence each other on all levels. Veld management tools include vegetation monitoring, erosion management, management of invasive and exotic plant species, fire management and the management of the stocking rate. Game management includes (besides the control of animal populations) the management of Red Data and exotic species, conducting game censuses, managing hunting and culling practices.

For the successful management of a game ranch the human component must not be left out, because it is equally as important as all the other aspects of management. To ensure a pleasant, secure and safe working environment, labour relations must be well understood and maintained. Lasting client relationships form the basis of the economic survival of a private game ranch and should therefore be regarded as a top priority. This will ensure for the most part that the game ranch remains economically viable.
The latter goes hand in hand with ecologically sensitive management and therefore other aspects that should not be overlooked are thorough planning and constant maintenance of the infrastructure, which includes roads, buildings and other structures.

2.3 CERTIFICATION

The Society of American Foresters Council (Society of American Foresters, 1995) reports that during the past decade, and particularly since the 1992 Earth Summit, governments, environmental groups, the business community, and consumers have become more aware that the market and consumer behaviour can be a powerful tool in influencing the management and use of natural resources.

Consumers throughout the United States say they would be willing to pay, on average, 6.6 percent more for products that they think are "environmentally friendly" (Salzhauer, 1991). If this is true, a potential market worth billions of dollars awaits consumer products that are so labelled. The challenge, then, is to take advantage of the current wave of green consumerism in a way that is acceptable and beneficial to both environmentalists and members of industry. One idea that may meet these criteria is called "eco-labelling," in which an unbiased group gives products its seal of approval based on the items' environmental soundness.

The nationality of the greater percentage of foreign hunters visiting South Africa is American, and Europe constitutes the second largest market. Bekker (1989) estimated that 67,5% of hunters visiting game ranches are American and 20% are from Europe. Americans and Europeans are generally more environmentally conscious than people from third world countries. Therefore the more ethical and environmentally conscious hunter or tourist is likely to choose a game ranch that has been through a certification process and has been given a legitimate eco-label. The eco-label will indicate the sustainable use of resources and ethically sound management practices on the game ranch.

2.3.1 Product certification

With the advent of the Green Revolution consumers desire, even demand, environmentally friendly products. Such products must be manufactured by processes that generate minimum waste, are energy efficient, and have a negligible impact on the environment. To qualify as environmentally friendly, consumer products must have a life cycle that respects the needs of the environment (Stauffer, 1997). The Green Revolution affected the agricultural sector but the basic principles should be the same for game ranches. Any developments or practices on a game ranch must be conducted in such a manner as to generate minimum waste, must be energy efficient and should have a negligible impact on the surrounding environment. Environmental certification programs exist to allow credible, third party organisations to pass judgement on the environmental performance of products and packaging, rather than leave such assertions to product manufacturers themselves (Vlosky & Ozanne, 1997). It is important that a non-governmental organisation, that is totally objective, must be involved in the certification process.

2.3.2 Forest certification

Concern for forest problems has increased dramatically over the last decade (Upton & Bass, 1995) and forest certification has been developed as a new and innovative tool, which is already having impacts on forests around the world, by providing a market incentive for improved management (Elliot, 1997).

By definition, certification is the process in which a forest owner voluntarily requests an independent certification body to inspect his/her forestland. The certifier visits the forest site and determines if the management meets clearly defined standards and criteria. The certification process may also include an account of the forest product from the log yard to the final point of sale, provided the forest owner wishes to sell the product as certified. This process is known as forest product certification and allows consumers to identify products that come from well-managed forests (Elliot & Donovan, 1996). Third-party certification is probably the most credible from the perspective of the consumer because the forest owner voluntarily requests certification (Hansen, 1997).

Environmental certification of forest products and forestry practices, as part of the more encompassing green movement, is proliferating globally. In response to environmental concerns, environmental organisations, wood products retailers, and manufactures are developing standards to encourage consumers to purchase wood originating from certified sustainable forests (Vlosky & Ozanne, 1997).

Two primary objectives of forest products certification are to secure access to environmentally sensitive wood products markets and to promote long-term sustainable forest management practices (Stevens *et al*, 1998; Vlosky & Ozanne, 1997). Certification of forest management systems has been promoted as a market-based incentive for improved forest management and is based on the premise that consumers will differentiate and perhaps be willing to pay a premium for products originating in well-managed forest ecosystems (Carter & Merry, 1998).

2.4 SUSTAINABLE MANAGEMENT

Sustainability, at its most general, relates to the planet and biosphere's ability to renew itself, to maintain its 'carrying capacity'. A sustainable action is thus one, which does not seriously disrupt essential ecological processes. However, all actions by all species could be considered as disturbing ecological processes, which leaves us with the problem of deciding which actions disturb these processes and which actions are part of ecological processes (Gray, 1997). According to Glasby (1991) sustainable management is defined as providing for the use, development, and protection of biological and physical resources in a way, and at a rate, which enables people to meet their needs now without compromising the ability of future generations to meet their own needs. Sustainable forest management is the cultivation and exploitation of timber and non-timber forest resources for economic gain leading to a perpetual, periodic yield of marketable products with strict preservation of capital. Capital to be preserved comprises the soil resources as well as an appropriate stocking level and species composition of forest cover required to maintain the biological potential for production of marketable products (Howard & Valerio, 1996).

Upton & Bass (1995) acknowledge the fact that attempts at defining what is required for sustainable forest management are almost always controversial. In certification they prefer to use the term quality forestry to describe a performance of forest management that is considered adequate, that is basic to the transition to sustainable forest management. Quality forestry is then defined as being environmentally sensitive, socially aware and economically viable.

In South Africa, according to the Department of Environmental Affairs (1996), direct and indirect utilisation of environmental resources for economic gain or recreational purposes, for the well being of humans, is the underlying cause of detrimental effects on the environment and the subsequent destruction of resources of wealth and prosperity. This is applicable to both renewable and non-renewable resources. The utilisation of non-renewable resources must be optimised and equilibrium between utilisation and recovery of renewable resources must be established.

8. DESCRIPTION AND SELECTION OF STUDY AREA

Historically the study area was situated in the Transvaal Province. But new borders were established in 1994 and the Transvaal Province was divided up into the Northern Province (formerly known as the northern Transvaal), Mpumalanga (formerly described as the eastern Transvaal), Gauteng (formerly Pretoria-Witwatersrand-Vereeniging (PWV) area) and the North West Province (includes former western Transvaal and parts of the former northern Cape Province). The study area is situated in the present Northern Province between 22° and 26° latitude and 26° and 30° longitude (Figure 1).

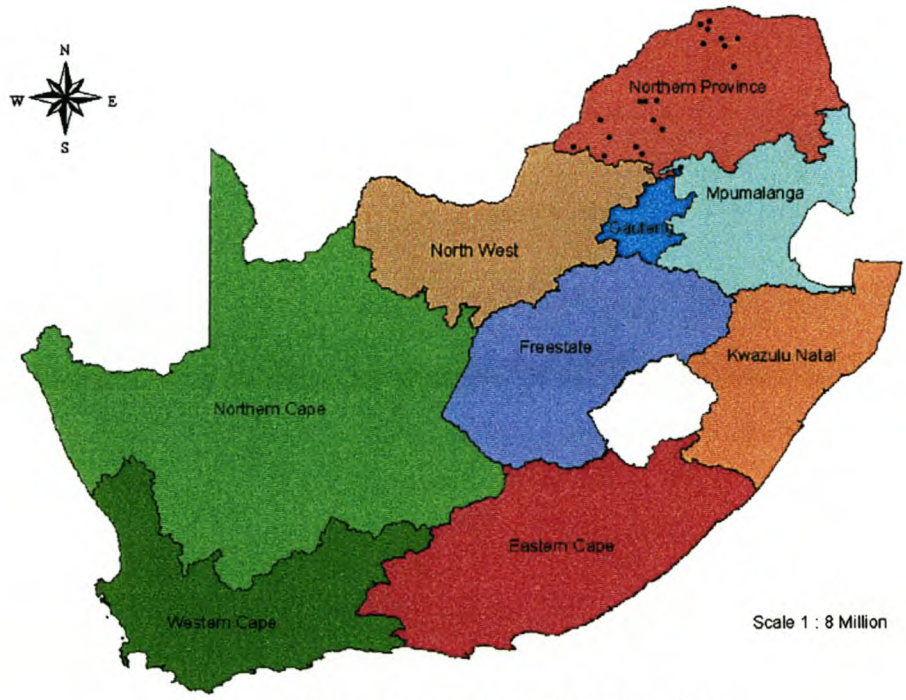


Figure 1. Map indicating areas visited.

The physiographic regions of the study area include mainly the Transvaal Plateau Basin and the Limpopo Depression. The Transvaal Plateau Basin is a compound region, which consists of the Bushveld Basin and the Palala and Pietersburg Plateaux and the Soutpansberg to the north. The bushveld is underlain by rocks of the Bushveld Complex. The average altitude varies from 900 to 1200 m above sea level, but near Pilanesberg in the west it rises locally to 1650 m.

The Palala Plateau, which comprises rocks belonging to the Waterberg Group, varies in altitude from 2100 m in the south to 1200 m north-west of Potgietersrus, from where it rises once more to more than 2000 m in the Blouberg and the Soutpansberg. The Pietersburg Plateau to the east is underlain mainly by Archaean granite and gneiss and is comparatively level, varying in altitude between 1350 m in the south and 900 m in the north. The Limpopo Depression is a comparatively narrow region, which borders the Transvaal Plateau Basin on its northwestern side. It is also underlain mainly by Archaean granite and gneiss but also by rocks belonging to the Fundamental and Beit Bridge Complexes, with outliers of Karoo rocks preserved therein along normal faults or in fault troughs. Fundamentally this is a re-exposed post-Waterberg topographic feature upon which the Karoo rocks have been deposited unconformably. This was followed by tension faulting which caused the Waterberg rocks in the Soutpansberg to be tilted towards the north and which was therefore primarily responsible for the formation of this depression. It varies in altitude from 1100 m above sea-level in the south-west to approximately 2450 m at the Mozambique border in the north-east, where it merges into the Mozambique Plain (Visser, 1989).

The study area is situated in the Savanna biome and the veld/vegetation types represented include: Clay Thorn Bushveld, Mixed Bushveld, Mopane Bushveld, Soutpansberg Arid Mountain Bushveld, Sweet Bushveld and Waterberg Moist Mountain Bushveld (Low & Rebelo 1998).

It is a summer rainfall area with the highest precipitation occurring in January and no rain in the winter season (June-August). Minimum temperatures range from 2.6°C to 18.8°C and maximum temperatures from 20.3°C -31.2°C.
The climatic data for the different regions is summarised in table 1.

Table 1. Climatic data for various regions in the study area.

Area	**Average annual rainfall (mm)**	**Highest monthly rainfall (mm)**	**Lowest monthly rainfall (mm)**	**Minimum temperatures (°C)**	**Maximum temperatures (°C)**
Warmbaths	518	103 (Dec)	0 (Jun-Aug)	3-17	20.6-29.5
Vaalwater	499	109 (Jan)	0 (Jun-Aug)	2.9-16.9	20.8-29.7
Thabazimbi	561	120 (Jan)	0 (Jul-Aug)	2.8-17.7	21.6-31.2
Louis Trichardt	536	134 (Jan)	3 (Aug)	6.1-18.4	21.1-29.5
Brits	566	111 (Jan)	0 (Jun-Aug)	2.6-17	20.3-29.9
Alldays	253	58 (Jan)	0 (May-Sept)	5.7-18.8	22.4-30.5

The main reason for selecting the area is that the Northern Province is one of the most important hunting areas in South Africa. Prior to 1980 an increasing number of farmers began realising the financial potential of meat and trophy hunting and invested heavily in game fencing and wildlife. These investments were continued with the upsurge in the growth of the industry in the 1980's. There was an unprecedented increase in the number of game farmers in all of the previous four provinces, especially in the old Transvaal (Mitchell, 1992). Also comparing the income earned from game breeding and hunting in the different provinces, the old Transvaal shows the highest income from hunting (Hosking, 1996). There appears to be a tendency for farmers to switch from cattle or mixed farming systems to only game game ranching. This has been defined as the managed, extensive production of free-living game on large land holdings for hunting, meat production, tourism, sale of live game and other non-consumptive uses (Bothma, 1995c).

Game ranching seems to be a more profitable enterprise than conventional farming, especially in low rainfall areas. In most cases the decision to switch was based on financial considerations and occurred mainly in those regions marginal to stock farming and well suited to game ranching like the Kalahari and the Mopane veld behind the Soutpansberg.

The change was gradual and caused by problems in the stock farming industry such as stagnating red meat prices and the severe impact of harsh environmental conditions in marginal farming areas. During the same period, prices of wildlife products more than doubled and it was found that wildlife, although severely affected by the drought, was far more resilient and adaptable to the harsh environmental conditions (Mitchell, 1992). However, Grossman *et al.* (1999) point out that mixed game-livestock enterprises appear to be the most productive and profitable.

4. METHODS OF STUDY

The method used was a questionnaire survey involving informal interviews. It was thought to be the best method in order to find out what the owners/managers are doing and how. Some of the issues were too complex to be covered by a simple postal questionnaire survey. The informal conversations were steered around the key issues. The sample selected by the researcher was the based on the ranch owners/managers' availability and willingness to undertake the interview. This aspect is dealt with further in section 8.1. The method used was availability sampling a form of non-probability sampling. The study was carried out in two phases. In the first phase, a sample of game ranch owners/managers was interviewed to assess current operations. From information obtained from a literature survey, a set of management guidelines was drafted. The second phase comprised a further questionnaire survey to evaluate management standards in terms of compliance with the drafted guidelines. The data obtained from the surveys was analysed by using the Fisher's exact probability test to test the dependence of management practices to determine how managers/owners manage the different aspects of a ranch and if the occurrence of certain practices are related. The motivation for the application of this test is that the chi^2-test is not reliable for small samples (Van Laar, 1991). P-values smaller than 0.05 indicate dependence, which implies that the two practices are related.

5. SURVEY 1

5.1. OBJECTIVES AND STUDY AREA

Informal interviews were used in an attempt to identify current issues, problems and management practices, and their relations, in the Northern Province. The extent to which management is based on scientific methods and/or the personal judgements of the owner/manager was also assessed. Nature Conservation officials in Louis Trichardt and Nylstroom in the Northern Province were contacted to get telephone numbers of private game ranch owners who would be willing to answer questions in an informal interview. This gave rise to a major source of bias. The twenty-two ranches visited are situated in six areas in the Northern Province; Alldays, Messina, Louis Trichardt, Vaalwater, Thabazimbi and Warmbaths.

5.2. QUESTIONNAIRE 1

Questionnaire 1 comprised questions on veld and wildlife management, hunting and harvesting practices, structures and maintenance, work force, community involvement, general environmental conservation, tourism facilities and ethical conduct. After testing a provisional version, the final, shortened questionnaire used in the study was prepared. Questions were kept simple and easy to answer and were designed to stimulate informal discussion during the interview. They were also designed to facilitate analyses of the responses. No questionnaires were mailed or filled in by the interviewees.

Depending on the owners/managers, on average, two ranches were visited per day.

5.3. RESULTS OF SURVEY 1

Table 2 indicates results obtained from the first survey. A discussion of the results follows.

Table 2. Results of survey 1.

QUESTIONS	YES	NO	Not applicable
Only game ranch	19	3	0
Game and livestock	3	19	0
Hunting	18	4	0
Tourism	19	3	0
Only hunting	3	19	0
Only tourism	4	18	0
Hunting and tourism	15	7	0
Veld monitoring	5	17	0
Erosion problems	12	10	0
Erosion management	12	3	0
Encroachment problem	12	10	0
Encroachment management	10	4	0
Alien vegetation	10	12	0
Alien vegetation management	9	3	0
Fire management	12	10	0
Knows carrying capacity of region	12	10	0
Knows carrying capacity of ranch	4	18	0
Exotic animals	13	9	0
Censuses	17	5	0
Cropping by means of relocation	17	5	0
Cropping numbers arbitrarily determined	12	10	0
Allows hunting from vehicle	7	11	4
Allows hunting alone	3	15	4
Issues hunting permits	12	6	4
Requires target shooting	16	2	4
Specifies calibre to be used	16	2	4
Expects pay for wounded animal	17	1	4
Provides retirement plan	9	13	0
Provides medical aid	18	4	0
Schooling available	19	3	0
Opportunity for career progress	10	12	0
Informal settlement next to ranch	11	11	0
Settlement benefit from ranch	10	1	11
People from settlement consulted	3	8	11
Ranches that give financial support	4	7	11
Recycle	6	16	0

Own waste dump	16	6	0
Water run-off near waste dump	2	14	6
Facilities: Self catering	21	1	0
Catering service	17	5	0
Camping sites	6	16	0
Caravan/camper sites	2	20	0

5.3.1. General information

Of the twenty-two ranches visited, nineteen were only game ranches, while three ranches had both game and livestock. The mean size is 6221 ha ranging from 175 ha to the biggest at 36000 ha. Most are in mixed bushveld while other veld types represented are Mopane -, sour -, thorn - and sweet bushveld. Hunting as the only activity is practised on three ranches, and tourism only on four ranches. Most of the ranches have both hunting and tourism (Table 2). Three of the four game ranches where only tourism is done are more commercially inclined and are bigger than 6000 ha. Seventeen (77.3%) of the surveyed ranches are smaller than 6000 ha and all of these offer hunting as an activity either combined with tourism or exclusively hunting.

5.3.2. Veld management

On only five of the ranches visited is veld monitoring done and this seems to be independent of the size of the farm. Bigger game ranches (>5000 ha) are therefore not more likely to have veld monitoring programs available than the smaller ranches (<5000 ha). About half of game ranch owners/managers are aware of erosion problems on the ranch and most of them have an erosion control program (Table 3). The same applies to bush encroachment, except that less is being done (Table 4).

Of the twelve game ranch owners/managers that know there is a bush encroachment problem, eight are currently implementing a control program (Table 4).

Table 3. Erosion management

	Erosion control			
Erosion	Yes	No	No Problem	Total
Yes	10	2	0	12
No	2	1	7	10
Total	12	3	7	22

Table 4. Bush encroachment management

	Encroachment control		
Encroachment	Yes	No	Total
Yes	8	4	12
No	2	0	10
Total	10	4	22

Erosion management is independent of erosion problems occurring on the game ranches visited and it is clear from table 2 that in some cases erosion management is conducted where erosion does not necessarily pose a problem or does not occur. When erosion management is practised it is probably a precautionary measure. Bush encroachment problems are however not independent of their management ($p=0.034$). This implies that when a bush encroachment problem is present on a game ranch, management will be conducted accordingly. Bush encroachment problems are also not independent of erosion problems occurring ($p=0.041$) and bush encroachment seems to have an influence on erosion. Bush encroachment control (where bush encroachment occurs) is independent of erosion control (where erosion occurs) and thus, when bush encroachment is managed, erosion is not necessarily controlled.

Alien eradication is implemented by almost all game ranch owners/managers where alien plants are present (Table 2 & Table 5). Management of alien vegetation is not independent of its occurrence ($p=0.0002$). When it is present, it is treated and managed. Veld monitoring is also not independent of alien vegetation control ($p=0.007$). It is thus likely that when veld monitoring is conducted, alien vegetation control will be implemented. Fire management plans are implemented by about half of the game ranch owners/managers interviewed (Table 2).

Table 5. Alien vegetation management

	Control		
Alien plants	Yes	No	Total
Yes	9	1	10
No	0	12	12
Total	9	13	22

5.3.3. Wildlife management

Just over half of the game ranch owners/managers were sure about the carrying capacity of their region. The remainder had an idea of the approximate value. According to the tests done on the data it was found that bush encroachment problems ($p=0.048$) and erosion problems ($p=0.048$) were not independent of whether managers/owners managed game numbers according to the prescribed carrying capacity of the region.

From table 2 it is clear that only a small number of managers/owners know what the carrying capacity of their ranch is. Consequently, animal numbers are not properly managed and problems like erosion and bush encroachment could be easily overlooked. This is further confirmed, because knowledge of the carrying capacities of the game ranches is independent of game censuses conducted. Game censuses are conducted by some owners/managers, while others had only a rough idea of what their game numbers were (Table 2). Census results are therefore not necessarily used in management of game numbers and/or the veld. Approximately three-quarters of the game ranches have animals that are exotic to the region (Table 2). Species include Cape mountain zebra (*Equus zebra zebra*), blesbok (*Damaliscus pygargus phillipsi*), gemsbok (*Oryx gazella*), reedbuck (*Redunca arundinum*), springbok (*Antidorcas marsupialis*) and black wildebeest (*Connochaetes gnou*).

5.3.4. Hunting, cropping and ethical questions

Hunting from a vehicle is allowed by 39% of the respondents to whom the question was applicable while 61% were against this practise. Exceptions are made in some cases and hunters will occasionally be allowed to hunt from a vehicle. In most cases (83%) hunters are not allowed to hunt alone and must always be accompanied by either a professional hunter or a guide. Almost 90% of respondents require hunters to do target shooting before they go on their hunt and also specify the rifle calibre to be used. With the exception of one, game ranchers require a hunter to pay for an animal if it was wounded. When the hunter is to remove meat from the property, two thirds of the owners/managers issue meat removal letters (Table 2).

Cropping is mostly done by relocation of excess animals and the number to be taken is established either by a formula or according to the personal judgement of the owner/manager. Slightly fewer owners/managers (45%) apply a formula than those using their own judgement (Table 2).

5.3.5. Structures and maintenance on the game ranch

With the exception of one ranch (that only has tourism activities) all properties surveyed have certificates of adequate enclosure issued by the Provincial conservation authority. On ranches where hunting takes place it is of the utmost importance that fences and gates are in a good condition and comply with legal requirements, especially if there is dangerous game present. Most of the fences were stated to be in good to excellent condition (Table 6) as were farm implements and vehicles. All but one of the game ranches that offer hunting have abattoirs or some form of slaughtering facilities. The exception provides for the slaughtering process to be done in the open.

Table 6. Infrastructure on hunting game ranches

	Fences & gates condition			
Hunting on game ranches	Excellent	Good	Fair	Total
Yes	4	12	2	18
No	1	2	1	4
Total	5	14	3	22

5.3.6. Work force and community involvement

Less than half (41%) of the game ranch owners/managers make provision for labourers' retirement. In most cases medical services are provided (82%), as are school facilities on or near the property (86%). Labourers are given the opportunity to do courses - to make some form of career progress - by 45% of the game ranch owners/managers. These include ranger courses, basic literary courses, chef courses, etc. (Table 2). Where housing is concerned, labourers are usually well looked after, but only a small number of the ranches visited had labour housing of a standard comparable to that of owners and/or managers housing.

Half of game ranches visited had a community or informal settlement on their borders. A large proportion (91%) of these communities/settlements derive benefit from the ranches and their resources. In only about a third of the cases would the manager/owner consult them and their labourers regarding certain management decisions. Game ranch owners/managers are however not keen on giving financial support (Table 2).

5.3.7. General environmental conservation

The sorting of waste to be recycled is practised on less than a third (27%) of the game ranches and is usually considered not worthwhile. Over two-thirds (73%)of the game ranches have their own waste dumps and there is a chance for water run-off at some of these dumps (Table 7).

Table 7. General environmental conservation

	Water run-off near waste dump		
Own waste dump	Yes	No	Total
Yes	2	14	16
No	0	6	6
Total	2	20	22

5.3.8. Tourism

Tourist accommodation provides self-catering facilities as well as offering catering at most of the game ranches. Only six of the ranches provide facilities for camping and only two make provision for caravans or campers (Table 2). The condition of the accommodation for visitors was mostly rated as good as assessed be the owners/managers themselves and most them were satisfied with the standard of accommodation on offer (Table 8).

Table 8. Condition and standard of accommodation

	Condition of accommodation			
Satisfied	Excellent	Good	Fair	Total
Yes	5	9	5	19
No	0	2	1	3
Total	5	11	6	22

6. FIRST DRAFT GUIDELINES

After the initial survey, a preliminary set of guidelines for sustainable utilisation of wildlife resources on game ranches was drafted. It was drawn up with the use of scientific journals and textbooks on the management of wildlife and other resources. The main references concerning the concepts that were included are found under 6.1 and 6.2 and the reference list could also be consulted. The document deals with both planning considerations and the management guidelines.

6.1. PLANNING CONSIDERATIONS

Effective planning (Lloyd *et al.* 1994) requires data on biotic and abiotic factors. Maps covering topography, geology (Visser, 1989), soils (Soil Classification Working Group, 1991) hydrology and infrastructure should be available. Records should be maintained of climate, natural disasters, occurrence of erosion, location of borrow pits and cultural assets. Important biotic aspects include:

- vegetation map indicating sensitive habitat types (Acocks, 1988 & Low & Rebelo (ed.) 1996)
- lists of plant species, (Palgrave, 1996 & Van Oudtshoorn, 1992), specifying red data (Hall *et al.* 1980), exotic (Brooke *et al.* 1986) and invasive species (Brooke *et al.* 1986, Bromilow, 1995 & Henderson & Wells, 1986)
- a vegetation monitoring program (Sutherland, 1997)
- lists of animal species
  - » mammals (Smithers, 1983)
  - » birds (Sinclair & Davidson, 1995)
  - » significant lower vertebrates (Branch 1988)
  - » significant invertebrates
  - » red data species (Siegfried *et al.* 1976)
  - » species exotic to the country or the region (Smithers, 1983, Brooke *et al.* 1986 & Kluge *et al.* 1986)

- a game counting program (Collinson, 1985)
- numbers and population composition of larger mammals and game birds.

6.2. MANAGEMENT GUIDELINES

Management guidelines deal with record keeping, infrastructure including road design and maintenance, buildings and other structures and fences. Veld management is considered one of the most important aspects of running a game ranch (Schmidt, 1992) and is therefore discussed extensively. Topics include vegetation monitoring (Sutherland, 1997 & Kent & Coker, 1995) erosion (Huntley *et al.* 1989 & Smith, 1997), invasive and exotic plant species (Bromilow, 1995), sensitive habitat types (Anonymous, 1999), fire (Van Wilgen & Scholes, 1997) and water (Ayeni, 1975 & Schmidt, 1992) management. The concepts of stocking rate, ecological grazing and browsing capacity and related factors are dealt with as well their practical implications (Danckwerts & Tainton, 1993; Fritz & Duncan, 1994; Peel *et al.* 1999). The management of red data species and exotic animals, censuses (Collinson, 1985) as well as techniques of hunting and cropping (Caughley & Sinclair, 1994 & Hanks *et al.* 1981) is discussed.

Predator control, supplementary feeding (Pauw, 1995), hunting (Mitchell, 1992), advertising and client relationships (Cassim & Langton, 1996) and controversial subjects such as ethical issues (Leopold, 1966 & Force, 1995) are discussed. Involvement of game ranch managers/owners with an adjacent community or informal settlement (Low & Hoon, 1990 & Hough & Sherpa, 1989) is also dealt with. Although this aspect is sometimes considered to be more applicable to communal land and national game parks and nature reserves it is also of utmost importance and relevance to private game ranch owners. Labour relations (Anonymous, 1997a) are an important factor in the successful management of a ranch. A subject that is often overlooked is that of general environmental conservation. Waste disposal and recycling are considered.

Based on the preliminary guidelines a second questionnaire was drawn and a further survey undertaken. This aimed to evaluate management standards on a sample of game ranches by assessing the degree of compliance with the guidelines. The preliminary guidelines are not included here as the final guidelines are similar, although more comprehensive and are based in the first set. To include them would involve unnecessary repetition.

7. SURVEY 2

7.1. OBJECTIVES AND STUDY AREA

The provisional guidelines document written after survey 1 was not shown to the game ranch owners/managers but provided a background to survey 2 which was conducted to establish to what extent it is possible to manage a private game ranch according to these guidelines. The second survey involved thirteen game ranches in the areas of Alldays, Louis Trichardt, Thabazimbi Brits and Warmbaths. Six of them had been visited in the course of the first survey. A final set of guidelines was drawn up in an effort to find a compromise between the scientific theory of game ranch management and what is practical.

7.2. QUESTIONNAIRE 2

The second questionnaire also included questions on veld and wildlife management, hunting and culling practices, structures and maintenance, work force, community involvement, general environmental conservation, and ethical conduct. Added to this were questions on management information available and the protection of cultural assets. The method used to conduct the first survey was also employed for the second survey. In an informal interview the questions were answered by the game ranch owners/managers.

7.3. RESULTS OF SURVEY 2

Table 9 summarises results obtained from the second survey. A discussion of these results follows.

Table 9. Results of survey 2.

QUESTIONS	YES	NO	Not Applicable
Only game ranch	7	6	0
Game and livestock	6	7	0
Hunting	12	1	0
Tourism	10	3	0
Hunting and tourism	9	4	0
Maps available: Topography	4	9	0
Orthophoto	1	12	0
Aerial photos	8	5	0
Hydrological	0	13	0
Geology	4	9	0
Infrastructure	5	8	0
Vegetation	1	12	0
Weather records: Temperature	2	11	0
Rainfall	12	1	0
Plans available for disasters	4	9	0
Inventories available: Mammals	5	8	0
Birds	4	9	0
Red Data animal species	2	11	0
Exotic animal species	2	11	0
Indigenous plant species	5	8	0
Red Data plant species	3	10	0
Exotic plant species	2	11	0
Invasive plant species	3	10	0
Aware of cultural assets	4	9	0
Protection for cultural assets	4	0	9
Certificate of adequate enclosure	13	0	0
Environmental impact assessments	4	9	0
Buildings and structures reachable by vehicle	13	0	0
Housing and buildings close	11	2	0
Abattoir facilities	10	3	0
Veld assessment	7	6	0
Veld monitoring	2	11	0
Erosion monitoring	4	9	0
Erosion management	6	7	0
Bush encroachment problem	8	5	0
Bush encroachment management	7	1	5

Alien vegetation	6	7	0
Alien vegetation management	4	2	7
Fire management	7	6	0
Fire breaks	8	5	0
Knows carrying capacity of region	9	4	0
Knows carrying capacity of ranch	1	12	0
Manage stocking rate according to carrying capacity	5	8	0
Exotic animals	9	4	0
Manage exotic animals	3	6	4
Censuses	13	0	0
Hunt to control animal numbers	7	6	0
Crop to control animal numbers	8	5	0
Hunt and crop to control animal numbers	2	11	0
Crop by shooting	3	10	0
Cropping by capture	11	2	0
Crop by shooting and capture	1	12	0
Predator management	7	6	0
Supplementary feeding	10	3	0
Allows hunting from vehicle	3	9	1
Allows hunting alone	3	9	1
Requires target shooting	10	2	1
Specifies calibre to be used	10	2	1
Expects pay for wounded animal	11	1	1
Provide retirement plan	4	9	0
Provide medical aid	11	2	0
Schooling available	11	2	0
Opportunity for career progress	6	7	0
Big difference between labour and management housing	4	9	1
Familiar with labour relations laws	11	2	0
Informal settlement next to ranch	4	9	0
Settlement benefit from ranch	1	2	10
People from settlement consulted	1	2	10
Recycle	5	8	0
Own waste dump	9	4	0
Water run-off near waste dump	3	6	4
Waste dump fenced off	2	7	4

7.3.1. General information

Seven of the ranches visited on the second survey were solely game ranches while six also conducted cattle farming. The biggest ranch is 10 000 ha, the smallest 200 ha and the mean size is 3 225,23 ha. Most (nine) of the ranches offer both hunting and tourism; one has only tourism activities and three host only hunters (Table 9). But hunting is conducted on 92% and tourism on 77% of the game ranches.

The vegetation represented in these areas is mostly combinations of different veld types with mixed bushveld being the commonest. On some of the ranches both sweet bushveld and mixed bushveld are present as well as a combination of sour and mixed bushveld. One property has a combination of sour and sweet bushveld. Only sweet bushveld occurs on three of the game ranches.

7.3.2. Management information

Availability of maps or photographs is indicated in table 9. Respondents indicated that 62% had aerial photos, 38% infrastructure maps and 30% geology and topographical maps available. Others are neglected. On the one ranch, where a vegetation map is available, the sensitive habitat types are also indicated. Another also had the sensitive habitat types indicated on a separate map. Rainfall is the most commonly measured weather factor, recorded by all but one respondent but only two owners/managers measure both temperature and rainfall. Management plans for unexpected occurrences or disasters are only available on four of the game ranches (Table 9). Species lists are available on less than half of the ranches. Mammals, plants (38%) and birds (31%) lead the field. Exotic animal and plant species are only listed on two ranches (Table 9).

7.3.3. Cultural assets

On all four game ranches where cultural assets occur, plans for managing and protecting them are available (Table 9). However, none of the assets are entered in a register. It is also questionable whether all the game ranch owners/managers know for sure if there are cultural assets of any kind present on their game ranches.

7.3.4. Infrastructure

All the game ranches visited had certificates of adequate enclosure. Structures and buildings are usually spread across the area but on six of the ranches structures and buildings were all closely grouped. On all the ranches all buildings and structures can be reached by vehicle. Environmental Impact Assessments (EIA) were included in the planning of new constructions/structures on only four ranches.

Abattoir facilities were built according to legal specifications and by consulting the regional health inspector. Some of the abattoir facilities were already there when the current owners arrived.

7.3.5. Veld management

Veld condition had been assessed by seven (54%) of the game ranch owners/managers. According to the knowledge of the current owners, no assessment had ever been done on the other six ranches. Only two owners/managers implement a veld-monitoring program. The latter have implemented both an assessment and a vegetation-monitoring program (by using the point method) (Table 9). The services of the Department of Agricultural Technical Services were also used by some for veld monitoring purposes. Veld assessments and veld monitoring seem to be independent of the size of the ranches; it is not necessarily true that the bigger the ranch (>5 000 ha) the more likely it is to have had a veld assessment done or a monitoring program available. Monitoring of erosion is regularly done on only four ranches and is independent of vegetation monitoring. Thus, when vegetation monitoring takes place, erosion monitoring is not necessarily done.

Erosion is actively managed on six ranches (46%) (Table 9) and management of erosion is independent of erosion problems. Where there is an erosion problem it is managed, but erosion management is also conducted without erosion occurring on the ranch by implementing precautionary measures. Erosion is prevented in a number of ways, including packing of rocks, stones, plant material, gravel, building materials and used motor tyres. Sluices and gabions are built to prevent erosion in erosion-prone areas and grass cover is established to minimise the amount of soil exposed. Grass species used in establishing cover include blue buffalo grass (*Cenchrus ciliaris*) and wool grass (*Anthephora pubescens*).

Bush encroachment occurs on eight (62%) ranches and is managed on seven of them. Management of bush encroachment is not independent of its occurrence ($p=0.013$); where a bush encroachment problem exists it is managed.

Methods employed include use of arboricides, bulldozing encroached areas, taking out trees for firewood and even the introduction of elephants in the bigger areas. Most common invasive species include sickle bush (*Dichrostachys cinerea*) and silver terminalia (*Terminalia sericea*). Bush encroachment problems are independent of invasive plant species occurring on the game ranches, which implies that exotic plant species in the Northern Province are not necessarily invasive.

Exotic plant species occur on six ranches (46%) and are controlled on four of them (Table 9). The most common species are prickly pear (*Opuntia* species), *Lantana* species, seringa (*Melia azedarach*) and oleander (*Nerium oleander*).

Of the game ranch owners/managers interviewed seven (54%) had a fire management plan available and on eight (62%) of the ranches fire belts apart from the roads were built. The availability of fire management plans is independent of that of a veld monitoring program and the occurrence of fire breaks is independent of the existence of a fire management plan. A possible explanation for this is that firebreaks may be built to stop veld fires spreading and not necessarily for the implementation of a fire management plan.

7.3.6. Wildlife management

Eleven game ranch owners/managers (85%) knew more or less what the prescribed agricultural carrying capacity of the region was, but only five (38%) managed animal numbers accordingly. Knowledge of the carrying capacity of the game ranch is independent of the availability of a veld monitoring program which implies that even when vegetation is monitored, the manager/owner does not necessarily know what the carrying capacity is. Managing the stocking rate according to the carrying capacity of either the region or the game ranch is independent of vegetation monitoring, bush encroachment problems and erosion problems. This could imply that stocking rate is not managed according to results from a vegetation-monitoring program or in response to bush encroachment and erosion problems occurring.

Supplementary feeding is provided on ten of the game ranches visited, especially in the winter season when natural food is in short supply. It is independent of whether a ranch is managed according to a certain carrying capacity or not.

Animals exotic to the Northern Province are present on nine of the ranches (69%), and of these, only three manage them in order to lower numbers for eventual removal (Table 9). On all the game ranches visited, animals numbers are estimated in some way and game count methods include helicopter, fixed wing aircraft and water hole counts. Populations are harvested in all cases.

7.3.7. Hunting, cropping and ethical questions

Harvesting to manage animal numbers comprises hunting, cropping by capture or shooting or combinations. Cropping is done on six of the game ranches (46%) and hunting is used to control animal numbers by five of the owners/managers while the other two use both methods. On only three of the ranches cropping involves shooting whereas the other ten owners/managers interviewed capture and sell live game for relocation, usually at auctions. One owner/manager uses both methods (Table 9). On two-thirds of the ranches, where hunting takes place, hunting from a vehicle is prohibited. On a third hunters are allowed to hunt alone. On all the game ranches where hunting takes place, the hunters are expected to do target shooting before commencing the hunt and rifle calibres are specified by most owners/managers. On all except one ranch, when an animal is wounded, the hunter is subject to payment in full whether it is found or not. Meat removal letters are usually issued by eight owners/managers (Table 9).

Predator control is implemented on six ranches (46%) and methods of control include shooting predators on sight or catching them for relocation. Species that are considered problem animals are the black backed jackal (*Canis mesomelas*) and caracal (*Caracal caracal*). Predator control is not independent of the type of ranch it will be done depending on whether there is livestock and game on a ranch or only game ($p=0.008$).

7.3.8. Work force and community involvement

On only four of the farms visited (31%) are labourers provided for after retirement. However, medical services are provided by most owners/managers and there are ample opportunities for children to attend school on most of the ranches (85%). Opportunities for labourers to develop a career by doing courses are available on seven ranches (54%) (Table 9).

Housing for labourers is good in most cases, but on four ranches (31%) there are significant differences between the housing conditions of the owners/managers and labourers as assessed by the respondents. The new labour relations laws are known to almost all (85%) owners/managers (Table 9). Informal settlements and/or communities are present on the boundaries of four of the game ranches visited. Two of these communities benefit from the ranch and its resources. Also two of the owners/managers -not necessarily the same two- consult with these communities when management decisions have to be made that could influence them directly or indirectly (Table 9).

7.3.9. General environmental conservation

Recycling of waste is done on only five (38%) of the game ranches visited. About two-thirds (69%) have their own waste dumps and care is taken to prevent water run-off to and from the dumpsite by six of the nine ranches with their own dumpsites. The waste dumps are fenced on only two of the ranches (Table 9). Abattoir waste is disposed of in various ways. Some abattoirs have a drainage system where the waste is drained into a manhole and treated with chemicals. The laborers usually take the bulk of the waste; the rest gets dumped in the veld. Waste sometimes gets buried. There is also the option of dumping the abattoir waste at a vulture restaurant.

8. DISCUSSION

8.1. STUDY METHOD

The method employed was availability sampling, a form of non-probability sampling. The sample selected was based on the ranch owners/managers' availability and willingness to undertake the interview. The exact number of game ranches in the Northern Province is not known and this information is not readily available and in any event changes every year. The assumption could however be made that the sample sizes are very small therefore biased and may not be representative. The area in which the study was conducted is mostly savanna bushveld and does not show much variation in ecological characteristics, climate (Table 1) and land use.

Potential problems that may be experienced in using the questionnaire survey method include the lack of resources. In this case the limiting resource was time. The other problems experienced include the lack of response where owners/managers were either not available or not interested, which would have given rise to a non-response bias. There is thus the possibility that owners/managers that were unwilling to participate or that weren't available could have had an influence on the results (Fillion, 1980). Respondents may perhaps have been more interested and better managers than non-respondents.

The way in which the interviews took place could have had an influence on responses from the interviewees and the interviewer might just have heard what he/she wanted to hear (Haynes, 1982). The interviewees' responses could have led to response bias (Fillion, 1980). An experienced interviewer would be able to pick up errors in response due to failure to understand, an unreliable memory, a desire to please, or outright lying (Bentham & Moseley, 1982).

The responses to questions may either have been affected by the design of the questionnaire or the manner in which questions were worded (Fillion, 1980). Mathematical formulae cannot correct for errors created by inappropriate wording, respondent or interviewer bias.

The responses to questions may either have been affected by the design of the questionnaire or the manner in which questions were worded (Fillion, 1980). Mathematical formulae cannot correct for errors created by inappropriate wording, respondent or interviewer bias. The questionnaire used in the surveys were pre-tested and redesigned after it was found that it would not be sufficient for data analysis. Problems with questionnaire surveys can be minimised by the pretesting of questionnaires, experimental studies, knowledge of the current literature on the merits and pitfalls of questionnaire survey techniques and a basic understanding of human nature (Fillion, 1980). The more experienced interviewer will have a better understanding of survey techniques and problems will be minimal.

Using stratified random sampling the precision of the sample could be increased considerably. This would involve classifying the target group into separate groups or strata. Then random samples are drawn from within each stratum (Bentham & Moseley, 1982). In this case, ranches could have been divided into different sizes, type or by veld types which could have been sampled randomly. The main reason why the stratified random sampling method was not used was because of the lack of time, money and other resources. It would have given rise to a much more extensive survey that is long-term and the information needed is not readily available. This study was a short-term study.

It is perhaps not unreasonable to assume that the interviews gave an overall impression of management practices followed on ranches in the region. In any event the information gathered gave an indication of which management practices are considered a higher priority than others. Practices could be compared for dependence on one another.

8.2. IMPLICATIONS OF RESULTS

Both hunting and tourism are offered but only the bigger, more commercial, ranches seem to be able to afford to have tourism activities alone. It is clear from both surveys that basic biotic and abiotic information is not readily available and is not generally used for management. This could be because the time spent on management is minimal.

Bothma (1989) found in a survey done in the former Transvaal Province that game ranch owners/managers devote only 14% of their time to actual management. It seems that only the more visible problems are managed or looked into. They include erosion, bush encroachment and exotic plant invasions. Owners/managers usually act on their own assumptions and impressions without using scientific methods in practices like veld monitoring or assessments. Bothma (1989) also states that owners/managers often overutilize the veld while being well aware of doing so and of the consequences. In the study assessed by Bothma (1989) no game rancher reported any scientific form of monitoring of all aspects relevant to his practice. He concluded that the most neglected part of game ranch management involves regular monitoring of trends in habitat composition and quality and game. Attempts are made to determine numbers of large mammals, but the results are not used to a great extent in management practices such as maintaining populations within the grazing/browsing capacity or determining seasonal offtakes.

In this study most owners/managers condemn unethical hunting practices, but exceptions are made under certain circumstances and ethical conduct is not always strictly practised. Predator control is usually carried out and is not considered unethical. Buildings and structures on the ranches surveyed are usually well maintained. The quality and standard of the buildings and structures, according to the assessments of the owners/managers themselves were fairly good and it seemed that it would vary according to the income and class of hunter or tourist that visits the ranch. When planning new buildings and/or structures, an Environmental Impact Assessment (EIA) is not always a consideration. Some managers/owners will carry out an assessment of the areas where the proposed building/structure will be built but it is usually not documented and done at the manager/owner's own discretion. The labourers (work force) are usually well looked after. These people are generally still illiterate and most come from the rural areas. The behaviour of the workers differs from area to area, some stay on one ranch and families have been there for generations. Others however move around and some ranches have a high turnover of workers.

Community involvement entails different things for different people. The community could be the local town, or it could be the informal settlement on the edge of the ranch. In both cases owners/managers are involved. It includes involvement with other farmers, game ranch owners/managers and people in the surrounding areas. Involvement with the informal settlement entails employment opportunities and provision of facilities and/or food and housing.

General environmental conservation is not considered a priority because practices like recycling seem to be impractical and not an economically viable option. Waste dump management is done by most of the managers/owners because there are waste dumps on most of the ranches. New ideas need to be implemented to minimise waste in general. This include organic, solid and toxic (especially pesticide) waste.

Scientific methods, assessments and measurements should be combined with practical field experience and knowledge. The starting point is formulating the objectives of the game ranch clearly. Information gathering follows, which also entails developing an information system in which management information can be stored. This is followed by identifying monitoring programs that need to be implemented to follow trends and progress. The challenge is to use what is present on the game ranch to reach the objectives. The following section leads to the final set of guidelines to help game ranch owners/managers to reach the set objectives combining field experience with scientific measurements and methods.

9. CURRENT ISSUES IN GAME RANCH MANAGEMENT

9.1. INTRODUCTION

The purpose of this section is to give an overview of what issues are currently important on private game ranches sampled in the Northern Province. The subjects discussed here stem largely from the surveys. There is uncertainty among game ranch owners/managers concerning some management practices and sometimes confusion and an attempt is made in the following section to clarify some of these aspects. The main areas of concern include exotic animal and plant species, fire, vegetation, erosion and bush encroachment management and game counts. Other aspects which are either controversial or where there is no uniformity include the concept of carrying capacity, harvesting, hunting and ethics.

9.2. EXOTIC INVASIVE PLANTS

Exotic plant invasions are often characterised by the spread of a particular species over a large area and are usually regarded as ecologically threatening events. As exotics become established native forage species used by ungulates may receive such a small share of available resources that they are able to persist only at very low population levels. Degradation of the native community and local extinction of preferred plant species may reduce the grazing/browsing potential of the area for native wildlife. Managers should be aware of exotic plant species that might occur in their area and recognise potential interactions. An inventory of exotic plant species occurring in an area will assist in making decisions concerning their possible effects on wildlife and wildlife habitats (Trommel & Butler, 1995).

Thompson *et al.* (1995) concluded that the greatest functional differences lie between invasive and non-invasive species in general, irrespective of exotic or indigenous status, and that a failure to recognise this may often be responsible for an inability to define clearly the characteristics of invasive exotics.

But whether plant species are exotic or indigenous invaders, management should be aimed at reducing these species to a level that is not detrimental to the area. Although great progress has been made with the development of effective chemical control techniques for alien invader plants (Kluge & Erasmus, 1991), herbicide use should be minimised, especially near watercourses. If chemicals are to be used then it would be useful to consider species occurring in KwaZulu-Natal (where most of the work has been done) that also occur in the Northern Province and that have the same detrimental effects. Herbicides are now registered for the 15 most important alien invasive plants occurring in KwaZulu-Natal. Despite the progress made with the development of effective control techniques, the progress with the actual control of alien invasive plants using these methods (*i.e.* implementation) has been disappointing.

Kluge & Erasmus (1991) give a number of possible reasons for this that include:

- No proper planning. Alien invader plant control is usually considered a low priority and gets done on an *ad hoc* basis.
- Disregard for common sense aspects. Many common sense "rules" which would greatly increase the effectiveness of alien invader plant control measures are disregarded.
- Lack of flexibility in the approach to control. Effective control of alien invasive plants requires flexibility, improvisation and the integration of all available control methods.
- Poor application of the available control methods.
- No follow-up. Initial clearing of an area should be followed up for as long as there is a threat of heavy re-infestation. Rehabilitated areas should be checked annually.
- Poor information on the real control costs involved. Apart from the cost of the herbicides, there is little information on the cost of aspects such as labour, equipment and follow-up treatments.

An economic evaluation of invasive alien plant control programmes in the mountain catchment areas of the Western Cape was done by Marais (1998). Clearing effort is measured in terms of the number of person days it takes to treat one hectare. These include labour costs, equipment, herbicides, fuel and follow-up treatment.

Attitudes towards alien invader plant control also play a role, because the battle can be lost even before it has begun because of the thinking around alien invaders. In a Natal Bureau Report (1994) it is stated that since there are registered herbicides and effective techniques for the control of almost all the major invasive plants, motivation appears to be the biggest obstacle standing in the way of controlling them. Also, there is a perception that alien invader plants are invincible and considered "super plants". In many cases an alien invader is simply a successful opportunist capitalising on conditions created for it by disturbance and/or neglect. Alien plant invasions could however be a symptom of an underlying problem like overgrazing, too frequent or infrequent burning and natural disturbances such as floods (Kluge & Erasmus, 1991). Commitment from all levels is required for the successful implementation of such an eradication programme.

Adjustments in wildlife population densities may be needed to reduce habitat degradation of habitats free of exotic plants because of the reduction in forage or avoidance of exotic plant-infested habitats. This may reduce the effect of exotic plant species that rely on disturbance such as overgrazing or over-browsing as a mechanism for spreading (Trommel & Butler, 1995). Therefore the problem rather than the symptom should be treated. It is also not a realistic goal to attempt to eradicate invasive plant species randomly rather than starting with specific land-units. It is more realisable to aim to reduce all the alien invasive plants within a well-defined unit of vegetation to a level where they do not present a problem. This unit may be a paddock, a patch of natural vegetation or, ultimately a whole farm. Another misconception preventing successful alien eradication is short-term thinking.

Alien invader plant control should be seen as an integral part of vegetation management and, as such, should be accepted as an ongoing process (Kluge & Erasmus, 1991). Two of the alien main invader species in the regions studied were lantana (*Lantana camara*) and prickly pear (*Opuntia stricta*). Lantana, originating in South America, is rated as one of the ten most harmful weeds in the world (Nel, 1994) and is also one of the most serious invader species in South Africa. It forms dense impenetrable thickets replacing indigenous plants and increasing erosion. Eradication is laborious and expensive. Chopping the dense bushes and then painting the stumps or spraying the re-growth with herbicide are usually the most effective methods of controlling lantana (Bromilow, 1995). The prickly pear was also introduced from South America. It is a declared weed in South Africa that has been identified as a threat to indigenous diversity. It removes patches of land from grazing and at later stages of invasion may severely reduce grazing potential and accessibility of range for livestock. This succulent is a well-recognised component of the mixed bushveld and its properties of drought resistance and modest habitat requirements allows it to prosper in this, often harsh, range type, which therefore makes it highly successful (Thrash, 1998).

Although only two alien species are mentioned above there are in total 32 alien species that are known to form moderately dense to dense stands in the grassland and eastern savanna biomes (Table 16) (Henderson & Wells, 1986).

9.3. EXOTIC ANIMALS

The last three decades have seen the establishment of game ranching as a form of commercial agriculture. This has led to the importation of alien mammals and the translocation of indigenous ones to areas in which they never occurred in the historical period. These animals are husbanded for their meat and for trophy hunting. The conflict here lies between the economic value of these animals and conservation theory.

The game ranch owner/manager does not necessarily share the same sentiments as the nature conservationist in preserving animal species in their natural environment.

His main goal is economic gain. Apart from the threat of hybridisation with indigenous animals there is also the threat of exotic animals becoming numerous and difficult to eradicate. But translocation of indigenous animal species can present more problems than alien introductions. For example the two *Connochaetes* species are said to hybridise freely when translocated and are also carriers of diseases that affect cattle. The springbok and impala have also been contaminated genetically because of many translocations (Brooke *et al.* 1986). Exotic large mammal species occurring in South Africa include fallow deer (*Cervus dama*) Himalayan tahr (*Hemitragus jemlahicus*), water buffalo (*Bubalus bubalis*) and barbary sheep (*Ammotragus lervia*). However, fallow deer is the only exotic to have been widely introduced. Effects on indigenous species are not documented but competition can be expected with browsers/grazers of equivalent size at high population densities. Fallow deer are indigenous to parts of Europe and Asia and can utilise a wide range of habitats including riverine bush, highveld grass plains and the Karoo.

Regional exotic animals:

* Cape Mountain Zebra (*Equus zebra zebra*):
  Occurs naturally in mountainous areas of the Western and Eastern Cape Province.
* Black Wildebeest (*Connochaetes gnou*):
  Did occur in parts of the Northern Province naturally but their habitat is open grass plains of the Highveld.
* Gemsbok (*Oryx gazella*):
  Originally occurred in the north western Cape, Karoo, Botswana and Namibia and will venture into open dry areas in the Northern Province but prefers open arid environments like open bush and grass savanna.
* Blesbuck (*Damaliscus pygargus phillipsi*):
  Originally inhabited open grass plains in the Northern Cape Province and Highveld, but they have been relocated to other areas where they adapted to sweet veld and water.

* Red Hartebeest (*Alcelaphus buselaphus*):
  Occurs in grass plains and open savanna from the Northern Cape Province to the Free State, KwaZulu-Natal, Gauteng and the North West Province.
* Springbok (*Antidorcas marsupialis*):
  Not native to the Northern Province region and occurred mainly in the Karoo, Northern Cape Province and marginally in the Highveld. They prefer semi-arid regions and open grass plains (Smithers, 1983).

The importance of this subject lies not only in the threat to the genetic stability and/or survival of a species but also because it may affect the survival of viable populations on game ranches. Each animal has specific habitat requirements needed in order to survive and reproduce. In terms of food requirements the owner/manager must consider both the wet and dry season food needs, particularly at the critical period at the end of the dry season when water and food tend to run short (Stroleny-Ford, 1990). Some animal species adapt when translocated to new areas and translocation has been done to such an extent that some species are considered endemic to the region by most of the game ranch owners/managers.

Table 10 shows regions suitable for various game species and their feeding preferences. It can be used to identify species naturally occurring in and has adapted to the Northern Province. This subject is the cause of much speculation and the question on the sensitivity of tourists and foreign hunters arise. Research is needed that can indicate what the public opinion is on having game in a habitat which is not their original or natural habitat.

Table 10. Suitable regions for different game species and feeding preferences of game (Stroleny-Ford, 1990 & Smithers, 1983).

Species	Region			Grazing preference			Browse level		
	Bushveld	Highveld/ Grassveld	Karoo	Tall	Short	Vlei	Low	Medium	High
Blesbok	-	+	-	-	+	-			
Bontebok	-	-	+	-	+	+			
Buffalo	+	.	-	+	-	+			
Bushpig	+	-	-	.	-	.			
Dikdik	+	.	-			.	+	-	-
Duiker, Grey	+	.	+	.	-	.	+	-	-
Eland	+	+	+	+	.	-	+	+	-
Bushbuck	+	-	.	-	+	.	+	+	-
Elephant	+	+	-	+	.	+	.	+	+
Gemsbok	.	-	+	-	+	.	+	+	-
Giraffe	+	-	-			-	.	.	+
Hartebeest	+	.	-	.	+	.			
Impala	+	-	-	-	+	.	+	.	-
Klipspringer	+	+	+			-	+	.	-
Kudu	+	-	+			-	+	+	.
Nyala	+	-	-		+	.	+	+	-
Oribi	-	+	-	.	+	.			
Common reedbuck	+	+	-	+	+	+			
Mountain reedbuck	+	+	+	+	+	-			
Rhebuck	-	+	+	.	+	-			
Black rhinoceros	+	-	+			-	+	.	
White rhinoceros	+	+	-	.	+	.			
Roan antelope	+	-	-	+	-	+			
Sable antelope	+	-	-	+	-	+			
Springbok	-	.	+		+	-	+	-	-
Steenbok	+	.	+	-	+	-	+	-	-
Tsessebe	+	-	-	+	.	+			
Warthog	+	-	-	-	+	+			
Waterbuck	+	-	-	+	.	+			
Black wildebeest	-	+	.	-	+	-			
Blue wildebeest	+	-	-	-	+	-			
Burchell's zebra	+	.	-	+	+	-			
Mountain zebra	-	.	.	.	+	-			

+ = definite - = not at all . = possibly Blank = irrelevant

9.4. FIRE MANAGEMENT

The use of fire in veld management in South Africa can be traced back to 1687. In the 1920s it was realised that veld deterioration and subsequent bush encroachment can result because of overstocking after veld fires or with the misuse of fire as a management tool. In the 70's it was the opinion of scientists that fire in conjunction with proper post-burn veld management was an important tool in maintaining open savannas (Jordaan, 1995).

The absence of fire is also regarded as one the major reasons for the occurrence of bush encroachment (Jordaan, 1995). Fire is a vital and useful instrument in veld management. Farmers and grazing experts consider organised veld burning essential to destroy invasive plants and to prevent grazing veld being taken over by them. Fire is also vital in removing overgrown or unpalatable grass ensuring only palatable nutritional grazing remains (Anonymous, 1995a). This is because high levels of moribundness and necromass in the grass layer lower the productivity of palatable grass species to grazers and will eventually result in a decrease in the density of grass tufts (Du Plessis, 1997).

Additional reasons for using fire in the successful management of a game ranch are: fire can be applied to destroy parasites such as ticks, firebreaks can be made to protect the veld and specific areas can also be burnt to induce rotational grazing on a game ranch Turner & Van Hoven (1997). The optimal practices for the management of natural areas like nature reserves or private game ranches are often those which most closely imitate natural processes. Hence burning regimes should ideally be modelled on the natural incidence of fire. The approach of simulating the expected incidence of fire caused by lightning is strongly recommended for drier regions of southern Africa (Du Plessis, 1997). As the mean annual rainfall increases, fire becomes more frequent due to the accumulation of available combustible material. (Van Wilgen & Scholes, 1997). In dry areas the natural incidence of fire is correlated with the occurrence of wet and dry cycles and controlled burning programmes must take this into account.

For management purposes the farm (area) should be divided into major zones (depending on size of area). Zones must be further divided into burning blocks based on relatively homogenous vegetation communities and edaphic and topographic features, using existing roads and/or firebreaks. September is considered the most suitable month to burn. Later fires become progressively more harmful, especially to the perennial grasses that begin to sprout as the temperature increases after the winter. It also becomes increasingly difficult to ensure an effective burn (Turner & Van Hoven, 1997).

Post fire management is of utmost importance. It is recommended that, when burning to remove moribund or unacceptable grass material, rotational grazing be applied soon after the burn while allowing adequate recovery periods between grazing. Rotational grazing could be implemented by regulating water points and (if present on the ranch) feeding points. For game the most important precaution is to burn large areas to avoid the danger of overgrazing on the new growth which follows a fire. As fire is based on highly variable ecological components a fixed or rigid fire management plan is not feasible. Management must therefore continually adapt to the needs of the environment, particularly to rainfall.

9.5. VEGETATION MANAGEMENT

9.5.1. Vegetation classification

The classification and description of vegetation units form the primary basis for the delineation of homogeneous vegetation units. The units must be as such that within them, the vegetation will react uniformly to use and management (Breebaart & Deutschländer, 1997). The delineation of homogeneous vegetation units in turn is essential for ecologically sound veld management as it provides a sound basis for the determination of the grazing/browsing potential, monitoring of trends in veld conditions, and assistance in planning the location and construction of roads and water holes (Dekker & Van Rooyen, 1995). Schulze *et al.* (1994) also stress the importance of detailed identification, classification and mapping of the vegetation of a region. Future land-use planning, management and conservation strategies must be based on sound plant ecological principles to facilitate optimal resource utilisation.

In the Northern Province bushveld, where this study was conducted, there is little detailed knowledge of the nature and distribution of vegetation and only broad-scale classifications have been conducted (Schmidt *et al.* 1993). Dekker & Van Rooyen (1995) state that vegetation types are the result of a specific set of environmental factors and therefore constitute different habitats. And ungulates display varying degrees of habitat selectivity and exhibit a heterogeneous distribution, following that of vegetation. The distribution of ungulates can be broadly predicted from that of different habitat types/vegetation units. Trollope (1999) reviews the theory and practice of veld burning in savanna and Grossman *et al.* (1999) discuss the use of fire in game ranch management.

Schulze *et al.* (1994) found the Braun-Blanquet procedure to be effective for delineating plant communities and habitats in the North West Province mixed bushveld. Dekker & Van Rooyen (1995) applied TWINSPAN (two-way indicator species analysis) to the floristic data set in order to derive a first approximation of vegetation types. Refinement of this classification was done by means of Braun-Blanquet procedures.

9.5.2. Veld condition assessment

According to Palmer & Van Staden (1992) the initial or preferred state of the vegetation must be determined first (condition assessment), and then treatments applied which modify the contemporary vegetation away from or towards the preferred state. When conducting veld condition assessments other processes can also be detected, for example, veld degradation and subsequent bush encroachment (Schulze *et al.* 1994). The development of techniques for assessing veld condition in South Africa has proven very valuable for assessing the current condition of the veld and for formulating veld management practices like stocking rate, rotational grazing, rotational resting and veld burning. For example, Trollope *et al.* (1989a) developed assessment techniques for monitoring effects of burning, development of water points and game control on vegetation in the Kruger National Park. Once veld condition has been determined the data can provide information on, for example, forage potential (for establishing stocking rates), fuel potential for fire management, trends in veld condition (for management objectives) and resistance of the veld to soil erosion (Trollope *et al.* 1989a).

Veld condition assessment in grassland is based on sampling to determine the relative abundance of plant species. Condition indices are then determined by using one of several available methods (Hardy *et al.* 1999). Those based on agronomic principles relate to the immediate forage production potential and are favoured in livestock systems. Ecologically based methods index veld condition according to the response of vegetation to abiotic and biotic environmental impacts. They include the benchmark, ecological index and key species methods and the use of degradation gradients. The benchmark and ecological index methods depend on classifying grasses and forbs as decreasers or increasers.

These categories are defined as follows (Van Oudtshoorn, 1992):

Decreaser: A species that is dominant in veld that is in a good condition but will decrease with bad veld management.

Increaser I: A species that is dominant in veld in a bad condition and increases with under utilisation and selective grazing.

Increaser Ia: A species that increases with mild under-stocking or selective grazing.

Increaser Ib: A species that increases with strict under-utilisation or selective grazing.

Increaser II: A species which is dominant in veld in a bad condition and that increases with overgrazing.

Increaser IIa: A species that increases with light overgrazing.

Increaser IIb: A species that increases with mild overgrazing.

Increaser IIc: A species that increases with heavy overgrazing.

Examples of species indicating severe overgrazing are given in Table 11.

Table 11. Grass species symptomatic of severe overgrazing (Van Rooyen, N. *et al.* 1995).

SCIENTIFIC NAME	**ENGLISH**	**AFRIKAANS**
Aristida congesta subsp. *congesta*	Tassel three-awn	Katstertsteekgras
Aristida junciformis	Ngongoni three-awn	Ngonogoni-steekgras
Cynodon dactylon	Couch grass	Kweek
Eleusine coracaca africana	Goose grass	Osgras
Enneapogon cenchroides	Nine-awned grass	Negenaaldgras
Eragrostis gummiflua	Gum grass	Gomgras
Eragrostis obtusa	Dew grass	Douvatgras
Eragrostis plana	Tough love grass	Taaipol eragrostis
Eragrostis trichophora	Hairy love grass	Harige pluimgras
Melinis repens	Natal red top	Rooipluim
Perotis patens	Cat's tail	Katstertgras
Pogonarthria squarrosa	Herringbone grass	Sekelgras
Schmidtia kalihariensis	Sourgrass	Suurgras
Setaria pallide-fusca	Garden bristle grass	Tuinmannagras
Sporobolus nitens	Curly leafed dropseed	Krulblaarfynsaadgras
Tragus berteronianus	Common seed grass	Gewone wortelsaadgras

In savanna the woody component may also need to be assessed to determine species abundance, density and size distribution. Tree populations may be expressed as tree equivalents (TE) and browsing value may be expressed as browse units (BU) (Tainton, 1999).

9.5.3. Vegetation monitoring

The reason for monitoring veld condition is to provide the wildlife manager with an objective means of formulating management strategies that will achieve the stated objectives for the management area (Trollope *et al.* 1989b). An efficient, rapid and reliable method is needed for routine monitoring of vegetation in natural grazing land in order to determine its condition and to calculate grazing capacities (Du Toit, 1998b). Another aim, and probably the most important, is to check whether management is achieving the desired goals (Novellie &Strydom, 1987). For moisture-limited grasslands and savannas, fluctuations in rainfall strongly affect species composition and production of the vegetation.

Furthermore, although individual factors may apparently have weak effects, soil properties, weather, fire and herbivory all interact, which complicates the evaluation of the causes of vegetation change. Several publications have emphasised the importance of monitoring, and the parameters of relevance, and there are some useful texts on statistical techniques for measuring vegetation. However, counsel on how to plan a monitoring study has attracted little attention. Furthermore, the growing adherence to adaptive management necessitates frequent monitoring to assess the attainment of, or departure from, predefined management goals (Mentis, 1989). Data collected for the purpose of monitoring are subject to various sources of error. Variation between different observers, as well as sampling errors, may be considerable and must always be kept in mind when dealing with any data collection or monitoring method.

Fixed-point photography is a useful tool in any monitoring program. It is an example of ground based monitoring and the simplest way of detecting vegetation change. Fixed points are established from where photographs are taken at the same time each year under similar environmental conditions (Myburgh & Van Staden, 1997). Another method utilises quadrats which are placed in the study area according to the sampling design. Different measures can be used to survey the vegetation (Bullock, 1996). The Nested Plot Technique can be used to create a species area curve to determine the minimal area of the quadrats required. This can also be determined by setting a standard of 5 or 10 percent sampling intensity. This refers to the area that is covered by the vegetation segment. If the latter covers 6 hectares, a 5% sample would extendc over an area of 0.05 X 60 000 m^2 = 3000 m^2. This area could be sampled by 30 10 X 10 m quadrats (Mueller-Dombois & Ellenberg, 1974). Remote sensing, however is an increasingly attractive alternative to ground based monitoring.

Remote sensing is an information-technology system, which stores, analyses and displays spatial and non-spatial data. Veld monitoring by remote sensing can be best accomplished within a Geographic Information system (GIS) framework.

First class of image or remote sensing information

Aerial photographs provide the highest resolution and capture the spatial and textural essence of the landscape more accurately than any other procedure. The disadvantages include the cost of film and processing, compounded by repeated coverage needed to detect change as well as the spectral sensitivity of conventional black and white photography.

Second class of image or remote sensing information

Satellite based remote sensing systems include the Landsat Multispectral Scanner (MSS), the Landsat Thematic Mapper (TM), SPOT (Systeme Pour l'Observation dela Terre) and AVHRR (Advanced Very High Resolution Radiometer). High-resolution remote-sensing systems may be used routinely in future to gather spectral data on different veld plant species and provide an instant analysis of the quality, quantity and condition of grazing.

Satellite imaging involves computer driven interpretation of satellite images such as those from the Landsat Thematic Mapper. The resolution (*i.e.* the spatial detail) of these images is determined by the pixel size used. The pixel is the area of land from which a single spectral image is taken and can now be less than 100 m^2. The spectral image measures the intensity of light at a range of different wavelengths. Pixels or groups of pixels are classified into types based on these readings and theses types are interpreted using field surveys. The vegetation types may be very coarse, e.g. forest, grassland etc.; mixed woodland or wet heath, dry heath and bogs. These satellite maps can be transferred onto computer systems, including geographical information systems, and the areas measured (Nel, 1991). Useful references that give the background to satellite imaging techniques are Turner & Gardner (1990), Haines-Young *et al.* (1993) and Sannier *et al.* (1998).

It is also important to consider the frequency at which monitoring surveys have to be repeated. The fact that rainfall fluctuations can have so marked an effect on the vegetation argues in favour of a high frequency of repeat surveys. Infrequently occurring climatic conditions, such as periods of exceptional rainfall, may bring about episodes of seedling establishment. Such an episode could be the major determinate of a community structure that may persist for many years afterwards.

Grazing pressure, or other factors under the control of management, prevailing at the time of such an episode may have a more critical influence than at any other time. If the frequency of repeat surveys is too low such uncommon events may go unrecorded, and this could seriously impair the interpretation of trends (Novellie & Strydom, 1987). If vegetation monitoring is done properly, problems like bush encroachment/densification can be detected early enough to prevent them from getting out of hand, thus saving money, time and manpower.

9.6. EROSION

Water and wind erosion are the cause of great soil losses each year. The tempo of accelerated erosion is such that soil loss is 20 times higher than the tempo of soil formation (Van Oudtshoorn, 1992). Huntley *et al.* (1989) also emphasise the economic loss due to erosion. Currently there are three million ha of land valued at approximately R1 500 million that are unavailable for grazing and thus useless because of erosion. Erosion is not constant however, varies seasonally and is worse during droughts than during wet periods. This apparent contradiction is due to a number of factors. For example, rain promotes plant growth that binds the soil but drought and associated veld fires cause the vegetation to die back and exposes sediment for erosion. The occasional rains during drought periods have a disproportionately large erosion effect (Smith, 1997).

Active management of wildlife and livestock is necessary to avoid trampling and overgrazing and subsequent erosion and degradation.

In the case of overgrazing, vegetation cover is reduced, the soil is more prone to erosion and bush encroachment will set in. Thus to prevent veld degradation erosion should be prevented, monitored and managed.

9.7. BUSH ENCROACHMENT

In Southern Africa the phenomenon of increasing woody plant density is commonly referred to as "bush encroachment" (Smit *et al.* 1999). A distinction is sometimes made between bush encroachment and bush thickening. Bush encroachment is the establishment of woody plants and the extension of their range because of the lack of competition for resources. Bush thickening is where the woody plant material increases and the range in which the trees occur does not necessarily expand. Increasing tree and shrub density leads to the decrease of available grass material as well as a decrease in browse availability and this phenomenon affects large areas of South African bushveld. There are various reasons for this, including poor pasture management, overstocking, injudicious use of fire, cattle monoculture, low and infrequent rainfall and old irrigation farmland (Van Rensburg, 1996). A possible explanation is that woody vegetation is generally better adapted to survive dry periods and these droughts can thus promote bush encroachment and/or bush thickening. However, the problem is a complicated one and detailed discussion is presented by Smit *et al.* (1999).

Figure 2 illustrates the decrease in grass and browse production with an increase in the density of *Acacia karroo*. If stocking rates are not reduced in drier periods then overgrazing will take place. The ability of the grass component to compete is drastically reduced and this will therefore promote the growth and establishment of trees. The exclusion of sporadic hot fires seems to be an important factor contributing to the current bush thickening and bush encroachment problems (Smit, 1993). The woody component of savanna areas require management because of the suppressive effect of bush encroachment on herbaceous production, and thus on grazing capacity. This is often the major reason why clearing of woody plants is considered as a management option (Smit *et al.* 1996). Management may be aimed at the sustainable use of woody plants themselves, or the selective thinning (mechanically, chemically or biologically) of woody plants in order to establish a woody to herbaceous plant ratio more suitable for a particular form of land-use. This however should be within the framework of economic viability and ecological responsibility (Smit *et al.* 1996).

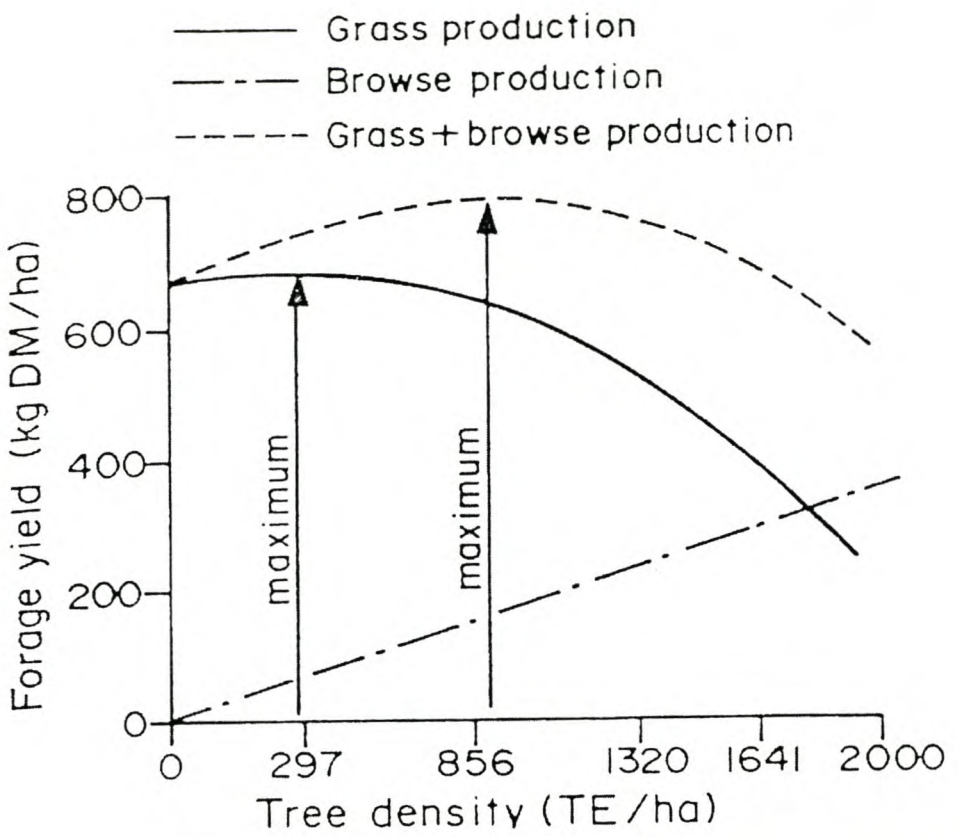


Figure 2. The influence of *Acacia karroo* density on grass, browse and total forage production (Danckwerts & Tainton, 1993).

More specific programs to curb bush encroachment/thickening may include:

- Predator reintroduction and ungulate removal
- Veld burning – The correct burning cycle is essential and must be followed
- Selective woody plant removal using techniques such as tractor stumping and arboricides
- Fuel wood harvesting by neighbouring communities
- Elephant reintroduction.

Jeltsch *et al.* (1997) found that simulated cattle grazing led to shrub encroachment under all rainfall scenarios, once stocking rates exceed a certain threshold. This threshold is determined by long-term mean annual rainfall. Where rainfall was lower and more stochastic, the rate of shrub encroachment in response to a given intensity of grazing became less predictable.

It was also found that even at or below recommended stocking rates, continual grazing could eventually cause a drastic increase in shrub cover. Sickle bush (*Dichrostachys cinerea*) grows on a variety of soils and is a major contributor to the bush encroachment problem. Due to climate, stocking densities and management practices, dense thickets of this plant form, preventing grazing animals from reaching available grass. While this plant can make a valuable contribution as feed for browsing stock, it nevertheless reduces the carrying capacity of the veld (Bell & Van Staden, 1993).

Other woody species that can contribute to bush encroachment include common hook-thorn (*Acacia caffra*), blue thorn (*Acacia erubescens*), three-hook thorn (*Acacia senegal* subsp. *rostrata*), and terminalia (*Terminalia sericea*).

Various studies have been conducted on the interaction between fire and bush encroachment. Very intense burns proved most effective in suppressing bush in the short term, but had no long-term effect. The impact of elephants on woody plants, however is significant in restricting the development of climax vegetation in savanna areas (Watson, 1995). Elephant utilisation and fire combined have been shown to result in a decline in woody vegetation density with elephants removing mature trees and fire preventing recruitment of young individuals. It was hypothesised that elephants will not regulate high-density tree populations, but may maintain low-density tree populations at low levels. In contrast the results of a study by Bowland & Yeaton (1997) indicate that elephants alone will not alleviate bush encroachment problems, but may aggravate the situation by favouring early successional, scrubby, multi-stemmed species. Also, according to Prins & Van der Jeugd (1993), it appears that in explaining the structure of *Acacia* woodlands the effect of elephant-induced tree mortality has been overrated. Impala seem to play a greater role in seed germination of *Acacia* species than elephants.

It seems that a combination of a good burning strategy, regulation of the stocking rate and mechanical/chemical eradication of woody plants (in the smaller areas) is needed to control the rate of bush encroachment and/or thickening.

9.8. STOCKING RATE AND CARRYING CAPACITY

Stocking rate is defined as the area of land that the manager/owner has allotted to each animal unit in the system of management, and is expressed per length of the grazable period of the year. Carrying capacity can be defined as the area of land required to maintain an animal unit in order to achieve maximum profit in the short term, while maintaining the condition of the vegetation and the soil in such a way as to be able to fulfil the needs of future land users (Danckwerts, 1989). The concept of carrying capacity has been known since the beginning of the 1900's and today, a century later, there is still no clarity or certainty as to what the concept entails. Fabricius (1994) describes the idea of a carrying capacity as uninformative and confusing when dealing with wildlife in a dynamic and patchy environment. McLeod (1997) questions the usefulness of carrying capacity. Nonetheless the concepts of carrying capacity and stocking rate are usually used when considering important management practices because the majority of decisions are based on these concepts.

The objectives set by the owner/manager must firstly be kept in mind when dealing with the rate at which the ranch will be stocked and the number of animals that can be successfully sustained on the ranch. For example there will be significant differences in optimal stocking rates for ranches where rare and endangered animals are being bred, where hunting takes place for trophies or for meat. After the management objectives of the ranch have been established, forage sources available for the different animal species present must be considered. There are two different forage sources in grass/bush communities, graze and browse, which are utilised separately by grazers and browsers although there is some overlap between them. Grazers can be subdivided in feeding categories namely long-medium grass feeders, short-grass grazers and mixed feeders (Grossman *et al.* 1999). One approach of expressing carrying capacity or stocking rate is the grazer unit (GU/ha)/browser unit (BU/ha). Grazers and browsers are defined as exclusively grazing and browsing animals of 450 and 140 kg respectively.

Grazer animal unit (GAU) and browser animal unit (BAU) replacement values may be calculated for herbivores using the hypothesised diet of the animal, its metabolic mass, and reference norm of 450 and 140 kg respectively (Peel *et al.* 1994). The carrying capacity of an area is taken as the sum of its grazing and browsing capacities (Peel *et al.* 1999).

Methods to determine the carrying capacity of a specific area have been established but these are time consuming, usually expensive and not always seen as a priority. In Texas (United States of America) less than 20% of ranchers have been found to use a quantifiable technique to monitor their grazing management or stocking rate decisions over the short or long term (Rowan *et al.* 1994). In South Africa the National Grazing Strategy (Anonymous, 1985) specified grazing capacity expressed as hectares per large stock unit (ha/LSU). This method uses the animal's metabolisable energy requirements and probable food intake and comparisons are generated and expressed as LSUs. Substitution tables (Table 12) for most game species that occur in South Africa and carrying capacities for veld types in the Northern Province (Table 13) are available (Van Rooyen, N. *et al.* 1995a). Dekker (1997) calculated substitution ratios in terms of browser unit (BU) (kudu) for the purpose of calculating game ranch stocking rates in the Mopani Veld of the Northern Province (Table 14). Peel *et al.* (1999) note shortcomings of this approach that include the usage of the term ha/LSU which is misleading and contrary to SI nomenclature. Stocking density should rather be used to describe the number of animals per unit area. Also, the LSU is based on a heavy-bodied grazing ruminant and does not take into account the feeding patterns (overlap), digestive systems of different herbivores and the fact that that there are two forage sources (grazing and browse). Lastly environmental and resource variation is largely ignored. The effect of the latter is that managers/owners react to drought by decreasing stocking levels and increasing stocking rates with increased rainfall. Neither of these management practices are good measures of the state of the land because large peaks and troughs, caused by the rainfall, obscure trends in animal production.

Table 12. Approximate large stock unit conversions for South African game species (Van Rooyen, N. *et al.* 1995a).

ANIMAL SPECIES	WEIGHT (KG)	LSU\ANIMAL	ANIMALS\LSU
Roan antelope – *Hippotragus equinus*	250	0.64	1.55
Tsessebe – *Damaliscus lunatus*	125	0.38	2.60
Mountain zebra – *Equus zebra*	240	0.63	1.58
Blesbok – *Damaliscus pygargus phillipsi*	61	0.22	4.48
Blue wildebeest – *Connochaetes taurinus*	180	0.50	1.99
Bontebok – *Damaliscus pygargus dorcas*	55	0.21	4.80
Burchell's zebra – *Equus burchelli*	260	0.66	1.51
Bushbuck – *Tragelaphus scriptus*	30	0.13	7.60
Bushpig – *Potamochoerus porcus*	59	0.22	4.5
Buffalo – *Syncerus caffer*	495	1.07	0.93
Damara dik-dik – *Madoqua kirki*	5	0.03	29.22
Blue duiker – *Cephalophus monticola*	5	0.03	29.22
Grey duiker – *Sylvicapra grimmia*	19	0.09	10.74
Natal duiker – *Cephalophus natalensis*	15	0.08	12.21
Eland – *Tragelaphus oryx*	500	1.08	0.92
Gemsbuck (Oryx) – *Oryx gazella*	210	0.56	1.77
Grysbok – *Raphicerus melanotis*	11	0.06	16.18
Sharpe's Grysbok – *Raphicerus sharpei*	8	0.05	20.54
Giraffe – *Giraffa camelopardalis*	830	1.58	0.63
Klipspringer – *Oreotragus oreotragus*	13	0.07	14.27
Kudu – *Tragelaphus strepsiceros*	200	0.54	1.84
Nyala – *Tragelaphus angasi*	60	0.23	4.40
Oribi – *Ourebia ourebia*	14	0.07	13.50
Reedbuck – *Redunca arundinum*	70	0.25	4.04
Impala – *Aepyceros melampus*	50	0.19	5.20
Red hartebeest – *Alcelaphus buselaphus caama*	120	0.37	2.69
Mountain reedbuck – *Redunca fulvorufula*	30	0.13	7.62
Hippopotamus – *Hippopotamus amphibius*	1 340	2.24	0.45
Suni – *Nesotragus moschatus*	5	0.03	29.22
Springbuck - *Antidorcas marsupialis*	37	0.15	6.51
Steenbok – *Raphicerus campestris*	11	0.06	16.18
Black rhinoceros – *Diceros bicornis*	900	1.65	0.60
Black wildebeest – *Connochaetes gnou*	160	0.46	2.17
Sable antelope – *Hippotragus niger*	210	0.56	1.77
Grey rhebuck – *Pelea capreolus*	20	0.10	10.33
Warthog – *Phachochoerus africanus*	70	0.25	4.04
Waterbuck – *Kobus ellipsiprymnus*	180	0.50	1.99
White rhinoceros – *Ceratotherium simum*	1 800	2.75	0.36

Table 13. Approximate game equivalents for bush veld habitats for optimal utilisation (Van Rooyen, N. *et al.* 1995a).

VELD TYPE	LSU's\100 HA
Mopane veld	4-5
Terminalia veld	6-8
Kalahari sand veld	6-7
Combretum veld	8
Wild *Syringa* veld	8-9
Mixed bushveld	10-12
Acacia tortilis veld	12
Knob thorn-marula veld	10-12

Table 14. Substitution rations in terms of a grazer unit (GU) (blue wildebeest) and browser unit (BU) (kudu) for ungulates for the purpose of calculation game ranch stocking rates in the Mopani Veld of the Northern Province (Dekker, 1997).

UNGULATE	MASS (KG)	ANIMALS/BU	ANIMALS/GU
Blue wildebeest	180*	0	1.00
Burchell's zebra	216*	0	1.13
Eland	460**	1.29	2.30
Gemsbok	210**	4.34	1.71
Giraffe	828**	1.03	0
Impala	41*	8.26	7.88
Kudu	140*	1.00	0
Warthog	30*	0	5.30

* Average mass of individual in a population.
** Average mass of an adult female.

As an ecosystem degrades, domestic stock show an ability to maintain production by switching to less palatable plants or plant communities, but then may crash to a lower level of production, perhaps when drought intervenes to apply the *coup de grace* to the already stressed perennial pasture plants. Also, given free range, animals select strongly for preferred sites, (area selective grazing), largely avoiding other areas. Such uneven animal distribution results in inefficient resource use, some areas being heavily affected, others being under-utilised. This gives rise to local overgrazing, reduction of biodiversity in terms of plant species and may stimulate bush encroachment/thickening with a subsequent decline in grazing/browsing potential.

Managers\owners should be able to predict the effects of a poor rainfall year, and must be able to modify management strategies to fit in with a sudden downturn in rainfall. Management of stocking rates is particularly important on ranches where game is confined to relatively small areas. Widespread continuous defoliation of herbaceous plants in excess of re-growth results in replacement of perennial grasses by annual and woody plants (Kreuter & Workman, 1994). Ben-Shahar & Coe (1992) found that within semi-arid savannas, areas with a higher diversity of grass communities will be likely to support more herbivores, and thus a high diversity area would have a higher diversity of animals.

The level of the various management actions required to ensure sustainability will require sacrifice of short-term welfare on the part of the grazier (owner/manager) but it generally pays to overstock in the short term (Danckwerts & Tainton, 1993). However, constant overstocking and under stocking have equally detrimental effects on veld vigour (Kirkman, 1995) and should be avoided. Changes in grazing pressure and intensity are recommended whereby under stocked, rested veld can form a source of cheap roughage for winter use and overstocking in the short term could increase biodiversity and subsequently the overall grazing/browsing potential of the area. Peel *et al.* (1999) suggest setting objectives and adapting a ranch specific approach to determining appropriate stoking densities and species mixes. Other factors include usage of long- and short-term rainfall data, geological and soil data, classification of vegetation types and indexes to provide indicators of where active vegetation growth and areas of greatest disturbance and worst range condition occur.

9.9. HUNTING

Hunting is an integral part of a game ranch enterprise. It is usually the main source of income but is sometimes combined with eco-tourism. Sport (recreational) hunting may be aimed at trophy animals or animals shot for meat and may assist in managing game numbers thus reducing or elimination the need for cropping. Sex and age classes of animals to be taken by hunters will depend on management objectives for the populations concerned. The manager/landowner must operate a hunting enterprise within a clearly defined framework so that any misunderstandings between operator and hunter are avoided.

Important components are:

- There must be a clear understanding of what the hunter is paying for
- The landowner has a responsibility to ensure that the client gets a fair chance of shooting what he came for.
- Boundaries must be clearly defined
- Hunters must be informed of preferred direction of firing

- Landowner must inform hunter of areas where employees are working, residing or likely to be travelling and roads to be used
- Travelling with loaded weapons in a vehicle is not allowed
- Alcohol intake is not allowed while hunting
- The sighting of a rifle prior to a hunt is compulsory. The owner/manager must establish whether the hunter has sighted his rifle and is satisfied with his performance
- Species, sex and age of animals to be hunted must be clearly defined
- If hunting for a trophy, explicit details must be given beforehand
- A game guard or professional hunter must accompany a hunter
- Animals wounded and not recovered should be paid for in full. An animal is classified as wounded where blood drops or stains are visible
- Littering is to be avoided (Anonymous, 1997).
- The rifle to be used must be appropriate for the size of the animal to be shot. The rifle must suit the type of veld and must be the right calibre (Potgieter, 1998).

Hunting goes further than this and because of the rise of animal rights movements and more people becoming aware of the welfare of animals, it is also important to consider the ethical component of hunting. This is discussed under 9.12.

9.10. HARVESTING

The artificial confinement of herbivores that is characteristic of most southern African wildlife areas is regarded as one of the main justifications for population control (Novellie *et al.* 1991). Once it is established that cropping is needed to meet the objectives of a game ranch, various questions arise. The number of animals that need to be cropped will be influenced by current climatic and veld conditions and must be adapted accordingly. If the objective is to stabilise populations, they must be harvested at their rate of increase. A population increasing at 20% per year can be harvested at around 20% per year. Figure 3 illustrates harvesting at a rate identical to the rate at which the population would increase if not harvested but where no resource is limiting.

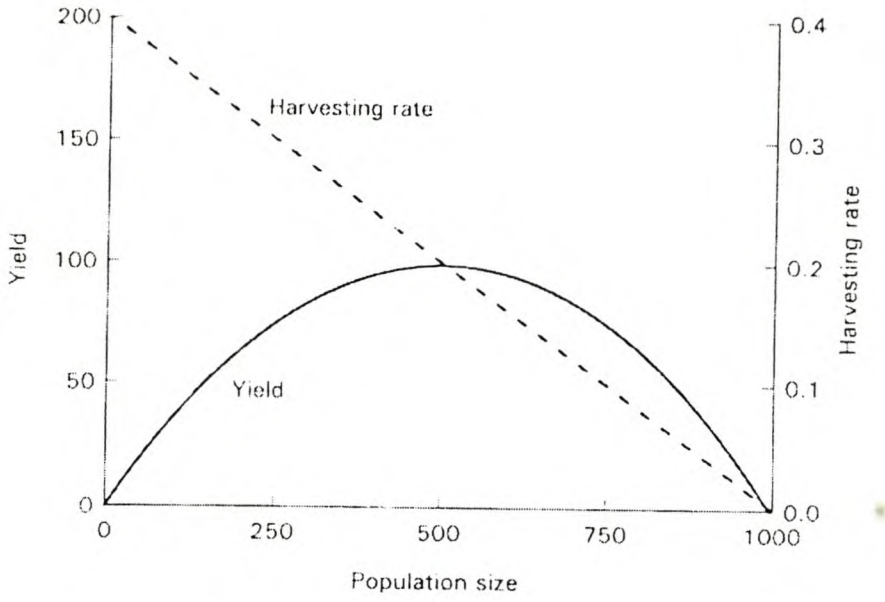


Figure 3. Sustained rate of harvesting and sustained yield in relation to population size when no resource is limiting. In the absence of harvesting the population would increase at its intrinsic rate of 0.2/year (Caughley & Sinclair, 1994).

If the population is limited by a consumable resource whose rate of renewal is influenced by the animals the trajectory of growth will vary according to the parameter values of the two components of the system, the animals and the resource and the interaction between them. Figure 4 indicates the relationships for a population of herbivores limited by food supply. Therefore harvesting rates could be based primarily on the condition of the veld as well as the condition of the animals for that specific year. A good starting point, according to Bothma (1995d) is to take off 30% of the population and then monitor the response closely. The practice of harvesting can however, be more complicated. An example comes from the Addo Elephant National Park in the Eastern Cape. In 1984 the dry conditions prevailing led management to anticipate a die-off among the buffalo. Between 40 and 50% of the population was harvested in an effort to forestall a crash, but this failed to prevent a substantial number of deaths (Novellie *et al.* 1991).

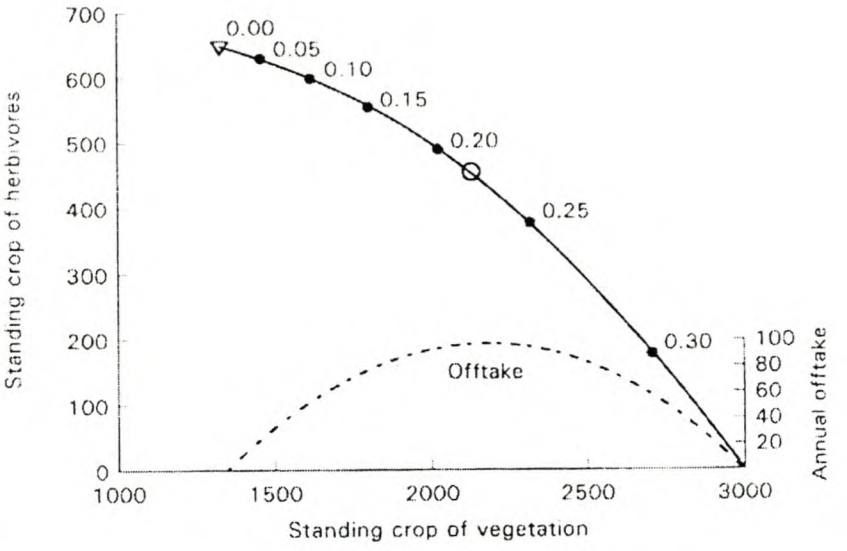


Figure 4. The isocline (solid line) of equilibrium between plant density and herbivore density, the rate of harvesting (broken line) needed to enforce the equilibria, and the sustained annual yield accruing therefrom. ∇=Ecological carrying capacity. O=Economic carrying capacity (Caughley & Sinclair, 1994).

The method of cropping adopted will depend mainly on logistics and financial considerations. Shooting is the method of choice in situations where the terrain is suitable and markets are available. In the study area, live capture is commonly utilised and since this requires skill and experience, professional operators are generally called in. The success of the capture, transport and relocation of game is not only dependent on the capture process but mostly on the handling of the game after capture and if and how they adapt to the new environment (Ebedes *et al.* 1995). For information on game capture *The capture and care manual* (McKenzie, 1993) can be consulted. Cropping by shooting or capture is generally confined to the cooler months. The decision on which age and sex categories to take out will depend mainly on the objectives set for the game ranch. The concept of adaptive management is strongly recommended here. Adaptive management is the term used to describe the system of making management decisions by learning from past mistakes and successes.

Central to this system is the monitoring of parameters that include rainfall, stocking rate, animal performance and vegetation composition and production (Stuart-Hill, 1989). A simple decision making model with respect to the control of animal numbers on ranches in the Northern Province is proposed in figure 5.

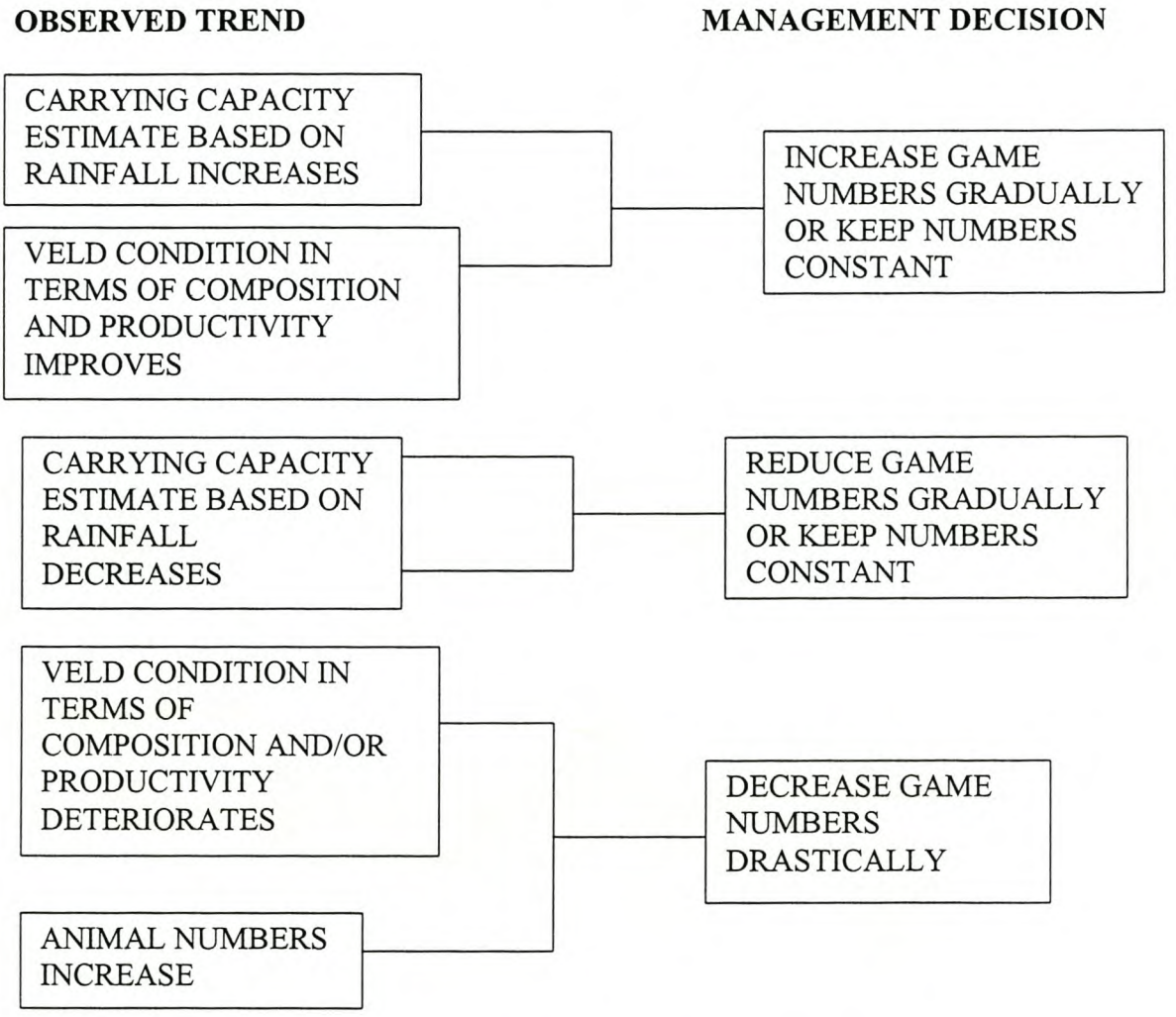


Figure 5. A simple decision making model with respect to the control of animals numbers (Schmidt, 1992).

9.11. GAME COUNTS AND CENSUSSING

Game ranch management requires reliable estimates of game numbers in the form of game counts (Bothma *et al.* 1990). Two aspects are involved in game counts, accuracy and precision. Accuracy is a measure of how close a count is to the actual population size, while precision broadly reflects the repeatability of a population estimate (Collinson, 1985). Eiselen (1994) stated that the main objective of many repeated aerial surveys is the determination of trends in animal numbers rather than absolute abundance. This has been done in the Kruger National Park and is called an Ecological Aerial Survey (EAS).

Bothma *et al.* (1990) compared the results of different methods of conducting game counts. They found that counts from a helicopter appear more accurate than those from fixed-wing aircraft. Publications exist on accuracy of helicopter counts but there are few references on precision and power of these applications (Reilly & Emslie, 1998). Reilly & Emslie (1998) found that the *post hoc* power analysis has demonstrated the calculation of minimum Type II error (when the null hypothesis is accepted but is false and the research hypothesis is true) probabilities from replicated monitoring actions. The major disadvantage of locating animals from the air is that when operating in moderately to densely wooded country, a high proportion escapes detection. This problem is exaggerated when animals are relatively inconspicuous with respect to size, colour and/or posture. Another disadvantage is the essential requirement for skilled observers, high observer fatigue, difficulty in standardisation and high costs. These disadvantages mitigate against this technique (Reilly & Emslie, 1998). Van Hensbergen *et al.* (1996) concluded that it is likely that game ranchers using smaller helicopters with fewer observers (≤ 4), and therefore a lower search effort, see a lower proportion of game animals than ranchers using more observers ($4 \leq$). Also, it has been found that more animals are missed with increasing distance form the aircraft. When taking all the factors into account it is recommended that flight paths should be 800 m apart with a counted zone of 200 m either side of the flight path for counting animals in relatively open habitats (Van Hensbergen *et al.* 1996).

Advantages of operating from the air is that a given area of land can be covered in a shorter period of time, objects can be located in areas where access from the ground is difficult or impossible and costs per unit area surveyed can be reasonable and often less expensive than ground methods using vehicles (Collinson, 1985). The use of the technique of aerial surveys is consistently applied to provide management guidelines for many game ranching undertakings (Reilly & Emslie, 1998). A combination of aerial and ground surveys should facilitate more reliable assessments of population trends by providing complementary data on population size and structure (Mason, 1990). There are various counting methods and managers must decide which will be most cost-efficient for the ranch. This will vary because game ranches differ in size and type and different people have access to different resources. However, regardless of the method used, the count should be carried out at the same time each year and under the same climatic conditions (Skinner, 1989). While counts can provide valuable data, population should ideally be censussed to determine sex and age composition and habitat use.

9.12. ETHICS

An important component that is vital to the on-going success of the private hunting industry is the human component. This includes all the stakeholders namely game ranch owners, managers, professional hunters, hunting clients, tourists, personnel and labourers. Of these the game ranch owners, managers and professional hunters have moral (and legal) obligations towards the hunting clients, tourists, personnel and labourers. Labour relations are discussed in the guidelines. Ethical conduct relating to hunting and client relationships is discussed here. Attitudes of the general public toward hunting are increasingly important in wildlife management. The importance of hunting as a management practice lies in the controversy and the attention attracted by it. This is, according to Peek (1986), because as our society becomes more and more urbanised, the anti-hunting groups, and those who are apathetic to the sport, will probably increase and make them heard more frequently within the wildlife management area. Peek (1986) also states that hunting for meat, subsistence or for the combination of recreation and meat are generally approved by the North American public.

However, hunting for recreation alone and most especially for trophies, received much less approval. The controversy is ages old and there is no readily foreseeable means to resolve it because it ultimately stems from two very different if equally valid fundamental philosophies, one with roots in religion and one with roots in biology. Peoples' attitudes are influenced mainly by what they do and who they are. Gilbert & Dodds (1987) investigated different kinds of factors influencing or forming attitudes in North American society and found it to be extremely diverse. This could be a reflection of the cultural complexity and the rapidly changing concepts affecting developed societies today.
A strong view in this regard comes from moralistic anti-hunters that view life as precious and sacred, to be preserved except in highly unusual circumstances or absolute necessity. Deliberate killing for sport and amusement is thought to be the essential ethical difference distinguishing the hunter from the meat-eating non-hunter. Most anti-hunters view the hunted animals as possessing a will to live as profound as any human's (Kellert, 1996). Thus animals are given a value that is on the same level as humans and animals are subsequently regarded in this light. The studies quoted here refer to attitudes of people in North America, similar work still needs to be done in South Africa.

Even with a strong moralistic view held by some people hunting is still a fast growing and professional business in South Africa, with all the components necessary to make it highly competitive on the world market. On this subject, in a study conducted by Larson (1996), non-hunters provided their views and the set of guidelines they recommend include the following:

→Respect the environment and wildlife
→Respect the property and landowners
→Show consideration for non-hunters
→Hunt safely
→Support wildlife and habitat conservation
→Know and obey the law
→Pass on an ethical hunting tradition
→Hunt only with other ethical hunters (Larson, 1996).

The most important aspect of ethics in game hunting is respect. Respect for the land and the animals; respect for the landowner and respect for the co-hunter. It is clear that there are a variety of ways to learn hunting ethics but nothing to ensure that everyone learns a common care ethic or even that they learn any ethics at all. The fair chase standard has served as the only widely accepted definition of "sportsmanship" in the hunt. It defines proper conduct of a hunt as "the ethical sportsmanlike, and lawful pursuit and taking of any free-ranging wild game animal in a manner that does not give the hunter an improper or unfair advantage over such game animals" (Larson, 1996). An improper advantage would be if the animal is in a small enclosure and/or drugged or if hunting takes place from a vehicle. Another important aspect in hunting is the follow-up procedure after shooting. In the case of a wounded animal, the professional hunter/guide and the hunter (client) should look for the wounded animal till it is found and killed as quickly as possible. Unnecessary firing of shots should be limited and every precaution should be taken to prevent the wounding of animals.

Professional Hunters Association of South Africa (PHASA) (Rowland, 1998) and KwaZulu-Natal Hunting and Conservation Association (KHCA) (Anonymous, 1997b) are two of the associations committed to the maintenance of a high standard of ethical hunting practice in South Africa. Both also strongly advocate the principle/spirit of fair chase. The KwaZulu-Natal Hunting and Conservation Association also offers guidelines to help maintain a high standard of ethical hunting, and to clarify the obligations of landowners/managers towards clients (hunters) in terms of information that has to be provided beforehand. These include:

- The cost and type of accommodation available.
- Animals available to be hunted.
- Prices and payments for hunted game (Anonymous, 1997b).

There must be no confusion on these aspects because it will greatly influence the hunter/client's attitude towards the landowner/manager, the veld and most probably his hunting behaviour.

Advertising is an important means by which consumers acquire information about the choices available in the market place. The Advertising Standards Authority (ASA) publishes a Code of Advertising Practice which contains a general prohibition against misleading advertising in the following words: 'Advertisements should not contain any statement or visual presentation which, directly or by implication, omission, ambiguity, or exaggerated claim, is likely to mislead the consumer about the product advertised, the advertiser, or about any other product of the advertiser' (Cassim & Langton, 1996). This is also applicable to game farm enterprises that advertise their services and goods. If a game farm is situated in "big five" country it doesn't necessarily mean that the "big five" (lion, leopard, buffalo, elephant and rhinoceros) occur there. It is important to supply the hunter with all the necessary information when visiting the game farm.

Occasional reports of unethical conduct still appear. Exotic animals such as tiger, deer or mountain goats are sometimes offered as indigenous species. There are still reports of caged or drugged animals being shot. These incidents are rare and it is unfair to judge the industry by them. The fact is that the stigma remains. Due to its profitability and the scarcity of certain trophies, the industry lends itself to unethical conduct so it is unlikely that it will ever be completely rid of this stigma (Mitchell, 1992).

Ethics are value-driven but are not synonymous with values. Ethics translate values into standards of behaviour. They evolve with societal changes rather than being cast in stone. Ethics, like laws, are not black and white. There are and always will be questions of judgement and interpretation to be answered by both the profession and its practising members (Force, 1995).

10. FINAL GUIDELINES FOR SUSTAINABLE GAME RANCH MANAGEMENT

10.1. INTRODUCTION

This section contains a framework for a management plan and guidelines for the sustainable management of game ranches. These final guidelines were drawn up from the preliminary set of guidelines with modifications as a result of the second survey. Planning procedures for the location of infrastructure are described. Standards and practices for sustainable veld management and other topics like ethics; local community involvement and labour relations are also discussed.

10.2. ENVIRONMENTAL MANAGEMENT PLAN

The main reason for having a Environmental Management Plan is to set out the game ranche's management objectives, strategies, records and information. For the implementation of an ISO Environmental Management System the operator must identify his environmental policies and objectives. Guidelines for the preparation of nature reserve management plans have been compiled by Cape Nature Conservation (Lloyd *et al.* 1994) and are also useful when compiling management plans for private game ranches. Bothma (1995a) also discusses game ranch planning in some detail. An equally important reason for having such a plan is to ensure continuity in management when managers and owners change (which could be frequent). It is imperative that the information be organised in some way, in either a filing system or on a personal computer in a user-friendly format.

10.3. ADMINISTRATIVE BACKGROUND

Administrative information includes the name of the ranch and the area covered by it in hectares, managing authority, locality data and legal status and should be incorporated in a management plan. Lloyd *et al.* (1994) includes a complete list of what constitutes the administrative side of management.

The laws applicable to a ranch must be reviewed since compliance with legal prescriptions is a minimum requirement for an environmental management system.
The owner/manager must be familiar with the national, provincial and regional legislation concerning the environment and must keep up to date with new legislation. Important areas include wildlife regulations, conservation of agricultural resources, water, invasive plants, use of biocides and labour legislation. Fuggle & Rabie (1983) is a useful source of environmental legislation as a background.

10.4. MANAGEMENT INFORMATION (ABIOTIC)

10.4.1. Soil maps

Every game ranch unit should have a soil map at an appropriate scale. Larger units with extensive management will require soil surveys of a lower intensity than small intensively managed holdings. Broad soil pattern classes can be read off directly from 1:250 000 Land Type series maps (ARC – Institute for Soil, Climate and Water). Soil Classification: A taxonomic system for South Africa (Soil Classification Working Group, 1991) is a basic reference and methods of examining soil profiles and determining soil texture are described by Sutherland (1997). Soil maps must indicate soil types at risk of erosion or compaction. Plans for avoiding erosion or compaction on these areas must be available especially in intensively managed areas.

10.4.2. Geological maps

Each game ranch unit should have a geological map at an appropriate scale. Geological series maps, at a scale of 1:250 000, are available from the Chief Director, Council of Geo-science.

10.4.3. Topographical maps

Topographical maps, ortho-photo maps or aerial photos at an appropriate scale (for areas of ± 2000 ha, 1:30 000) should be available.

10.4.4. Hydrological maps

Maps showing the location of drainages, wetlands, rivers and streams must be available. Wetlands requiring special management must be indicated on the maps.

10.4.5. Erosion information

All sites where erosion is occurring should be indicated on maps. Plans for restoring eroded areas and preventing further erosion should be available.

10.4.6. Weather records

Records of precipitation and temperature must be kept as a minimum but more comprehensive data are an advantage.

10.4.7. Infrastructure map

A map showing the location of all developments, fences, roads and water points on the property should be available. In addition, descriptions of all infrastructure must be kept on record. Figure 6 illustrates an infrastructure map drawn up for the Madikwe Game Reserve in the North West Province.

10.4.8. Cultural assets

All cultural assets should be identified and listed on a Register and should also be mapped. These include rock art, archaeological and palaeontological sites, sites of conflict, oral and traditions, historic buildings, movable and immovable structures and objects, burial sites and marked graves, place names, -social' and economic processes. Plans for protecting these sites must be available.

10.4.9. Natural disasters

Incidence of flooding (historically) and exceptionally dry periods must be known for in the case of exceptionally high rainfall or a severe drought an emergency plan must be available.

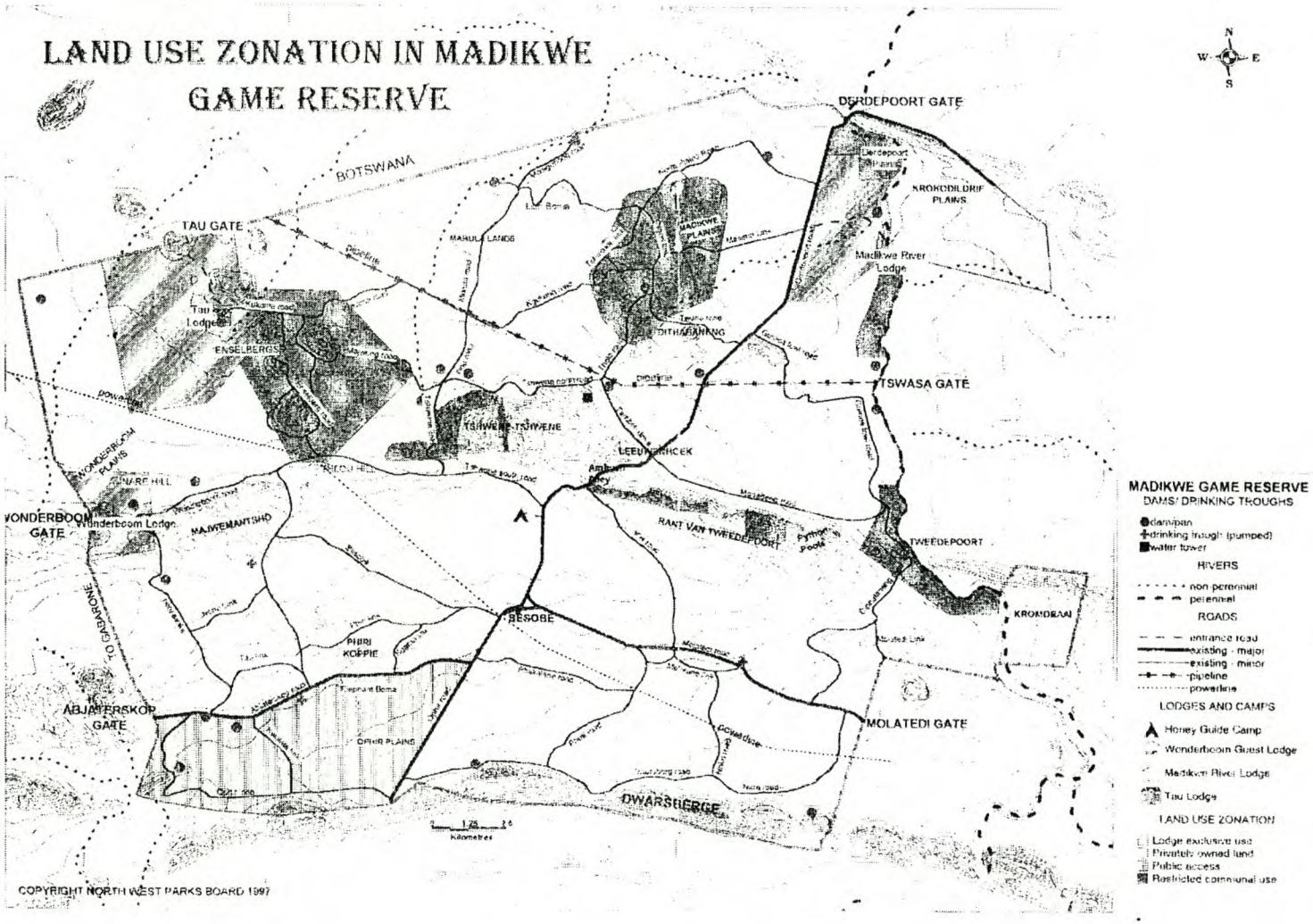


Figure 6. Infrastructure map of the Madikwe Nature Reserve (Madikwe Development Task Team, 1997)

10.4.10. Borrow pits and quarries

The design for these pits and quarries must be available and the sites indicated on a map. A restoration plan after usage must be drawn up.

10.5. MANAGEMENT INFORMATION (BIOTIC)

10.5.1. Vegetation map

The farm must be divided up into homogenous vegetation units, which are mapped on an appropriate scale. Vegetation mapping is described and discussed in Sutherland (1997). Vegetation types of South Africa are described in Low & Rebelo (1996). Vegetation mapping should be combined with realistic wildlife management units. Figure 7 illustrates a vegetation map for the Madikwe Game Reserve.

10.5.2. Sensitive habitat types

Sensitive habitats (for example wetlands and caves) must be identified and indicated on a map. A plan must be available for the effective management and protection of sensitive habitats.

10.5.3. Lists of plant species

Indigenous species

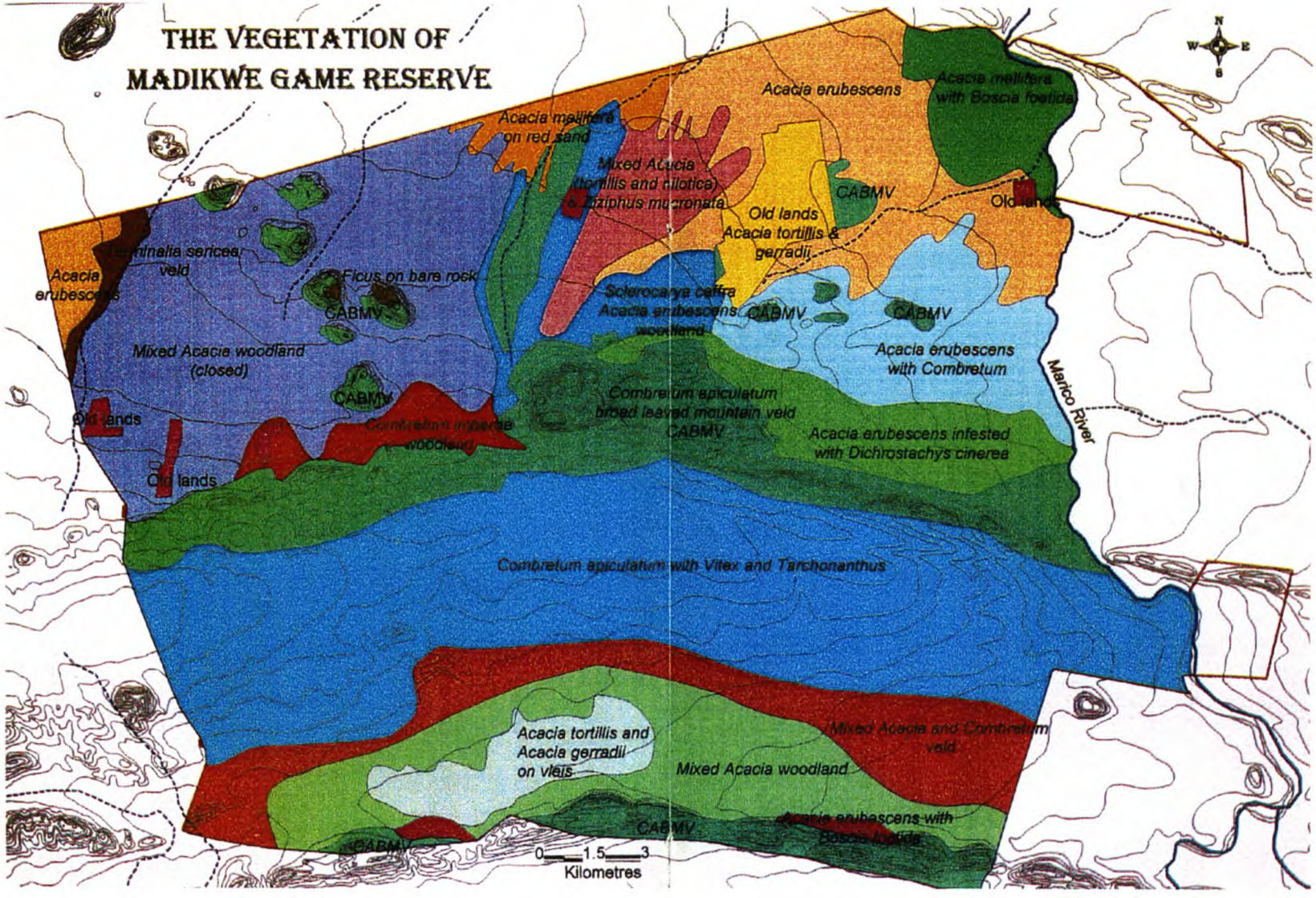
A list of indigenous plant species that occur on the game ranch must be available. Most frequently occurring grasses, shrubs and woody plants should be identified and listed. A more complete list of other vascular plants should be drawn up over time.

Red Data species

All species listed in the South Africa Red Data books present on the property should be identified and their location in the field identified on a map. A plan for monitoring their status and plans for reducing risks to these plants should be available see Hall *et al.* (1980).

Exotic species

Exotic plant species present on the ranch should be listed with records of their abundance, problems caused and control measures adapted.



Vegetation map of the Madikwe Nature Reserve (Davies, 1997).

Invasive species

A list of invasive plant species (indigenous as well as exotic) should be kept, together with records of their abundance and current/possible problems caused by them. There should be a plan for managing invasive plant species and preventing their spread.

10.5.4. Vegetation monitoring

A monitoring program for the vegetation must be developed. Kent & Coker (1995) can be consulted. There are however numerous ways of monitoring vegetation that range from very simple to fairly complicated. Therefore methods that are suited for the purpose and objectives of individual game ranches must be selected. They are discussed in 9.5.3.

10.5.5. Lists of animal species

Invertebrates

It is recommended that species lists of prominent invertebrates (like termites, locusts and Mopane worms - where applicable) as well as interesting amphibians and reptiles be drawn up over a period of time.

Birds

Mammals

Red Data Species

All species listed in the South African Red Data books present on the ranch should be identified. Habitat critical to these species must be identified and management requirements specified. Basic references are Branch (1988), Smithers (1986) and Siegfried *et al.* (1976).

Exotic Animals

A list of species exotic to the country as well as the region present on the game ranch must be kept, together with records of their abundance and of any problems caused. Reasons for maintaining exotics should be stated clearly.

10.5.6. Game counts

A program for the monitoring of wildlife numbers must be available, that includes the budget, manpower and expertise available for analysing the data. Only large mammals would normally be involved but where bird shooting is offered, game bird counts are also necessary. Viljoen (1995) describes suitable methods.

10.5.7. Population composition

Wildlife populations should be periodically censussed to determine sex and age ratios. Laubscher (2000) concluded that for most species in her Northern Cape study area, seasonal sex ratio estimates may be sufficient in determining population structure, *i.e.* counts over three months. Only the overall (yearly) calf/cow ratio estimates carried out each month are precise enough to render them of any practical use to a wildlife manager. Population composition tables, in which the age and sex composition of all the major species is indicated, should be available and updated each season after censuses have been conducted. An example is given in table 15. This is a complex subject and a more detailed discussion can be found in Laubscher (2000).

Table 15. An example of demographic tables drawn up after conducting a game census, from the Leon Taljaard Nature Reserve near Vryburg in the North West Transvaal (Dreyer, 1998).

I NON-SELECTIVE GRAZERS (LONG GRASS)

SPECIES	MALE	FEMALE	YOUNG	TOTAL
White Rhinoceros	3	5	1	9
Cape Buffalo	3	5	0	8
Hartmann Zebra	2	6	0	8
Birchell Zebra	2	3	0	5

II SELECTIVE GRAZERS (SHORT GRASS)

SPECIES	MALE	FEMALE	YOUNG	TOTAL
Blue Wildebeest	6	13	6	25
Black Wildebeest	12	25	8	45
Red Hartebeest	13	39	11	63
Sable Antelope	2	0	0	2
Warthog	6	9	5	20
Waterbuck	3	6	5	14
Blesbuck	10	30	6	46

III MIXED GRAZERS (GRASS AND LEAVES)

SPECIES	MALE	FEMALE	YOUNG	TOTAL
Eland	16	30	10	56
Gemsbok	19	47	12	78
Impala	18	69	11	98
Springbok	14	53	8	75
Ostrich	21	34	0	55

IV BROWSERS

SPECIES	MALE	FEMALE	YOUNG	TOTAL
Giraffe	1	0	0	1
Grey Duiker	8	8	1	17
Steenbok	11	13	2	26

10.6. ENVIRONMENTAL MANAGEMENT GUIDELINES

10.6.1. Weather data

Rainfall should be measured daily at a set time, preferably 8:00 am, if possible, and accurately noted. Standardised rain gauges should be used and must be evenly spaced across the area. For remote areas gauges suitable for weekly readings are available. If the game ranch is bigger than 4000 ha, one rain gauge per 1000 ha should be sufficient. If the game ranch is smaller than 4000 ha then it is recommended that rain gauges should be spread out in a 2X2 km block grid pattern (one rain gauge for every 400 ha). The spacing of rain gauges will also depend on the topography. Rainfall measurements should be taken on the highest as well as the lowest points on the ranch.

Minimum and maximum temperatures should be noted by taking readings each day at the same time from a thermometer that is in the shade and on a standard height.

10.6.2. Infrastructure

Road design

Disturbance should be limited to an absolute minimum during road construction, and the long-term effect that the road will have on the fauna and flora must be assessed first and limited. For aesthetic reasons roads should be aligned to minimise visibility. When designing or planning roads, two aspects must be taken into consideration: -drainage and the construction itself. This includes determining the amount of material needed, -and the compaction process of the soil and gravel. Roads should not be routed within 20 m of a watercourse or wetland except where they cross. There must be effective drainage of above ground water to prevent water from flowing into roads. The main aim must be to minimise environmental degradation and reduce maintenance requirements. Du Toit and Van Rooyen (1995a) provide guidelines for road design and construction.

Road maintenance

If the roads have been properly designed, maintenance should be minimal. Compaction of roads and rebuilding of furrows (drains) next to roads will be needed in summer rainfall areas after a big rainstorm. No water should led off roads directly into watercourses but must flow through at least 10 m of vegetation before entering a stream.

Buildings and structures

Buildings on the game ranch must blend into the surroundings and the effects on the plant and animal life should be minimal. When planning any type of building an environmental impact assessment (EIA) should be drawn up to establish what the effects of the building process and the building itself will have on the environment.

At its simplest an EIA consists of four steps:

⇒ Describe the existing environment.

⇒ Describe the proposed development.

⇒ Identify and assess potential impacts.

⇒ Propose mitigatory measures for minimising adverse impacts.

All buildings must be accessible by road. Labour housing must provide for the labourers' basic needs. Management houses should be in close vicinity of each other to prevent the impact of housing on the environment being too high. Abattoir facilities must be according to specific regulations and hygiene is of utmost importance. Plans for building a farm abattoir must be discussed with the local Health inspector. Hygiene is of utmost importance and the following requirements also:

→Abattoir must be free of flies and dust

→Floor must have a cement surface with no cracks and good draining

→Sufficient ventilation and 10% of wall surface must be windows

→Tables must be of stainless steel. Never wood.

→Ablution facilities nearby is essential

→Garden hose must be nearby for cleaning area and carcasses (Skinner, 1989).

Figures 8 and 9 illustrate examples of abattoir facilities.

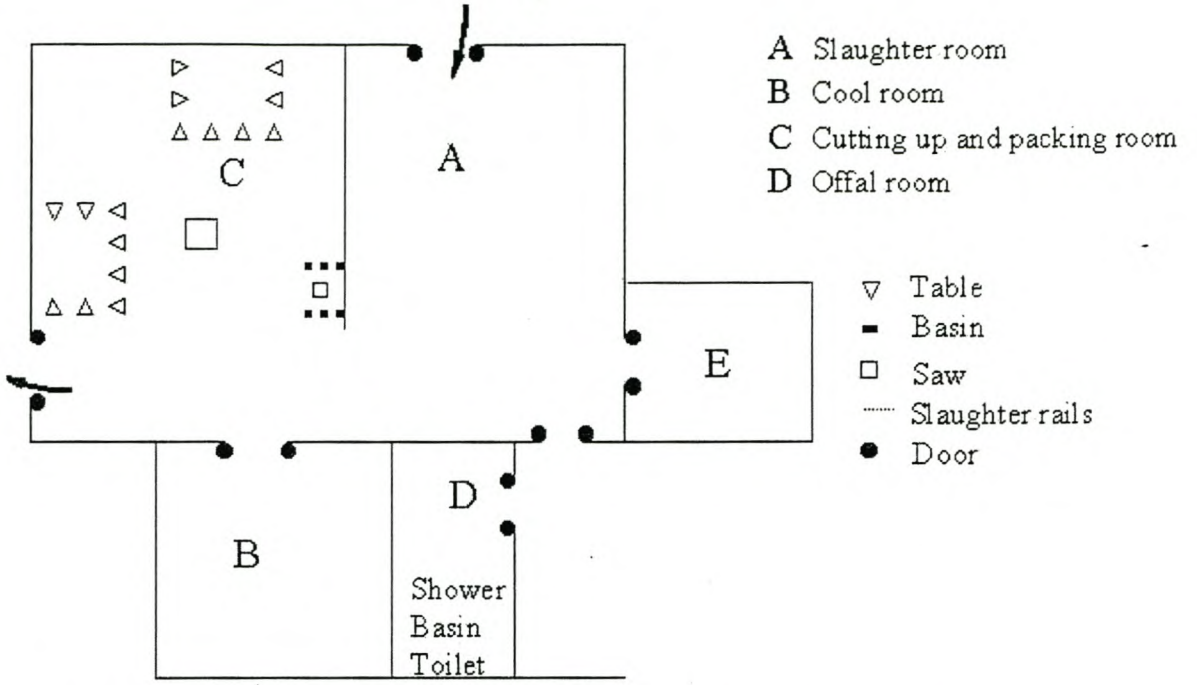


Figure 8. Example of an abattoir which complies with health regulations (Skinner, 1989).

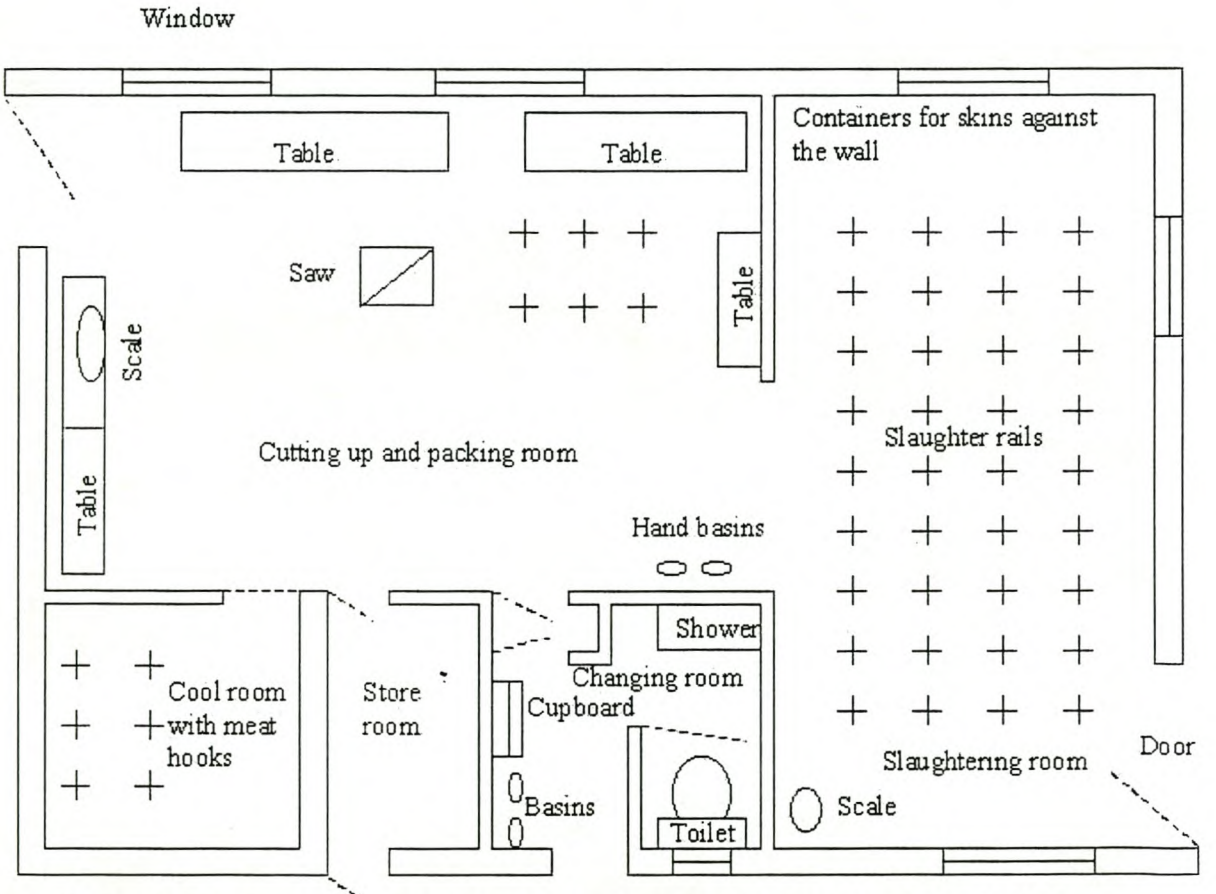


Figure 9. Diagram of an abattoir for a game ranch (Van Rooyen, J. *et al.* 1995).

Land use zonation

The game ranch should be divided into at least two major zones, namely a natural and a development/utilisation zone. The natural zone is there for visitor activities and management purposes with minimal disturbances. The second zone is usually fragmented but further fragmentation should be prevented. It includes offices, houses, workshops etc. Large areas may provide opportunities for further zonation to accommodate a variety of uses (Bothma, 1995a).

Fences

Fences should be appropriate for the animal species on ranch (Van Rooyen, N *et al.* 1995b & Du Toit, 1995), well planned to minimise impact and well maintained. They must also conform to legal specifications if the ranch is to qualify for a certificate of adequate enclosure. Negative effects of fencing relatively small areas for game have led some farmers to combine their resources and manage a number of properties as a single unit, often called a conservancy. This prospect should be considered and if practicable, followed.

Water points

Water points must be adequate and well distributed. It is recommended that artificial watering points should be built next to natural pans where water accumulates in the wet season (Schmidt, 1992). Sites with vulnerable grazing close by, and soil which is highly erodable, or which washes away readily, particularly on slopes, should be avoided if possible (Young, 1992). Factors to be kept in mind, that could influence the behaviour of game, include the effect of tourists visiting watering points, the type of watering point, the behaviour of predators, water quality and the influence the game will have on the watering point. Water points can be successfully used as a management tool. Water availability is a crucial parameter in calculating the carrying capacity of the game ranch (Western, 1975). Waterholes can be used to distribute game more evenly on the ranch, preventing over-utilisation of river-beds and other sensitive habitat types (Ayeni, 1975). However, Grossman *et al.* (1999) point out that where water points are too closely spaced, sedentary water-dependent game species may maintain heavily grazed areas around each water point, thus rendering the habitat unsuitable for other species. Du Toit & Van Rooyen (1995b) discuss the design or waterpoints.

10.6.3. Cultural assets and natural heritage sites

Natural Heritage Sites are areas or phenomena considered as being of national significance. Stringent criteria are applied in selecting and registering them. Owners/managers on ranches with natural features of particular conservation significance should consider applying to have them registered. Provincial conservation authorities should be consulted. Cultural items should also be identified, listed on a Register and managed appropriately. There is a National Monuments Council Memorandum available, which provides guidelines as to how historical, archaeological and palaeontological discoveries should be dealt with. Sites/areas of religious or spiritual significance or any special social or cultural interest must also be protected. The Environmental Conservation Act No. 73 of 1989 provides for the integration of cultural resources in environmental management processes (Department of Environmental Affairs and Tourism, 1998). All marked cultural assets must be protected by fences and/or markings. Degradation to these assets must be avoided and maintenance should not be overlooked. Markings and signs should be put up nearby to inform labourers and visitors of these assets. However, care must be taken to avoid advertising the existence of these assets to the extent that theft and vandalism is stimulated.

10.6.4. Veld management

10.6.4.1. Vegetation monitoring

Veld condition assessment

A thorough assessment of the veld condition must be made before any monitoring can be done. This may be done by subjective assessment if the observer is experienced enough. However application of an accepted scientific method will provide more reliable results. For each of the homogenous vegetation units, the grass layer should be point-sampled along a transect to yield 200 points. The abundance of each species is expressed as a percentage of the total and the species classified into decreaser or increaser categories. Data sets collected from sample sites are compared with that from a benchmark site and a veld condition score is calculated (Benchmark or Ecological Index methods). Alternatively veld condition can be estimated by the key species or weighted key species methods and compared with the score from a benchmark site (Hardy *et al.* 1999).

A more sophisticated approach is to use veld condition score to estimate grazing capacity. The woody component of savannas requires separate assessment. Homogenous vegetation units should be sampled by means of a belt transect or step point procedure, the length of the sampling unit required being larger the sparser the trees or shrubs. Woody plants are recorded by species and size class and density and size composition calculated. A further refinement is to determine tree equivalents and browse units (Tainton, 1999).

Vegetation monitoring

Once veld condition has been established, any change can be detected through monitoring. This can indicate whether the veld has improved, deteriorated or stayed the same and whether a particular management program is effective. Vegetation monitoring can be done by various methods. One of the simplest is to use fixed point photography, points established in all the different vegetation units being photographed annually on the same dates and at the same time of day. For larger areas remote sensing (aerial photographs taken annually on the same dates each year at the same time of day) and satellite based remote sensing systems can be employed. The costs of the methods should be considered and the most cost efficient monitoring strategy should be applied. Repeated assessments of veld condition provide the most reliable data. Sutherland (1997) describes various methods of vegetation monitoring, of which quadrants and transects are most widely used, and also outlines the advantages and disadvantages of each method.

10.6.4.2. Erosion

Erosion prevention

The most effective way of preventing erosion is to maintain as much vegetation cover as possible. In identified erodable areas, erosion and compaction should be prevented. The most important management principle that must be applied to prevent erosion is to maintain the stocking rate at the carrying capacity of the area. Figure 10 illustrates the influence of carrying capacity on soil erosion and *vice versa*.

Erosion monitoring

Marked erosion sites must be photographed before work is carried out and photographs must be taken twice a year for the first two years, then annually.

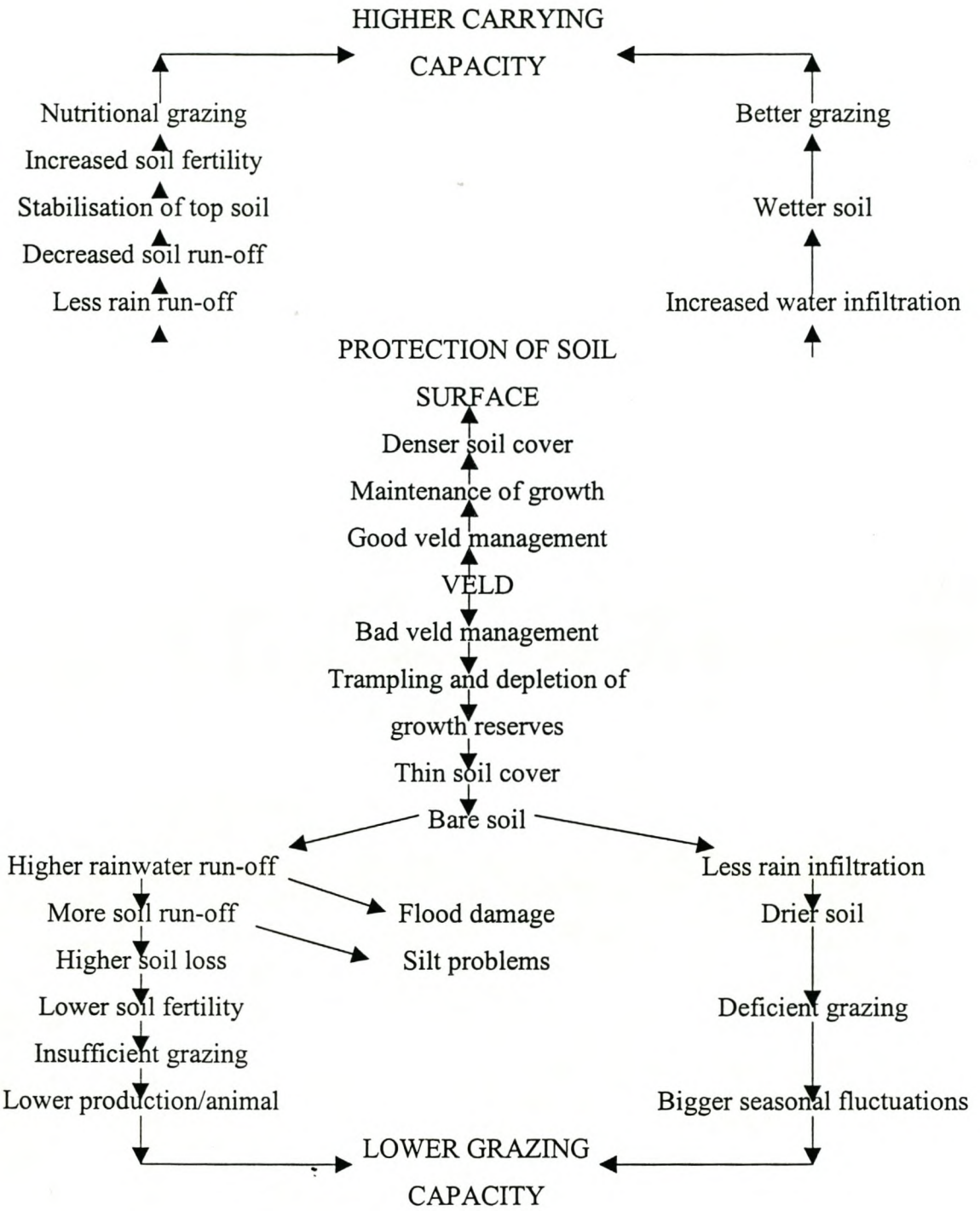


Figure 10. The relationship between veld, soil and water in the wildlife habitat (Van Rooyen, N. *et al.* 1995a).

Erosion management

Eroded areas should be managed to prevent further erosion and promote soil restoration. In open areas of reduced vegetation cover one option is to cultivate the soil surface and sow seeds of suitable grasses e.g. kweek (couch grass - *Cynodon dactylon*) and weeping love-grass (*Eragrostis curvula*). Snyman (1999) discusses suitable implements and grass species for veld reclamation. In the case of gully erosion and dongas, dead vegetation, pole structures or stones can be packed to prevent any further erosion and to stabilise the soil. Van Oudtshoorn (1992) and Snyman (1999) provide further information and Bothma (1995b) gives examples of soil stabilising structures.

10.6.4.3. Management of invasive plant species (Bush encroachment)

Prevention of bush encroachment/thickening

An uncontrolled increase in woody plants often as a direct or indirect consequence of human interference with the system will eventually suppress the herbaceous component due to woody plants competing with herbaceous plants. Bush encroachment/thickening should be prevented, by keeping to the areas' potential grazing/browsing capacity and by managing invasive species (Fig. 10), because bush encroachment may also be detrimental to browsers and not only grazers as is generally accepted (Smit *et al.* 1996).

Bush encroachment/thickening monitoring

Identified invasive species must be monitored by vegetation analysis and fixed point/aerial photography. Monitoring is needed to measure rate of bush encroachment/thickening and to determine whether management thereof is effective.

Bush encroachment/thickening management

When it is established, after the vegetation analysis, that a bush encroachment problem exists, a control program should be implemented. Examples of control methods, as well as a further discussion on bush encroachment/thickening are given in 9.7.

Exotic plant species

There are 32 alien species that are known to form moderately dense to dense stand in the grassland and eastern savanna biomes (Table 16). Managers should be aware of exotic plant species that might occur in their area and must recognise potential interactions with the immediate environment.

Habitats, free of exotic plants, should be managed by adjustments in wildlife population densities to reduce habitat degradation. The reduction in forage and/or avoidance of exotic plant-infested habitats could be causes of degradation but with good habitat management the effect of exotic plant species, that rely on disturbance such as overgrazing or over-browsing as a mechanism for spreading, can be reduced (Trommel & Butler, 1995).

Table 16. Alien invaders that occur in moderately dense to dense stands in major habitat classes in the grassland and eastern savanna biomes (Henderson & Wells, 1986).

	Grassland biome		Savanna biome	
Species and (life form*)	Terrestrial habitats	Streambanks	Terrestrial habitats	Streambanks
Acacia dealbata (T)	XY	XY		X
A decurrens (T)	X	XY		
A mearnsii (T)	XY	XY		X
A melanoxylon (T)		XY		
Arundo donax (T/S)				X
Caesalpinia decapetala (S/C)		X		XY
Cassia bicapsularis (T/S)				X
C didymobotrya (T/S)				X
+ *Cereus peruvianus* (T/S)			X	
Cestrum laevigatum (T/S)				X
Chromolaena odorata (S/C)			XY	XY
Eucalyptus spp. (T)		X		
Eupatorium adenophorum (H)	X			
Jacaranda mimosifolia (T)			X	X
Leucaena leucocephala (T/S)				X
Lantana camara (S/C)			XY	XY
Mangifera indica (T)				X
Melia azedarach (T)		X	X	XY
Morus alba (T)		X		X
Opuntia aurantiaca (S)	X		XY	
+ *O ficus-indica* (T/S)	X		XY	X
+ *O imbricata* (S)	X		X	
+ *O rosea* (S)			X	
+ *O vulgaris* (T/S)	X			
+ *Pereskia aculeata* (S/C)			X	
Pinus patula (T)	X			
Populus canescens (T)		XY		XY
Psidium guajava (T/S)			X	
Rubus cuneifolius (S)	XY	XY		
Sesbania punicea (S)		X		XY
Solanum mauritianum (T/S)		XY	X	X
Stipa trichotoma (H)	X			

XY signifies dense stands * T = tree, S = shrub, C = climber, H = herb/grass, + = succulent

A "land-unit based" approach to alien invader plant control is proposed here. Figure 11 illustrates the components and procedures of an integrated weed control program. The following guidelines should be followed.

- A survey must be made of all the alien invasive plants occurring on a unit of land.
- An alien invasive plant control program must then be drawn up taking into consideration, variety, density and age-structure of the plants targeted for control, the nature of the indigenous vegetation, the financial commitment the land-user is able to make, and all the operations on the farm throughout the year to, for example, determine the availability of labour.
- The farm should be divided into manageable blocks for control purposes.
- Specific treatments such as initial clearing and follow-up must then be assigned to each block on a time schedule.
- Adaptations should be made to the initial program as and when required.
- All input costs and the results of the prescribed control practices must be monitored and analysed (Kluge & Erasmus, 1991).

Wherever possible biological control methods should be used to combat exotic plants. Where biocides are employed, those with the least side effects should be selected. Only biocides that have been registered for the control of a particular exotic plant species may be used. A more detailed discussion is provided in 9.2.

10.6.4.4. Fire management

Fire breaks

Fire breaks should be located strategically to form burning blocks. If the farm is small enough, the roads will be sufficient otherwise firebreaks should be built. Provisions of the National Veld and Forest Fire Act regarding boundary fire breaks must be taken into account.

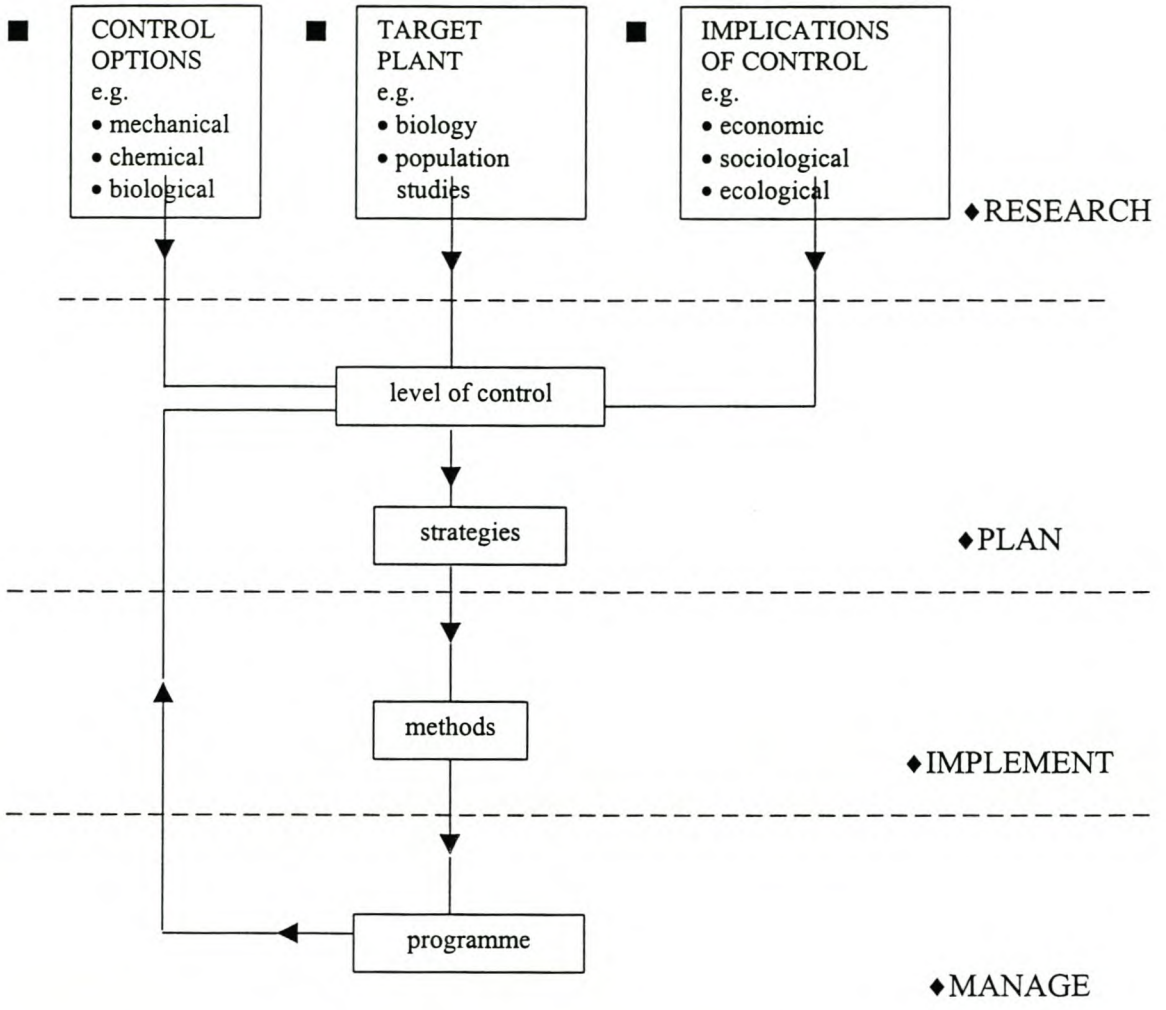


Figure 11. The components (■) and procedures (♦) of an integrated weed control programme (Kluge *et al.* 1986).

Fire management plan

A detailed fire management plan must be available and must include a map, indicating fire breaks, different burning blocks (or boundaries) and sensitive areas, as well as the fire regime (strategy) to be used. The manager/owner must be familiar with legal aspects of veld burning, the burning strategy of the game ranch itself and the risks involved. A fire management plan is essential to ensure continuity and consistency, because in some areas there is a high staff turnover and subjectivity can easily lead to discontinuity and inconsistency. More detail on the execution of a fire management plan is available under 9.4.

10.6.4.5. Sensitive habitat types

Sensitive habitat types will require special management. Wetlands are sensitive habitats, which are especially vulnerable to overgrazing, trampling and over-utilisation. There are four specific indicators for the identification of riparian/wetland habitat: the terrain morphological unit, vegetation, soil form and soil wetness factor. They are discussed and illustrated in *A Practical Procedure For The Delineation Of Riparian/Wetland Habitats for Land Use Practices in South Africa* (Anonymous, 1999).

10.6.5. Game management

10.6.5.1. Stocking rate

Stocking rates must comply with the average grazing and browsing capacities of the veld types concerned, modified in accordance with assessed veld condition and current rainfall. Slight under-stocking is advisable to hedge against seasonal shortages, but adaptability in management strategies is advisable. Stocking rate management and carrying capacity are discussed in the current issues section under 9.8.

10.6.5.2. Species populations

Populations of each species should be large enough to enable the social systems to function normally and to prevent genetic deterioration (Du Toit & Bothma, 1995).

10.6.5.3. Red Data species

Special habitat requirements of Red Data species should be known and special care taken to ensure their preservation. Specific management requirements should be formulated and applied.

10.6.5.4. Exotic animals

Exotics to the country and to the region in which the farm is situated are listed and discussed in 9.3. The potential problems (e.g. cross breeding and competition with indigenous species) that could be caused by these species must be known and if and when such problems, occur these animals must be relocated or culled.

10.6.5.5. Wildlife census

Wildlife populations must be monitored regularly with as much precision as possible to follow population trends. A thorough census must be conducted annually at the same time each year and under the same climatic conditions, recording sex and age composition and distribution in various habitats. For further information consult either Sutherland (1997) or Collinson (1985). Sex/age composition sampling is discussed by Laubscher (2000).

10.6.5.6. Hunting

When conducting hunting as an enterprise there must be a clear understanding between landowner/manager and client. These aspects as well as ethical requirements for trophy hunting are dealt with in 9.9.

10.6.5.7. Harvesting

Following the wildlife census, veld condition and rainfall must be taken into account in determining the off-take for the year. If hunting alone does not achieve the requisite target, cropping by shooting or capture must be arranged. Culling is further discussed under 9.10.

10.7. ETHICAL CONDUCT

10.7.1. Predator control

On most of the ranches, large predators are absent, especially in mixed farming systems where cattle are present. Predator-prey relationships are thus not part of the system to be managed. The decision to use predator control as a management strategy is primarily ecological but ultimately an ethical judgement and the following questions must be answered to establish whether it is necessary or not.

→Are the aims of predator control acceptable?

→Are the methods of predator control acceptable?

→Are the consequences of predator control for the target predator population and associated non-target wildlife acceptable?

10.7.2. Supplementary feeding

It is questionable whether it is ethical conduct to put out supplementary feeding for game. A higher stocking rate is maintained than the carrying capacity and may lead to an artificial management strategy of feeding game that is supposedly in a natural area. It is also illegal to add commercial products to licks for tick control that are not thoroughly researched and not proven to have any negative effects on the environment.

10.7.3. Hunting ethics

Hunters should adhere to an ethical code. Hunters should conduct themselves professionally in a manner, which will reflect honesty, integrity and morality. In the spirit of fair chase, the principle of sustainable utilisation of natural resources must be adhered to. Principles of hunting ethics are listed in 9.12.

10.7.4. Advertising and client relationship

Advertisements should not contain any statement or visual presentation which, directly or by implication, omission, ambiguity, or exaggerated claim, is likely to mislead the consumer about the product advertised, the advertiser, or about any other product of the advertiser. Clear and sufficient information must be made available to the client.

10.8. COMMUNITY INVOLVEMENT

If there is an informal settlement or indigenous community on the edge of or near the farm some form of involvement is required. If labour is needed for construction projects, it should be used from the local community. Game guard and labour requirements can be drawn from local people. An example of a simple program could be to let neighbouring communities remove firewood as a form of bush encroachment control. The implementation of such a program would be beneficial not only in alleviating bush encroachment, but in empowering, reducing the hostility of, and hence the threat posed by, the surrounding communities. This could be the long-term solution where others fail (Watson, 1995).

The basic needs of local communities should be looked into and this entails participation and consultation with them (Hough & Sherpa, 1989). Wildlife must be seen as a resource, which can provide food and income to the local people. Equipping local communities with knowledge, skills an enhancing their rights is an insurance against misuse (like poaching) of wildlife and is worth the investment (Sibanda & Omwega, 1996).

10.9. LABOUR RELATIONS

Game farm owners and managers must be well acquainted with the new labour legislation. The most important are the laws on basic conditions of employment and labour relations. The Basic Conditions of Employment Act includes specifications on leave (labourers are entitled to three weeks leave per year, four months pregnancy leave, three days family responsibility leave), wages (overtime payments are one and a third of the normal salary), working time (a working week consists of 45 hours), child and forced labour, protection of employees and enforcement and monitoring (Anonymous, 1997a). The Labour Relations Act 66 of 1995 emphasises affirmative action (not discrimination) that has to be implemented in any enterprise. It also deals with strikes, dispute resolution, unfair dismissal, collective bargaining and other issues. Apart from ensuring the health and safety of employees in general, it should also be a priority to see that they are adequately and comprehensively informed and trained for the tasks they perform. Potential risks must be clear to them and they should have proper protection as well as protective equipment. This is applies particularly to management practices such as bush encroachment control, fire management and culling programs.

10.10. GENERAL ENVIRONMENTAL CONSERVATION

10.10.1. Waste disposal

A permit issued by the Minister of Water Affairs is needed to establish, provide or operate any disposal site. To discard waste or dispose of it in any other manner except at a disposal site for which a permit has been issued is illegal. An environmental impact assessment must be conducted before the establishment of a disposal site.

Waste disposal sites must be situated away from water sources, fenced off and protected against wind dispersal. The risk associated with waste transport must be taken into consideration when planning and designing a waste disposal site as well as well as the locations of buildings and structures where waste could be generated.

10.10.2. Recycling

To minimise the volume of solid waste, a recycling program should be available. Recyclable material (paper, glass, tins) should be collected, degradable rubbish composted and other material dumped at demarcated waste disposal sites, which are closed when full (see requirements for sites above). The implementation of the principle of *reuse, recycle, return* amongst employees, workers and visitors (tourists) can minimise waste generation and reduce labour requirements for waste management.

10.10.3. Chemicals and other substances

Where chemicals like pesticides are concerned, it is of utmost importance that they be stored safely. All chemicals and liquid and solid non-organic wastes including fuel and oil that could be harmful to the environment and to humans, must be well marked and stored in containers, in a safe place. All substances should be handled with utmost care.

11. CERTIFICATION

11.1. INTRODUCTION

It has been established that the market and consumer behaviour can be a powerful tool in influencing the management and use of natural resources. Certification programs have developed out of this recognition as new mechanisms to pro-actively address environmental concerns and communication challenges, including those surrounding forest management. Continued public demand and pressure from environmental groups to maintain environmental quality across the United States, and around the globe, have enhanced interest in forestry certification programs over the last decade (Society of American Foresters, 1995). There is a perceived need for consumers to be assured by neutral third party organisations that forest products companies are employing sound practices that will ensure a sustainable forest (Vlosky & Ozanne, 1998). Originally promoted as a tool to mitigate tropical deforestation, certification has widened its focus to include temperate and boreal forests. This change in perspective signifies that United States (US) wood producers must now at least consider including certification as a part of their forest management strategy (Carter & Merry, 1998).

Certification programs focused on timber harvesters often spring from isolated negative experiences involving poor forestry practices (MacKay *et al.* 1996). In its simplest form, forest certification is an instrument used to communicate credible environmental information to consumers about the forest resource (Stevens *et al.* 1998). A number of companies have stated that they implemented ISO 9000 (the quality standard preceding ISO 14001) because clients demanded it.

Many countries, including South Africa have indicated that they will favour ISO 14001 certified companies in procurement contracts. ISO 14001 certification will, therefore, be of great value when marketing national parks as tourist destinations for foreign visitors, who are aware of the values attached to such a certification (Bancroft, 1998).

A certification process for private game ranches could be based on a simplified form of forest certification process. The certifier or certifying company is contacted by the owner/manager of a private game ranch. The owner/manager then uses the checklist (Section 12, Table 16) to assess his performance against the standards proposed. After problems have been rectified and improvements made, the certifier makes a scoping visit which is a pre-evaluation where further recommendations are made before the actual audit. When the owner/manager has carried out the recommendations the audit takes place and if it is successful, a certificate is awarded.

11.2. STANDARDS

The subject of standards was touched on under 2.1, but a further discussion is required to fully understand the aim and function of standards in forest certification as well as in the practice of game ranch management. In forest management certification standards are the primary tool by which an independent assessor evaluates forest management practice (Vlosky & Ozanne, 1997). Ervin & Elliot (1996) define standards as a measure for comparing existing management practices within a particular forest unit against standards that address ecological, social and economic issues but do not directly measure the sustainability of forest management. Rather, standards measure the application of acceptable forest management practices for a given area. While standards are the basis of any certification assessment, they are not in themselves sufficient for a credible certification program. Since quality management (ISO 9001 and 9002) proved to be such a success, it was logical that when requested to do so by industry, the South African Bureau of Standards (SABS) accepted the challenge to draft similar standards for environmental management.

A national technical committee working on the drafting of standards decided to base their standard on the British Standards Institution document, BS 7750, (on environmental management) and to restructure it in such a manner that it would not only be compatible with ISO 9000 principles but also be applicable to South African conditions (see 2.1).

11.3. ENVIRONMENTAL MANAGEMENT SYSTEMS

The development of environmental management systems occurred separately in different countries and continents (e.g. BS7750 – United Kingdom, EMAS – Europe, etc.). These were consolidated under the guidance of the International Organisation for Standardisation (ISO), as 14001 – Environmental Management System (EMS) (Bancroft, 1998). The ISO 14000 series consist of ISO 14001, *Environmental management systems – Specification with guidance for use*, ISO 14004, *Environmental management systems – General guidance on principles, systems and supporting techniques*, ISO 14010, *General principles of environmental auditing*, ISO 14011/1, *Auditing of environmental management systems* and ISO 14012, *Qualification requirements for environmental auditors* (Van Rensburg, 1996).

The philosophy of ISO 14001, is one of continual environmental improvement, i.e. planning, implementing, monitoring and improving of an organisations environmental performance. It is a flexible environmental management system, which enables organisations to improve their environmental performance, by setting, monitoring and improving their own environmental standards, within a legal framework (Bancroft *et al.* 1998). The ISO 14001, a procedural environmental management system, is a tool which an organisation can use to manage its environmental aspects and impacts and improve its environmental performance (SABS ISO 1996a). The EMS model from ISO 14001 (Figure 12) illustrates the different steps in implementing an EMS. The EMS requirements entail (from the model in figure 12) the clear definition of an environmental policy to clarify where the manager/owner stands. Planning procedures must take into consideration environmental aspects, legal and other requirements, objectives and targets and environmental management programmes. The implementation and operation of these planning procedures is monitored and if needed, corrective action is taken. The management review follows to ensure the continuing suitability, adequacy and effectiveness of the EMS. This leads to a practice of continual improvement.

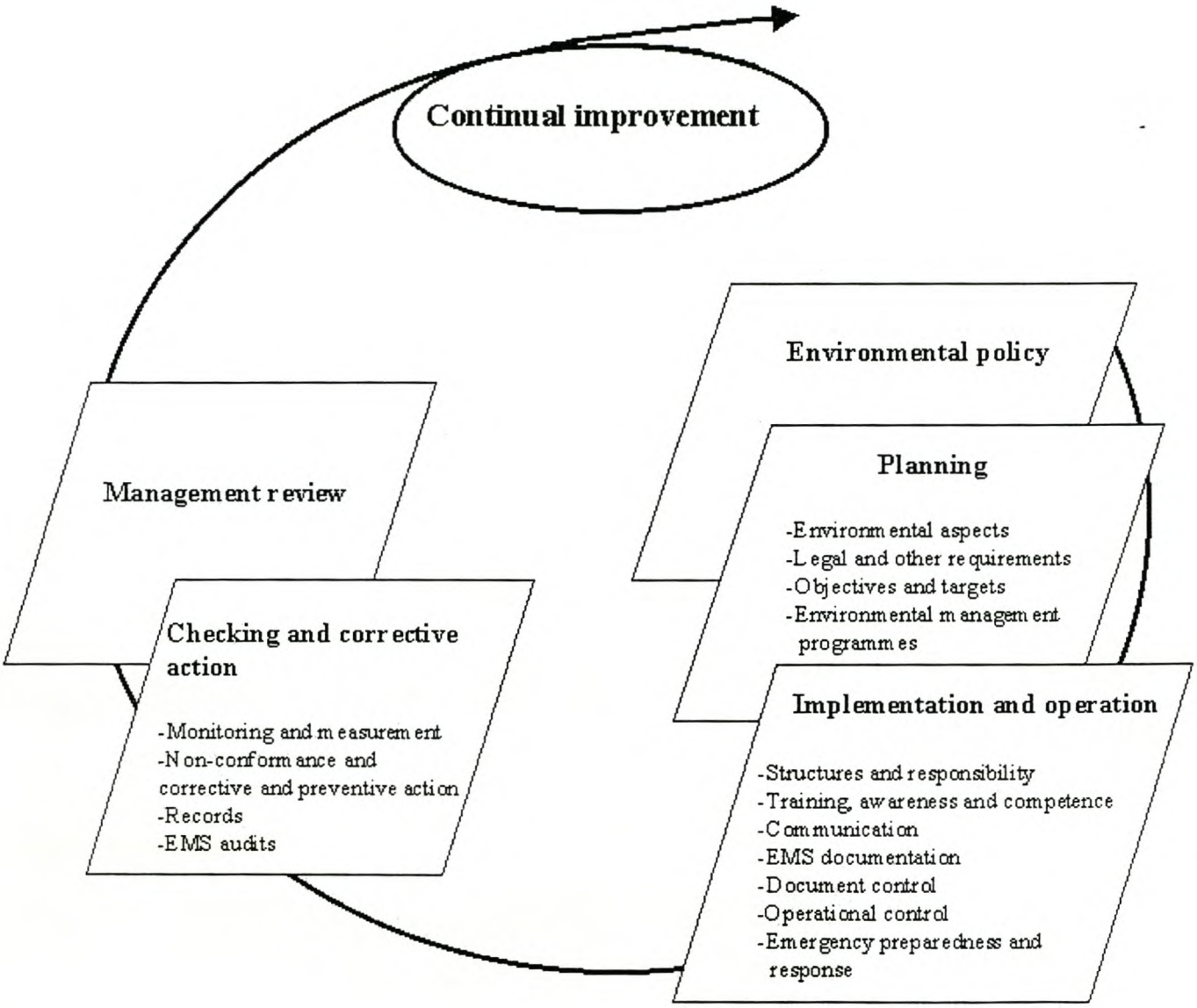


Figure 12. Environmental management system model from ISO 14001:1996 (Anonymous, 1998b).

The SABS ISO 14001 Draft Interpretation document is useful as it includes the SABS ISO 14001 procedure, SABS interpretation of the minimum requirements of SABS ISO 14001 as well as additional information and clarification (Anonymous 1998a).

According to Environmental Management Systems international (EMSi) (Anonymous, 1998c), an EMS is the systematic application of business management to environmental issues. In common with all business systems it contains the PDCA concept – Plan, Do, Check/correct and Act/improve. There are standard system specifications to guide an organisation in implementing an EMS. To be economically viable, game ranches need to be managed as small businesses. Guidelines for implementing an EMS for corporate businesses (ISO 9000) already exist, however, game ranching has become a fast growing and lucrative business field in its own right. Guidelines for implementing the concept in game ranching enterprises, based on the EMS model – fig, 12, is proposed here. They incorporate PDCA of:

- ✓ Plan – Draw up a management plan containing management objectives, legal requirements and management information and guidelines.
- ✓ Do – Implement the guidelines.
- ✓ Check – Monitor the effects of the implementation of the management guidelines and keep complete records.
- ✓ Act – Act upon the results of the monitoring of the effects of the implementation of the guidelines. This also complies with the EMS principle of continual improvement.

According to Bancroft (1998) implementation and conformance to ISO 14001 will eliminate any inconsistency of environmental management within all national parks. Conformance to an environmental management system, like ISO 14001, not only sets a good example for other organisations, but will also enable the organisation to reap the benefits of ISO 14001, including market advantages, compliance performance, and cost savings. Many of the ranches are too small to support the costs of developing and implementing their own environmental management system and the additional expense of conducting audits. Constraints are similar to those identified for small-medium national parks by Bancroft (1998). As a result, these owners are unlikely to be interested in certification even it were beneficial because it would not be cost effective. This problem was also experienced by private forest owners. In response the Forest Stewardship Council developed group certification (FSC, 1998). Group certification means that a group of forest owners are certified simultaneously.

The group is connected by an umbrella organisation that is responsible to the certifier and guarantees that the forest owners within the group perform and maintain good forest management. Control is performed by random sampling and credibility and cost-effectiveness is the key for group certification (Larsson, 1998).

It is doubtful whether the ISO approach, which evaluates only the administrative system followed by an organisation to attain orderly environmental management, is the most appropriate for game ranches or even groups of game ranches. One based mainly on evaluating management performance on the ground is likely to be more successful. This is the essence of the Forestry Stewardship Council approach and that of many other bodies (Dykstra & Heinrich, 1996). Perhaps what is needed is to combine the philosophy of the ISO model shown in Figure 12 with an audit in which field inspection plays a prominent part. The checklist proposed in the next section would be suitable for use in such a system and its acceptability for certification by ISO or another body would need discussion.

12. STANDARD AND CHECKLIST FOR EVALUATION OF GAME RANCHES

This checklist presents a standard and is based on the Soil Association Forestry Programme Generic Standard and Checklist (FSC, 1999) and has been designed for use as the basis for:

- development of a regionally specific standard, prior to an evaluation
- self assessment by a ranch manager/owner
- a pre-evaluation (scoping) visit
- an evaluation (audit)

The standard is designed to identify principles and criteria which should be followed in order to ensure the sustainable and responsible management of game ranches. Requirements for each criterion explain what the owner/manager has to achieve in order to fully meet the criterion. Verifiers are listed and are elements of evidence that the inspector can use to verify that the requirements are met. When the standard is being used for self assessment by a manager/owner, the third column can be used for recording the manager/owner's comments or questions. During a pre-evaluation or 'scoping' visit the inspector can record observations in the column and make notes about any aspects of the standard that the manager/owner does not comply with. The third column is indicates the minimum score required (3) for certification and in some cases other scores are also indicated. The fourth column is only used for a full evaluation and is there for the inspector to provide a 'score' for each requirement, and each criterion.

The scoring works as follows; for each requirement, the inspector will mark the fourth column with the appropriate symbol:

✓ = criterion has been met,

? = it is uncertain whether criterion has been met,

✗ = criterion has not been met or

NA = the criterion is not applicable in this situation.

For each criterion the inspector will recommend a score or between 1 and 5, on the following basis:

1. A score of 1 represents a major non-compliance with the standard, and requires some corrective action to be taken before a certificate can be awarded;
2. The most important requirements of the criterion are met, but there are elements that should be improved to ensure that good stewardship is maintained in the long term;
3. A score of 3 is what would be expected from a well managed ranch in relation to the size, type and complexity of the particular ranch;
4. A score of 4 represents a particularly high level of performance for the criterion. It would be awarded when the ranch has had to overcome particular obstacles to achieve the level of performance shown, or scores particularly highly on some aspects of the criterion, though not on others;
5. A score of 5 would be awarded for outstanding performance on a particular criterion. A score of 5 recognises outstanding merit in achieving the criterion, through innovative or state of the art management. A score of 5 could be awarded for technical, social or environmental aspects of the management.

The scores of each principle are added together and averaged. In order for a certificate to be issued, the manager/owner must have an average score of at least 3 on each principle. If the score on any principle averaged less than 3, then a certificate would not be awarded. If the manager/owner takes corrective actions within a reasonable length of time, then the inspector will carry out an inspection of the requirements for that principle only, and if performance now averages 3 or more a certificate can be issued. Thus a score of three indicates the minimum standard required for certification.

Table 17. Checklist of principles and criteria for evaluating sustainable and responsible management of a game ranch.

PRINCIPLE 1 COMPLIANCE WITH LAWS			
REQUIREMENTS	VERIFIER(S)	STANDARDS	SCORE
Criterion 1.1 Management shall respect all national and local laws.			
1. There must be no substantiated outstanding claims of non-compliance with national and regional laws and administrative requirements related to ranch management.	Consultation with regional conservation officials. Ranch management policies and procedures demonstrate compliance with relevant requirements	Score 3⇒All applicable laws must be applied.	
Criterion 1.2 All applicable and legally prescribed fees, taxes and other charges must be paid.			
1. Manager/owner must be able to provide evidence that applicable fees, taxes and other applicable charges have been paid.	Receipts Accounts No evidence of non-payment	Score 3⇒All applicable fees and charges must be paid.	
Criterion 1.3 The provisions of all binding international agreements such as CITES and Convention on Biological diversity must be respected.			
1. Manager/owner is aware of implications of the Convention on International Trade in Endangered Species (CITES) in region and implements appropriate controls to ensure that its provisions are respected.	Discussion with manager/owner. Species on CITES list are protected. Licenses and permits required are available	Score 3⇒All applicable licenses and permits for rare and endangered must be available.	
2. Manager/owner is aware of implication of Convention on Biological diversity applicable in the region and implement appropriate controls to ensure that its provisions are respected.	Discussion with manager/owner. Policies and procedures.	Score 3⇒Implications of Convention on Biological diversity in the region are noted. Score 5⇒All the provisions are respected.	

PRINCIPLE 2 MANAGEMENT PLAN			
REQUIREMENTS	VERIFIER(S)	STANDARDS	SCORE
Criterion 2.1a The management plan must provide management objectives			
1. There is a clear statement of the objectives of ranch management	A management plan	Score 3⇒Simple broad statement on what objectives are for the ranch Score 5⇒Complete and detailed set of objectives concerning all aspects of ranch.	
Criterion 2.1b The management plan must provide a description of the resources to be managed.			
2. The management plan must provide a description of land use and ownership, status, including summary of previous use and ownership status.	Documents Infrastructure map	Score 1⇒No map Score 3⇒Broad indication of major structures/areas on separate map or on another map. Score 5⇒Detailed separate infrastructure map.	
3. The management plan must include a description of the abiotic components of the area (e.g. weather, soils, geology, topography, etc.)	Documents Maps	Weather data: Score3⇒ Rainfall: (area>4000ha - 1 rain gauge/1000ha & area<4000ha 1 rain gauge/400ha). Air temperature: Measured 8:00 every day. Thermometer on a standard height in the shade. Score 5⇒Rainfall, temperature, wind and cloud cover recorded. Score 3⇒ Soil: Landtype series map 1:250 000. Score 3⇒Geology: Geological series maps 1:250 000. Topography: Score 3 ⇒ Topographical map 1:30 000.	

4. Vegetation communities must be identified; dominant plant species listed.	Inventories Maps	Score 3⇒Species lists of dominant trees, shrubs, grasses and forbs available. Score 4⇒Palatability and feeding values of dominant trees, shrubs, grasses is indicated. Score 5⇒Identified herbarium specimens available. Score 3⇒Simple vegetation map indicating major vegetation communities available. Score 5⇒Detailed vegetation map indicating all vegetation communities available.	
5. Records of vertebrates and prominent invertebrates must be kept.	Inventories	Score 3⇒Mammals, Red Data and exotic species lists complete. Score 5⇒Species lists of birds, reptiles, amphibians and prominent invertebrates.	
Criterion 2.1c. The management plan must provide monitoring procedures.			
6. Procedures for monitoring vegetation, animal populations are documented and easily accessible and easy to understand.	Documented procedures	Score 3⇒Monitoring procedures documented. Score 5⇒Monitoring done by professional scientists.	

PRINCIPLE 3 MONITORING AND ASSESSMENT			
REQUIREMENTS	VERIFIER(S)	STANDARDS	SCORE
Criterion 3.1 The frequency and intensity of monitoring should be determined by the scale and intensity of management as well as size of managed area. Monitoring procedures should be consistent and replicable over time to allow comparison of results and assessment of change. Monitoring is done to assess condition of veld and habitat and to detect significant changes in the habitat.			
1. Monitoring procedures should be appropriate to the nature and scale of the operation and replicable over time.	Monitoring system justified. Discussion with manager. Field inspection.	**VEGETATION - Grassveld- veld condition assessed:** Score 1⇒Subjective evaluation. Score 3⇒200 point samples or 5% sampling items in quadrats per uniform community; species status evaluated. Score 4⇒Samples compared with benchmarks. Score 5⇒Grazing capacity calculated. **Woody vegetation- veld condition assessed:** Score 1⇒Subjective evaluation of density, dominant species. Score 3⇒Belt transects recording density, species composition, size classes. Score 4⇒Tree equivalents calculated. Score 5⇒Browse units calculated. units calculated.	

		Vegetation monitored: Score 1⇒Subjective evaluation. Score 3⇒Condition assessment as above every 3 years. Score 4⇒Fixed point photography every 2 years. Score 5⇒Monitoring by remote sensing every 5 years.	
		ANIMALS **Large mammals:** Score 1⇒Numbers estimated. Score 3⇒Annual road strip drive or waterhole counts. Score 4⇒Counts include sex and age composition records. Score 5⇒Aerial counts with calculation of confidence intervals. **Game birds:** Score 1⇒Density estimated. Score 3⇒Annual road strip counts. Score 5⇒Annual road strip counts with age class determination.	

Criterion 3.2 The results of monitoring must be incorporated into the implementation and revision of the management plan.			
1. Monitoring records are maintained in a well-ordered, up to date and accessible form.	As above	.	
2. There is evidence to demonstrate how the results of monitoring are to be incorporated into revised management plans.	Management plan. Procedure documented. Discussion with manager. Field inspections.	**Vegetation:** Score 1⇒Results of monitoring produce no or arbitrary change to stocking rate. Score 3⇒Stocking rates of dominant grazers and mixed feeders adjusted in response to condition of grass layer. Score 4⇒Stocking rates also adjusted in accordance with seasonal rainfall. Score 5⇒Stocking rates of all game feeding categories adjusted in response to grass and tree/shrub layers. **Bush encroachment and exotics:** Score 1⇒Sporadic unplanned control. Score 3⇒Systematic planned control be mechanical or chemical means. Score 4⇒Control includes planned follow up operations. Score 5⇒Control by biological means/using local communities. **Large mammals:** Score 1⇒Harvest determined arbitrarily. Score 2⇒Arbitrary harvest of one sex. Score 3⇒Harvest determined from current and previous counts. Score 4⇒Harvest determined from counts, sex and age structure. Score 5⇒Harvest determined using computer models of populations.	

PRINCIPLE 4: FIRE MANAGEMENT			
REQUIREMENTS	VERIFIER(S)	STANDARDS	SCORE
Criterion 4.1 Fire management is a useful tool in veld management and must be utilised effectively through careful planning.			
1. A burning regime should be clearly defined in the management plan or should be available as a separate document.	Management plan Documentation	Score 1⇒Fixed burning plan. Score 3⇒Burning frequency and intensity determined by subjective evaluation. Score 4⇒State of rainfall cycle considered. Score 5⇒Burning frequency/intensity determined from measurement of fuel characteristics and rainfall.	
2. Adequate firebreaks should be maintained.	Management plan Discussion with manager/owner	Score 1⇒No fire breaks. Score 3⇒Legal requirements for boundary breaks met. Score 4⇒Roads and other features suitable as internal breaks identified. Score 5⇒Additional breaks planned to protect against areas of greatest danger/strongest winds.	
3. Veld should be burnt when fuel loads and weather conditions are suitable to achieve stated objectives.	Management plan Documentation	Score 1⇒Burning haphazard. Score 2⇒Block burning at fixed intervals. Score 3⇒Burning just before first summer rains; fuel load>2000kg/ha in grass, >4000kg/ha in bush; high intensity fire for bush control air temperature 25-30°C, wind speed 0-20km/h, Relative Humidity<30%; frequency 2-3 years. Score 4⇒Block size appropriate for post-burn animals populations expected. Score 5⇒Flexible burning policy adapted to veld condition, animal populations and rainfall.	

PRINCIPLE 5: COMMUNITY RELATIONS AND WORKER'S RIGHTS			
REQUIREMENTS	VERIFIER(S)	STANDARD	SCORE
Criterion 5.1 Sites of cultural, ecological, economic or religious significance to indigenous peoples shall be clearly identified in conjunction with such peoples, and recognised and protected by managers/owners.			
1. Policies and procedures for the identification, recording and mapping of sites of archaeological, religious, historical or other cultural sensitivity and plans for the protection or management of such sites must be available.	Documented policies and procedures. Records. Maps. Management planning documents.	Score 3⇒Areas are marked and fenced off. Score 5⇒ Areas are marked, fenced off and mapped.	
Criterion 5.2. The communities adjacent to the ranch should be given opportunities for employment, training, and other services			
1. All reasonable efforts are made to employ, and if necessary provide training, for workers from local communities before workers are sought from further afield.	Recruitment strategy. Evidence of employment of local personnel. Discussion with local communities.	Score 3⇒Most employees from local communities. Score 5⇒All employees from local communities.	
2. All reasonable efforts, appropriate to the size, type and location of the ranch are made to ensure that members of local communities have access to basic services (e.g. health and education)	Support of local health facilities. Provision of clean water. Provision of training Provision of worker's accommodation.	Score 3⇒Primary health care available and education facilities accessible. Score 5⇒Health care, education as well as recreational facilities.	

Criterion 5.3 Managers/owner should meet or exceed all applicable laws and/or regulations covering health and safety of employees and their families.			
1. Managers/owners are familiar with relevant health and safety guidelines and regulations.	Accessible copies of regulations. Discussion with managers/owners.		
2. Managers/owners have assessed the risk to workers of particular tasks and equipment and take all reasonable measures to reduce or eliminate such risks.	Written assessment of risk. Discussions with managers/owners.	Score 3⇒Workers are fully informed and trained by manager/owner. Score 5⇒Workers are fully informed and trained by specialists in the tasks.	
3. Health and safety measures comply with national minimum requirements.	No evidence of non-compliance. Safety procedures and manuals.		
Criterion 5.4 Appropriate mechanisms must be employed for resolving grievances and for providing fair compensation in the case of loss or damage affecting the resources, property, or livelihoods of local peoples. Measures shall be taken to avoid such loss or damage.			
1. Appropriate mechanisms for resolving grievances are documented and implemented.	Documented mechanisms for resolving grievances. Use of mechanisms recorded.	Score 3⇒Meetings with community representatives/leaders. Score 5⇒Meetings with representatives/leaders as well as other people.	
2. Appropriate mechanisms exist and are implemented for providing fair compensation to local people where their resources, property, or livelihoods have been damaged.	Documented procedure for deciding compensation.	Score 3⇒Compromise between people and management. Score 5⇒Compromise between people and management and full compensation for loss or damage.	

PRINCIPLE 6: RESOURCE USE ON THE GAME RANCH			
REQUIREMENTS	VERIFIER(S)	STANDARD	SCORE
Criterion 6.1 Management should strive toward economic viability, while taking into account the full environmental, social and operational costs and ensuring the investments necessary to maintain the ecological productivity of the ranch.			
1. There is a work plan and budget for the ranch showing expected costs and revenues for at least the current financial year.	Annual budget.		
Criterion 6.2 The rate at which animals are harvested (by means of hunting or cropping) shall not exceed levels which can be permanently sustained.			
1. A system by which animal populations are being managed should be clearly stated.	Management plan and/or associated documentation.	Score 3⇒Simple information system indicating management principles and procedures. Score 5⇒Complex complete documented procedure.	
2. The ranch should be big enough to be ecologically viable.	Field inspection and documentation.	Score 1⇒Size well below minimum specified for registration. Score 3⇒Meets or slightly exceeds statutory minimum size. Score 5⇒Managed as part of larger complex of adjoining properties.	

3. Species populations of game should be large enough to ensure normal social behaviour and avoid dangers of close inbreeding.	Management plan. Discussion with manager/owner.	Score 1⇒Many species each with <10 animals. Score 3⇒Populations of several herd living species 30-50 with near natural sex ratio. Score 5⇒All herd living species >50 with 1male:2females sex ratio.	
4. Game species should be indigenous to region and suited to habitats on ranch.	Discussion with manager/owner. Field inspection.	Score 1⇒>1 species unsuited to ranch; 1 or more exotics. Score 3⇒Most species suited to ranch <2 regional exotics. Score 4⇒No regional exotics. Score 5⇒All species indigenous to region and suited to ranch habitat.	
Criterion 6.3 Natural and cultural assets occurring on the game ranch are an important resource that should be utilised.			
1. All natural and cultural assets of ranch should be identified and utilised.		Score 1⇒No inventory of natural assets. Score 2⇒Game, mammals, waterholes and rivers utilised. Score 3⇒Game birds, impressive or interesting vegetation stands, good birding areas, view sites identified. Score 4⇒Hiking and vehicle trails, viewing hides developed. Score 5⇒Cultural assets utilised. Interpretative literature available.	

PRINCIPLE 7: INFRASTRUCURE			
REQUIREMENTS	VERIFIER(S)	STANDARD	SCORE
Criterion 7.1 Buildings and structures on the ranch should be looked after and well maintained at all times.			
1. Visitor facilities should be appropriate in scope and design for the type of recreation offered.	Field inspection	Score 1⇒Campsites undeveloped. Huts stark, without character. No firewood, water, toilets. Score 3⇒Campsites well laid out, simple toilets, adequate firewood, water. Huts simple of rustic character. Firewood, hot water. Score 5⇒Tented camp or attractive rustic huts; furniture and fittings of character. Firewood, gas cooker, shower and bath.	
2. Water points should be well planned and sensitively designed.		Score 1⇒Single water point at one border; pump and trough. Score 3⇒1-2 waterpoints/1000ha on smaller ranches. 1 per 2000ha on larger ranches. Solar pump and natural trough. Score 5⇒Water points sited in relation to soil and habitat characteristics. Solar pump, natural trough with facilities for small bird s and reptiles.	
3. Boundary fences should meet the needs of the ranch and be well maintained.		Score 1⇒Fence unnecessarily complex for game species present. Score 3⇒Fences meet standards of conservation authorities, appropriate for game species present. Repaired if necessary. Score 4⇒additional electrified strands to control burrowers; routine patrols and repairs; markers attached when new animals introduced. Score 5⇒Ranch part of a larger complex with game proof fencing on outer perimeter.	

4. Roads should be well planned, of appropriate design and adequately maintained.	Documentation. Field inspection.	Score 1⇒Unplanned road system, poorly maintained. Score 3⇒Roads winding, follows contours or ecotones. Major roads constructed on engineering principles, minimum cut and fill, adequately drained. Grading and drain maintenance when needed. Score 5⇒Secondary tracks differentiated, grassed where possible. River/stream crossings at right angles. Drifts hardened, embankments seeded, routine maintenance.	

PRINCIPLE 8: ENVRIONMENTAL IMPACT			
REQUIREMENTS	VERIFIER(S)	STANDARD	SCORE
Criterion 8.1 Assessment of environmental impacts must be completed appropriate to the scale, intensity of management and the uniqueness of the affected resources and adequately integrated into management systems. Environmental impacts shall be assessed prior to commencement of any disturbing operations.			
1. A system is available (according to scale) in which assessment of environmental impact is specified.	Documented system. Records of results of assessment.	Score 3⇒Assessment documentation stating aspects to take into consideration before development /construction commences. Score 5⇒Documented detailed Environmental Impact Assessment (EIA) procedures.	
2. It must be ensured that the system is implemented whenever new developments are undertaken.	Documented system. Records of results of assessment.	Score 3⇒EIA implemented for roads, fences and buildings. Score 5⇒EIA implemented for above as well as other less conspicuous structures such as bird hides.	
Criterion 8.2a Safeguards should exist which protect Red Data species and their habitats.			
1. Red Data species and their habitats should be identified.	Management plan. Discussion with owner/manger.		
2. Areas containing or likely to contain such species are identified and marked on maps.	Maps	Score 3⇒Habitats of Red Data animal species are indicated on a map as well as areas where Red Data plant species occur. Score 5⇒Exact ranges of Red Data animal and plant species are indicated on a map.	

3. Effective procedures are documented and implemented to safeguard such species and their habitats.	Management plan.		
Criterion 8.2b Inappropriate hunting, trapping and collecting must be controlled.			
4. Measures for controlling hunting, trapping and collecting of animals or plants are documented and implemented.	Documents Management plan Discussion with manager/owner.	Control measures taken: Score 3⇒Patrolling of fences, removal of snares and reporting of all incidences. Score 5⇒All above as well as permanent patrolling of whole area.	
Criterion 8.3a Guidelines should be prepared and implemented to control erosion, minimise damage during road construction and all other mechanical disturbances.			
1. Eroded areas should be identified, managed and restored.		Score 1⇒Haphazard minor erosion control. Score 3⇒Eroded areas mapped; gullies, with stumps, tyres or simple stone packs. bare areas packed with bushes. Score 4⇒Gullies with vegetation cover, bare areas seeded. Score 5⇒Gullies with gabions, bare areas cultivated, ploughed, seeded and protected with bush packs.	
Criterion 8.3b Guidelines should be prepared and implemented to protect water resources.			
2. Written policies and procedures for protection of water resources should be available and implemented in general and during new construction/developments.	Management plan	Score 1⇒Water resources undocumented. Score 3⇒Water sources identified, mapped. Catchments adequately protected or rehabilitated where necessary. Score 5⇒Water resource quantified, active conservation measures followed. Chemical composition monitored.	

Criterion 8.4 Management systems should promote the adoption of environmentally friendly non-chemical methods of pest management and strive to avoid the use of chemical pesticides.			
1. Documented pest, disease and weed control strategies are available.	Documentation		
2. Chemicals are only used when absolutely necessary to achieve defined management aims.	Discussion with owner/manager.	Score 3⇒Alternative to chemical use not cost-effective but applied in an environmentally responsible manner. Score 5⇒Chemicals only used in extreme cases.	
3. Synthetic chemicals are only used where there is no known non-chemical alternative not entailing excessive cost.	Discussion with owner/manager.	Score 3⇒Alternative to synthetic chemical use not cost-effective but applied in an environmentally responsible manner. Score 5⇒Synthetic chemicals only used in extreme cases.	
4. Chemicals are used only in minimum effective quantities, with strict observation of controls and regulations.	Records Field observation		
Criterion 8.5a If chemicals are used, proper equipment and training shall be provided to minimise health and environmental risks.			
1. Training and appropriate equipment re provided to all operators	Training manuals Training records	Score 3⇒Training by manager/owner. Score 5⇒Training by outside specialists in form of courses.	
2. All equipment for the transport, storage and application of chemicals must be maintained in a safe and leak proof condition.	Field inspection	Score 3⇒Facilities and equipment for storage safe. Score 5⇒Equipment for transport and application safe and leak proof.	
3. Application of chemicals must be conducted responsibly and safely.	Documented procedure/ manuals	Score 3⇒Application of chemicals is not allowed within 10 m watercourses and 30 m around reservoirs and lakes. Staff equipped with protective clothes.	

Criterion 8.6 Organic waste, chemicals, containers, liquid and solid non-organic wastes including fuel and oil should be disposed of in an environmentally appropriate manner.			
1. Locations have been identified for the disposal of chemicals, containers, liquid and solid non-organic wastes in an environmentally appropriate manner.	Field inspection	Score 3⇒Locations mapped and might have a insignificant influence on the environment but precautionary actions are taken. Score 5⇒Locations are mapped and will have no influence on the environment but precautionary measures are taken anyway.	
2. There is no evidence of waste in the veld or near human settlements'	No evidence of inappropriate disposal.	Score 3⇒Evidence of disposal but not appropriate. Score 5⇒There is no evidence of inappropriate disposal.	
3. Waste must be managed in an environmentally appropriate manner	Field inspection	Score 3⇒Waste is burnt and buried. Site is fenced off and there is no chance for water run-off. Score 5⇒Waste is taken off the ranch.	
4. Waste must be minimised as far as possible.		Score 3⇒Recycle organic material. Score 5⇒Recycle organic material as well as solid waste such as glass and tins.	

PRINCIPLE 9 ETHICAL CONCUCT			
REQUIREMENTS	VERIFIER(S)	STANDARD	SCORE
Criterion 9.1 Managers/owners should promote and adhere to ethical conduct in all aspects of game ranching			
1. If predator control is implemented, it should be done responsibly and for the right reasons.	Discussion with manager	Score 3⇒To protect Red Data animal species. Score 5⇒Aim to protect the livelihood of humans.	
2. Supplementary feeding should be provided only when necessary.	Discussion with manager/owner.	Score 1⇒To sustain artificially high animal population. Score 3⇒To sustain animal populations normally within carrying capacity during seasonal bottlenecks. Score 5⇒ Only extreme conditions, severe droughts, after runaway fires.	
3. Hunting ethics. Statement of ethical behaviour should be available and all hunting laws must be complied to.	Discussion with manager/owner. Documentation of laws.	Score 3⇒All hunting laws are obeyed and manager/owner agrees with the spirit of fair chase and has respect for the land and animals.	

13. FINAL DISCUSSION AND CONCLUSION

It is clear from the surveys that game ranch owners/managers in the study area are currently not able to manage according the guidelines proposed in section 10. Main reasons for this are that they do not have documented management plans, filing or electronic information systems. Vegetation monitoring programs are seldom available or used for decision-making and in very few cases have veld assessments been conducted. The managers/owners are either uninformed, ignorant or cannot afford it. In most instances the grazing/browsing potentials of the game ranches are not known. Most of the game ranch owners/managers do not have the knowledge of how to manage stocking rates. It is however possible that although the owner/manager does not necessarily have a filing system or undertake administrative management tasks he/she successfully manages his/her game ranch. It is however imperative that an information system be established to ensure continuity for future management purposes. It is also important for the understanding of processes and interactions on a game ranch in order to make predictions for the future.

The aim of the study was to set up specific standards for the sustainable and ethical management of game ranches in the Northern Province based on the principles of the ISO 14000 Environmental Management System.

These should be practical, easily understandable and adequate. The data collected from the sample surveyed was sufficient to come to some conclusions on the management practices followed on game ranches in the Northern Province. It was concluded that ranchers paid attention to some aspects of management but seriously neglected other aspects. It seems that management problems which are the most visible or considered serious get most attention, while other problems go unnoticed. The data showed that most of the game ranch owners/managers are ethically inclined and regard ethically sound practices as very important.

Owners/managers are quite knowledgeable about the implications of new labour laws governing their relationships with their work force. The infrastructure is usually well maintained and again the most visible parts are considered the most important while those structures and buildings not often seen are regarded as less important. Aspects that are overlooked include cultural assets (owners/managers are not always aware if there are any artefacts of historical, paleaontological or archaeological significance), community involvement and general environmental conservation.

Before commencing on the second survey draft guidelines was drawn up. They were however, found to be impractical and in most cases could not be implemented by private game ranch owners/managers. Modified guidelines were designed to be more user-friendly and easier to implement. It is proposed that these guidelines should be applied as part of an EMS. This would provide a basis for a certification system for privately owned game ranches in South Africa, starting in the Northern Province. Such a system would create an incentive which is market-based and the products (hunting experience, trophies, tourism) could be sold in environmentally conscious markets. It would also stimulate game ranch owners/managers to become more conscious of the consequences and impacts of their actions and activities, and promote the continuing sustainable management of wildlife resources on privately owned land. It is to be expected that implementation of such a system will not be easy; there will be growing pains. What is needed is commitment from landowners, managers and all interested and affected parties, as well as the incentive to launch this new approach to private game ranch management. The ideal would be for similar studies to be conducted in all the provinces of South Africa in order to compile a comprehensive document setting out requirements for sustainable management of land maintained in some form of a natural state.

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