CHAPTER 5

MANAGEMENT RECOMMENDATIONS

5.1 Introduction

The present study resulted in a classification of the vegetation and an assessment of the main environmental factors influencing the vegetation. The range management with respect to grazing capacity and carrying capacity was also described. In order to develop a management plan for MNP the following aspects should be considered, namely: the combination of related plant communities into management units, a sound burning program, monitoring of vegetation condition, game numbers and the placing of roads and other infrastructure in the park.

5.2 Management Units

Individual plant communities and/or an ecological related group of plant communities are used for the delimitation of management units. The management units could be separated from one another by roads for management purposes where possible (Bredenkamp & Van Rooyen 1991 a&b).

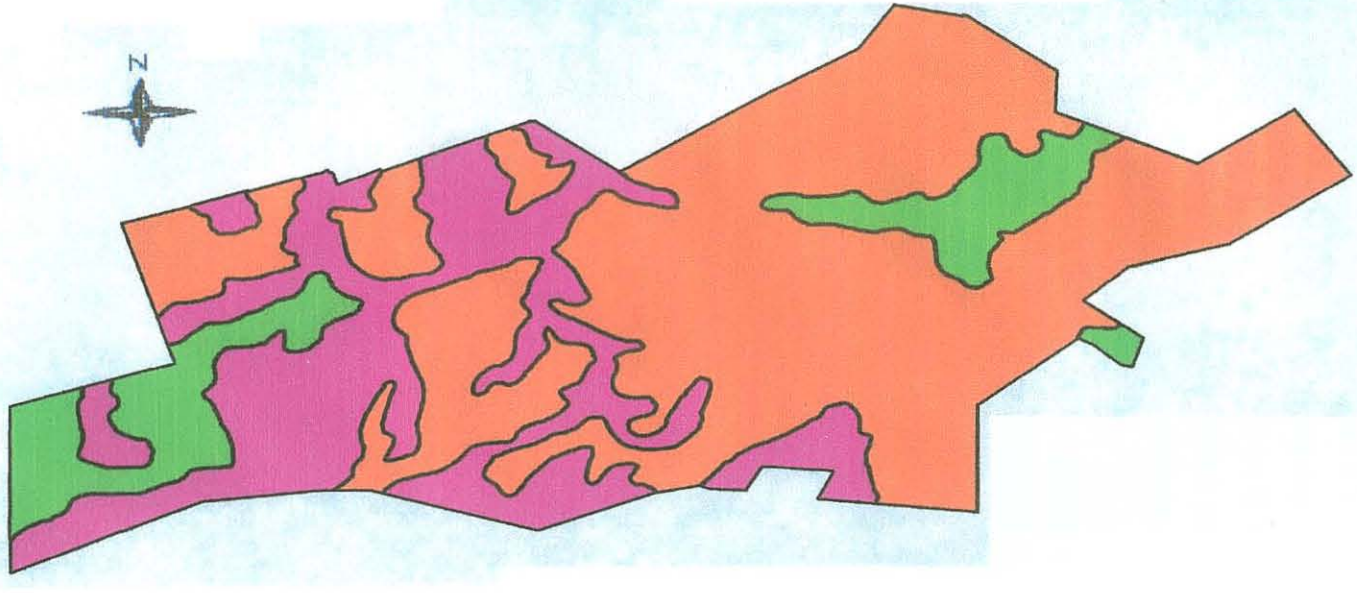
Coetzee (1983) defined a landscape as an area with a recurrent pattern of plant communities with their associated fauna and abiotic habitat. Gertenbach (1983) defined a landscape as an area with a specific geomorphology, macroclimate, soil and vegetation pattern and associated fauna. The five components that characterize a landscape (Gertenbach 1987), serve as the basis for the discussion of the landscapes identified in MNP.

The geomorphology was discussed from the geological discriptions from De Vries (1968/69), SACS (1980), Westfall (1981) and the 1:250 000 geological map of Thabazimbi. Information on the climate was collected from two stations in MNP and from the station at Thabazimbi where rainfall and limited temperature data were measured.

The discription of the different soil types was done according to the Land Type Survey Staff (1988). Vegetation discriptions were done by Coetzee (1975), Coetzee et al. (1976) and Westfall (1981). These descriptions, together with the data contained in Chapter 4 of this study, were used for the classification and discription of the landscapes for MNP. The discussion of the associated fauna of the study area was done according to the past and present geographical distribution of the Perissodactyla and Artiodactyla in Southern Africa (Du Plessis 1969)(See sections 5.2.1; 5.2.2 & 5.2.3). The geographical distribution of each of the landscapes is given in Figure 5.1.

It cannot be expected that the subdivision of the study area into landscapes is a demarcation of homogeneous units. Heterogeneity does occur in a landscape, but the most dominant abiotic and biotic components were grouped together as relatively homogeneous units in a specific area (Gertenbach 1987). The names of the landscapes were derived from the Land Types of Thabazimbi area (Land Type Survey Staff 1988), in combination with the underlying geological formations (SACS 1980), the most conspicuous woody plant species (Chapter 4) and the plant structural classification (see section 3.6). A summary of the sizes of the landscapes in the study area, as well as the percentage each represent of the study area and MNP, are given in Table 5.1.

According to Gertenbach (1983) landscapes can be considered as functional management units, and that any form of wildlife management could be based on the stratification of an area into landscapes. Landscapes can be used as management units in MNP.



Scale approx 1: 50 000

Figure 5.1 Landscapes of the study area

- Red-yellow apedal, well drained soils with *Acacia caffra* short closed woodland.
- Shallow lithocutanic soils of the Mispah Form with *Burkea africana* low woodland.
- Shallow lithocutanic soils of the Mispah Form with *Podocarpus latifolius* forests.

Table 5.1 Areas of the different landscapes of the study area and the areas expressed as a % of MNP and the study area.

	Area (km²)	% of MNP	% of Study area
1	59,81	13,3	20,6
2	136,40	30,3	47,0
3	94,30	21,0	32,4
Total	290,51	64,6	100,0

5.2.1 Red-yellow apedal, freely drained soils with *Acacia caffra* short closed woodland

Typical landscape: Zwarthoek

Location and geomorphology

This landscape is discontinuous because it is interrupted by other landscapes. One part of the landscape occurs in the southwestern part of the study area and the other part in the northeastern part (Figure 5.1). The underlying rock is sandstone of the Matlabas Subgroup, Aasvoëlkop Formation with dykes and sills of Post-Waterberg diabase, which cut throught the dykes and sills (Figure 2.2; SACS 1980).

This landscape occurs mainly on lower slopes to valley floors (see section 3.7.2). The landscape is found at 1 160 m to 1 600 m above sea level and occupies 59,81 km² or 13,3 % of MNP and 20,6 % of the study area (Table 5.1).

Climate

This landscape experiences a moderate to warm climate with frost occasionally in the low lying areas. In Table 2.2 the temperature data are given for Blespaardspruit and Waterhoutboom, which is also relevent for this landscape. The rainfall differs between 440 mm to 924 mm per annum with the average rainfall for Blespaardspruit, Thabazimbi and Waterhoutboom as 500,7 mm, 636,1 mm and 556,1 mm respectively (Table 2.3).

Soils

The soils are sandy with a clay content between 10-20 % in the A-horizon. The dominant soil form in this landscape is Clovelly and is between 300-1 200 mm deep (Land Type Survey Staff 1988).

Vegetation

The following plant communities occur in this landscape: *Rhus leptodictya-Mimusops zeyheri* Termitaria Thickets in the valleys with the following trees as characteristic: *Rhus leptodictya, Mimusops zeyheri, Olea europaea* subsp. *africana, Clerodendrum glabrum* and *Euphorbia ingens* (see section 4.2.4);

Acacia karroo-Eragrostis chloromelas Short Closed Woodland on the lower slopes with the following trees as characteristic: *Acacia karroo, A. caffra, Pterocarpus rotundifolius* subsp. *rotundifolius, Combretum apiculatum, C. imberbe, Ziziphus mucronata and Dombeya rotundifolia* (see section 4.3.1);

Acacia caffra-Setaria sphacelata Low Closed Woodland on the valley floor and lower slopes with the following trees as characteristic: *Acacia caffra, Burkea africana, Faurea saligna, Vangueria infausta* and *Ochna pulchra* (see section 4.3.2) with the two variations (see section 4.3.2.1 and 4.3.2.2).

A part of *Olea europaea* subsp. *africana-Calpurnia aurea* Tall Closed Woodland (see section4.2.5) and a part of *Burkea africana-Setaria lindenbergiana* Low Thicket (see section 4.5.1) also occur in this landscape.

The predominant grass species occurring in this community are *Andropogon schirensis, Aristida congesta* subsp. *barbicollis, A. congesta* subsp. *congesta, Brachiaria serrata, Cynodon dactylon, Digitaria eriantha, Elionurus muticus, Eragrostis curvula, E. rigidior, Heteropogon contortus, Panicum maximum, Setaria lindenbergiana, S. sphacelata* and *Themeda triandra*. The following conspicuous forbs are *Fadogia homblei, Hypoestes forskaolii, Ipomoea magnusiana, Pavonia burchelli, Schistostephium heptalobum* and *Sida dregei*.

Fauna

The following game species occur in this landscape: impala (*Aepyceros melampus*), Burchell's zebra (*Equus burchelli*), kudu (*Tragelaphus strepsiceros*), eland (*Taurotragus oryx*), tsessebe (*Damaliscus lunatis*), red hartebeest (*Alcelaphus buselaphus*), giraffe (*Giraffa camelopardalis*), elephant (*Loxodonta africana*), blue

wildebeest (*Connochaetus taurinus*), warthog (*Phacochoerus aethiopicus*), bushpig (*Potamochoerus porcus*), black rhinoceros (*Dicornis bicornis*), white rhinoceros (*Ceratotherium simum*) and sable antilope (*Hippotragus niger*). Predators such as leopard (*Panthera pardus*), caracal (*Felis caracal*), spotted hyaena (*Crocuta crocuta*) and brown hyaena (*Hyaena brunnea*) are also present in this landscape.

5.2.2 Shallow lithocutanic soils of the Mispah Form with *Burkea africana* low woodland.

Typical landscape: Mamiaanshoek

Location and geomorphology

This landscape is discontinuous because it is interrupted by other landscapes. The biggest part of this landscape occurs in the eastern part of the study area with small sections in the western parts of the study area (Figure 5.1). The underlying rock is sandstone of the Kransberg Subgroup, Sandriviersberg Formation (Figure 2.2).

This is a moderately undulating landscape with a pronounced crest, seepage zone, upper slope, lower slope and valley floor (see section 3.7.2). The landscape is found at 1 300 m to 1 700 m above sea level and occupies 136,40 km² or 30,3 % of MNP and 47,0 % of the study area (Table 5.1).

Climate

This landscape experiences a moderate to cool climate with frost occurring occasionally in the low-lying areas. In Table 2.2 the temperature data are given for Blespaard- spruit and Waterhoutboom, which is also relevent for this landscape. The rainfall varies from 440 mm to 924 mm per annum with the average rainfall for Blespaardspruit, Thabazimbi and Waterhoutboom as 500,7 mm, 636,1 mm and 556,1 mm respectively (Table 2.3).

Soils

The soils are sandy with a clay content between 6-10 % in the A-horizon. The dominant soil form in this landscape is Mispah and is between 50-300 mm deep (Land Type Survey Staff 1988).

Vegetation

The following plant communities occur in this landscape: *Protea caffra-Encephalartos eugene-maraisii* Low Open Woodland on the upper slopes with the following trees as characteristic: *Englerophyton magalismontanum, Protea caffra, Combretum molle, Brachylaena rotundata, Vitex rehmannii* and *Heteropyxis natalensis* (see section 4.4.2). The predominant grass species on the upper slopes are *Andropogon schirensis, Diheteropogon amplectens, Eragrostis racemosa, Loudetia simplex, Setaria lindenbergiana, Themeda triandra* and *Trachypogon spicatus*. The most prominent forb species are *Rhynchosia monophylla, R. totta, Littonia modesta* and *Sphenostylis angustifolia* (see section 4.4.2).

The *Protea caffra-Rhus dentata* Low Open Woodland occurs on upper to lower slopes with the following trees as characteristic: *Lannea discolor, Strychnos pungens, Mimusops zeyheri, Burkea africana, Elephantorrhiza burkei, Apodytes dimidiata, Maytenus undata, Ancylobotrys capensis* and *Ozoroa paniculosa*. The most prominant grass species are *Andropogon schirensis, Cymbopogon validus, Diheteropogon amplectens, Loudetia simplex, Melinis nerviglume* and *Schizachyrium sanguineum*.

The most prominant forb species are *Commelina africana, Cyperus leptocladus, Leonotis microphylla, Crassula swaziensis, Fadogia homblei, Indigofera mollicoma, Cheillanthus hirta, Tephrosia rhodesica, Xerophyta retinervis* and *Silene burchelli* (see section 4.4.3).

Burkea africana-Setaria lindenbergiana Low Thickets present on lower to upper slopes with the following trees as characteristic: *Diplorhynchus condylocarpon, Maytenus tenuispina, Pseudolachnostylis maprouneifolia, Combretum apiculatum, C. molle, Croton gratissimus, Pterocarpus rotundifolius* subsp. *rotundifolius, Ochna*

pulchra, Strychnos pungens, Ziziphus mucronata and *Dombeya rotundifolia*. The most prominant grass species are *Andropogon chinensis, A. schirensis, Aristida scabrivalvis, Brachiaria serrata, Diheteropogon amplectens, Eustachys paspaloides, Heteropogon contortus, Schizachyrium sanguineum, Setaria lindenbergiana* and *S. sphacelata* var. *sphacelata*. The most prominant forbs are *Hypoestes forskaolii, Cheilanthus viridis, Rhynchosia totta, Commelina africana, Ipomoea transvaalensis, Tephrosia rhodesica, Indigofera comosa, Talinum caffrum, Cyperus leptocladus* and *Fadogia homblei* (see section 4.5.1), with the two variations (see section 4.5.1.1 and 4.5.1.2);

Protea welwitchii-Tristachya leucothrix Low Open Woodland situated in the valley floor with the following shrubs as characteristic: *Protea welwitchii, Elephantorrhiza elephantina* and *Parinari capensis* (see section 4.4.4). The most dominant grass species are *Brachiaria serrata, Cymbopogon excavatus, Cynodon dactylon, Hyparrhenia hirta, Eragrostis plana, E. racemosa, Heteropogon contortus, Trachypogon spicatus, Tristachya leucothrix* and *Urelytrum agropyroides*. The most prominent forb species are: *Gnidia kraussiana, Senecio coronatus* and *Pygmaeothamnus zeyheri* (see section 4.4.4).

Syzygium cordatum-Miscanthus junceus Short Thickets present along the banks of watercourses with the following tree species: *Syzygium cordatum, S. guineense, Ilex mitis, Curtisia dentata* and *Cliffortia linearifolia*. The predominant grass species are *Ischaemum fasciculatum, Miscanthus junceus, Phragmites australis* and *P. mauritianus*. The predominant forb species are: *Polygonum pulchrum, Lycopodium cernuum, Xyris capensis, Osmunda regalis* and *Cyperus leptocladus* (see section 4.6.1).

Fuirena pubescens-Chironia purpurascens Low Closed Grassland situated in the valley floor with the characteristic grass species as *Monocymbium ceresiiforme, Aristida bipartita* and *Andropogon huilense*. The most prominent forbes are *Fuirena pubescens, Drosera madagascariensis, Xyris capense, Hypericum lalandii, Monopsis decipiens, Kyllinga alba, Chironia purpurascens, Nemesia fruticans* and *Disa woodii* (see section 4.6.3). A part of the *Andropogon schirensis-Dicoma anomala* Short Closed Grassland (see section 4.4.5) occurs in this landscape with *Podocarpus latifolius* and *Protea roupelliae* sparsely distributed in the grassland.

Fauna

The following game species occur in this landscape: kudu (*Tragelaphus strepsiceros*), bushpig (*Potamochoerus porcus*), black rhino (*Dicornis bicornis*), white rhino (*Ceratotherium simum*), klipspringer (*Oreotragus oreotragus*), bushbuck (*Tragelaphus scriptus*), reedbuck (*Redunca arundinum*), mountain reedbuck (*Redunca fulvorufula*), elephant (*Loxodonta africana*), Burchell's zebra (*Equus burchellii*) and red hartebeest (*Alcelaphus buselaphus*). Predators such as leopard (*Panthera pardus*), brown hyaena (*Hyaena brunnea*) and caracal (*Felis caracal*) are also present in this landscape.

5.2.3 Shallow lithocutanic soils of the Mispah Form with *Podocarpus latifolius* Forests

Typical Landscape: Bergfontein

Location and geomorphology

This landscape is discontinuous because it is interrupted by other landscapes. This landscape occurs in the southern and northern parts of the study area (Figure 5.1). The underlying rock is sandstone of the Matlabas Subgroup, Aasvoëlkop Formation (see section 2.3.1). This landscape occurs mainly on slopes, kloofs and vlei areas and is found at 1 110 m to 1 880 m above sea level and occupies 94,30 km² or 21,0 % of MNP and 32,4 % of the study area (Table 5.1).

Climate

This landscape experiences a moderate to warm climate with frost occasionally in the low-lying areas. In Table 2.2 the temperature data are given for Blespaardspruit and Waterhoutboom, which are also relevent for this landscape. The rainfall varies from 440 mm to 924 mm per annum with the average rainfall for Blespaardspruit,

Thabazimbi and Waterhoutboom as 500,7 mm, 636,1 mm and 556,1 mm respectively (Table 2.3).

Soils

The soils are sandy with a clay content between 10-20 % in the A-horizon. The dominant soil form in this landscape is Mispah and is between 50-300 mm deep (Land Type Survey Staff 1988).

Vegetation

The following plant communities occur in this landscape: the *Widdringtonia nodiflora-Podocarpus latifolius* Short Forest in deep ravines with the following trees as characteristic: *Widdringtonia nodiflora, Podocarpus latifolius, Ilex mitis, Syzygium cordatum* and *Pittosporum viridiflorum* (see section 4.2.1). Very little grass species occur in this plant community, with *Oplismenus hirtellus* and *Setaria lindenbergiana* as the only species. The following conspicuous forbs found in this landscape are *Asparagus setaceus, Agapanthus campanulatus, Cyperus albostriatus, Tetradenia brevispica, Blechnum giganteum, Secamone alpinii* and *Pteridium aquilinum* (see section 4.2.1).

The *Podocarpus latifolius-Rothmannia capensis* Tall Forest plant community present on the upper slopes occurs in this landscape with the following trees as characteristic: *Podocarpus latifolius, Diospyros whyteana, Grewia occidentalis, Celtis africana, Strychnos usambarensis, Nuxia congesta, Combretum moggii, Trema orientalis, Obetia tenax, Calodendrum capense, Curtisia dentata, Pittosporum viridiflorum, Rothmannia capensis, Ficus sur, Mimusops zeyheri, Myrsine africana* and *Pterocelastrus echinatus* (see section 4.2.2). The following grass species predominant in this community is *Oplismenus hirtellus*, the forbs which are well represented in this landscape includes *Tetradenia brevispica, Clematis brachiata, Cyperus albostriatus, Asparagus setaceus, Cyphostemma lanigerum* and *Solanum giganteum* (see section 4.2.2).

The *Buxus macowanii-Kirkia wilmsii* Low Forest Community situated on lower western and northern slopes with the following trees characteristic in this landscape: *Buxus macowanii, Kirkia wilmsii, Mimusops zeyheri, Olea europaea* subsp. *africana, Euphorbia turicalli, Ficus thonningii, Berchemia zeyheri* and *Combretum zeyheri* (see section 4.2.3). The following forbs are characteristic: *Cyperus leptocladus, Cryptolepis transvaalensis* and *Psiadia punctulata* (see section 4.2.3).

The *Protea caffra-Tristachya rehmannii* Low Open Shrubland Community occurs along the upper slopes with the following trees as characteristic for this landscape: *Protea caffra, P. roupelliae, Erica drakensbergensis, Rhus dentata, Englerophytum magalismontanum, Vangueria infausta, Podocarpus latifolius* and *Passerina montana* (see section 4.4.1). The following grass species predominant for this community are *Andropogon schirensis, Diheteropogon amplectans, Eragrostis racemosa, Loudetia simplex, Monocymbium ceresiiforme, Panicum natalense, Themeda triandra, Trachypogon spicatus, Tristachya rehmannii* and *Urelytrum agropyroides* with *Rhynchosia nitens, Hypoxis obtusa, Xerophyta retinervis, Senecio venosus, Indigofera hedyantha, I. hilaris* and *Becium obovatum* as the most common forbs (see section 4.4.1).

The low-lying areas such as the vlei areas are characterised by a dense grass cover and the absence of woody vegetation. The following predominant grass species are *Andropogon huilensis, Aristida junciformis* subsp. *junciformis, Diplachne fusca, Miscanthus junceus* and *Monocymbium ceresiiforme.* The following predominant forbs are *Fuirena pubescens, Xyris capensis, Ascolepis capensis, Carex cernua, Cyperus leptocladus, C. dedunatus, Helichrysum epapposum, H. aureonitens, Sopubia simplex, Hypericum lalandii, Sebaea leiostyla* and *Haplocarpha scaposa* (see section 4.6.2).

Fauna

The following game species occur in this landscape: kudu (*Tragelaphus strepsiceros*), bushpig (*Potamochoerus porcus*), warthog (*Phacochoerus aethiopicus*), white rhino (*Ceratotherium simum*), black rhino (*Dicornis bicornis*), Reedbuck (*Redunca arundinum*), mountain reedbuck (*R. fulvorufula*). Predators such as leopard (*Panthera pardus*), brown hyaena (*Hyanea brunnea*) are also present in this landscape.

5.3 Fire Management

Fire is regarded as being a natural factor of the environment in southern Africa and it has been occurring since time immemorial (Scott 1966 & 1972, Trollope et al. 1991). The role of fire as a major factor in southern African ecology has long been recognized and research in this field has an extended history in South Africa (Westfall 1981, Hough 1993, Hunter 1993). Komarek (1971) states that Africa has a unique fire climate that accentuates the probability of lightning fires that occur most often at the end of the dry period (Barclay et al. 1993).

The most important factors to consider when planning a fire management program are the reasons for burning and the appropriate fire regime to be applied (Tainton 1978, Trollope 1984, Trollope & Potgieter 1985, Thompson 1992, Stander et al. 1993). There are basically two reasons for burning veld:

i) To remove moribund and/or unacceptable grass material, thereby stimulating new, fresh growth of the grass.

ii) To eradicate and/or prevent the encroachment of undesirable plants.

The fire regime refers to the type and intensity of fire and the season and frequency of burning (Trollope et al.1989). According to Trollope et al. (1991) the type and intensity of fire recommended is that head fires burning with the wind be used in controlled burning because they cause least damage to the grass sward but can cause maximum damage to woody vegetation.

Low intensity fires (<1 000 kJ/s/m) are recommended for the removal of moribund and/or unacceptable grass material, while high intensity fires (>2 000 kJ/s/m) are generally recommended to improve range condition by controlling undesirable plants and encouraging desirable forage species (Trollope et al. 1991).

In the past the study area was a rangeland for livestock and a reason for burning the rangeland was to stimulate out of season green grazing, especially in plant community 4.6.2 (see Chapter 4). This was often done during late autumn or late winter to provide green grazing for livestock. According to Trollope et al (1991) this practice is completely unacceptable and should be condemned because it:

- reduces the vigour of the grass sward;
- reduces the canopy and basal cover of the grass sward;

- increases the run-off of rain water;
- results in increased soil erosion.

5.3.1 Recommended burning program for MNP

Gertenbach & Potgieter (1979) and Brown (1997) maintain that the best fire management practices on nature reserves are those that most closely imitate natural processes (Trollope & Potgieter 1985). The exclusion of fire from savanna areas, and overgrazing has resulted in an increase in the density of woody species (Brown 1997).

Since 1988 the frequency of lightning fires occurring in MNP showed that the vegetation of the Park burned every second year (Table 5.2). These lightning fires are however, difficult to control and restrict to a specific area. The fires normally start at the end of September just before the rainy season, when dry thunder storms occur in the area.

The ideal fire management strategy would therefore, be to rely on lightning to set the veld alight, since it would cause a greater mosaic effect on the vegetation as a result of the different types and intensities of fires caused by lightning (Brown 1997). The study area is mountainous with very little or no access, which make the lightning fires difficult to control whilst requiring a large labour force.

Controlled burning along fires breaks and roads are necessary to curb lightning fires in order to prevent the burning of all grazing material.

To maintain a burning program it is important to take factors such as overgrazing, drought, rainfall and available plant material into consideration. According to Brown (1997), moribundness of grass and game pressure on an area should also be taken into account before deciding to burn. Areas with 20 percent or less moribundness of grasses, as well as selected areas with high game pressure where the amount of material is little, should therefore not be burned. Areas with 50 percent and higher could burn.

Since the abovementioned factors differ each year, it is important that the proposed burning program, as part of the management plan for MNP,

must not be a rigid, but flexible system, that can be adapted in order to accommodate the changes in the above mentioned factors.

The study area is mostly sourveld with only a small section that can be regarded as sweetveld (see Chapter 4). Thus, veld burning is especially important in situations where both sour and sweetveld occur in MNP. The proposed burning program make use of the management units described in 5.2, but it must be stressed that the whole study area burns every second year (Table 5.2), depending on the built-up of excess grass material of above 2 500 kg/ha.

The study area is very mountainous and remote therefore it is difficult to combat lightning fires when they occur. The aim of the program is to burn fire breaks around MNP to prevent lightning fires burning out of MNP into neighbouring farms and vice versa. Firebreaks along roads are also of importance, because it would prevent fires from spreading to plant communities that should be left unburned. The following plant community needs also to be protected against fires, viz. *Widdringtonia nodiflora-Podocarpus latifolius* Short Forest (Luger & Moll 1993). A firebreak should be made around all stands of this plant community. It is also recommended that the three tributaries of the Matlabas River in MNP be used as fire breaks.

The plant communities belonging to the *Fuirena pubescens-Chironia purpurascens* Low Closed Grassland and the *Fuirena pubescens-Aristida junciformis* Low Closed Grassland (see chapter 4.6), should not be burned unless the fuel load has been determined properly. These communities are associated with wetlands, and burning these areas unnecessary would have a negative effect on the basal cover of the grass in these communities. This is because it would attract large numbers of grazing animals that would compact the soil which would be detrimental to the flow of the water to the Matlabas River.

However, it is recommended that the wetland areas be burned alternatively every three years to prevent the encroachment of woody vegetation into the wetlands.

It is important that the veld be monitored before and after a burn. If it is found that the current burning program is not achieving the desired effect (e.g.

maintaining and/or increasing plant species diversity or controlling bush encroachment), it is important that the burning program and strategy be revised.

5.4 Monitoring

The recent development of techniques for assessing veld condition is one of the most important advances in the field of veld management. This is because veld condition data are not only important in the planning of a veld management program, but trends in veld condition monitored over time can be used to evaluate and adapt veld management practices when necessary (Trollope et al.1991) (see Chapter 3.8).

It is recommended that monitoring of the veld condition should be undertaken in the different management units, described in chapter 5.2, on an annual basis. An annual aerial census of the game and the annual rainfall data for MNP should be used to develop a sound management program. The carrying capacity for MNP can then be determined on an annual basis to determine if any game should be removed or not.

5.5 Roads

There are no permanent roads in MNP except a narrow tar road to the top of the mountain where the SABC and other companies have masts. The only roads that occur in MNP are jeep tracks and are used by 4x4 vehicles. A proper zonation of MNP should be undertaken for the planning, placement and construction of roads for a tourism road network, because ill-constructed and poorly planned roads may lead to, or enhance erosion.

The aim of tourist roads is to introduce the visitor to as wide a variety of habitats in MNP as possible. These roads should be winding through the bush, avoiding long stretches, while allowing for good game viewing. The roads that are planned for MNP, should be made along contours where possible, and that the roads should not be wider than six metres in total. The reason for narrower roads is that it is aesthetically more acceptable and it also force tourists to drive slower.

The present road infrastructure on MNP is inadequate to carry a large portion of vehicles, it is therefore recommended that a quota system be introduced to avoid overcrowding of vehicles in MNP.

It is recommended that no roads should be built in the wilderness areas (see 5.2) in MNP, that limited roads be permitted in natural areas and that a network of roads be made in the tourism areas, as soon as a zonation plan is compiled.

5.6 Fencing

The entire area of MNP is fenced off with a 2.4 m electrical game fence. In order to increase the efficiency of the electrical fencing, it is recommended that the vegetation along the fence lines of MNP, be removed (3 m on each side). This will allow for more effective patrolling as well as a more effective fire control.

It is recommended that two energisers per station are used to prevent the outbreak of animals if one of the energisers turns faulty. Regular patrolling and maintenance of the fence is of the utmost importance, especially the maintenance of the electrical fence, because if the electrical fence is not working, the elephants may break out.

5.7 Water

Water is an essential resource without which no life is possible. The survival of animals in nature reserves and national parks therefore, not only depends on the vegetation, but also on the availability of water (Brown 1997). It is therefore important that the water resources in MNP be assessed in terms of quality, quantity and distribution thereof. It is recommended that all boreholes and fountains be mapped for management purposes. The following data needs to be available for all the boreholes in MNP: depth of borehole, depth of watertable, type of equipment used (windmill, etc.) and water quality.

MNP is situated in the Waterberg mountain range, which is the catchment of the following rivers: Matlabas-, Mamba- and Sterkstroom Rivers (see chapter 2). Earthen dams were built in these rivers by previous landowners. These earthen

dams are mainly not very large, but large dams, with cement walls were built in the Matlabas River. Some of the earthen dams were not well constructed and broke over the years and it is recommended that these dams need to be rehabilitated.

There is sufficient natural water in MNP, so very little superficial waterholes need to be provided. In areas where there is no permanent water, it is recommended that borehole water be pumped into the natural watercourses, especially during the drier parts of the season, to create a natural effect.

Waterholes in sweetveld should be curb to the minimum, and should be distributed evenly throughout the area in order to achieve an even utilisation of the area.

Because of the presence of all the man-made dams, the Matlabas-, Mamba- and Sterkstroom Rivers and other smaller streams, it seems as though the provision of water satisfies the water requirements of game throughout the year. It is however recommended that the placement of more controllable waterholes in the northern and western section of MNP be investigated.

5.8 Exotic problem plants

The following exotic and/or alien vegetation occur over large areas in MNP: *Eucalyptus* spp., *Acacia* spp. (wattles), *Populus* spp., *Jacaranda mimosifolia*, *Melia azedarach*, *Cereus jamacura*, *Opuntia ficus-indica* and *Opuntia aurantiaca*.

It is recommended that all these exotics be eradicated from MNP, and where possible the wood could be sold or given to local communities for fuel. Monitoring and followup operations must be undertaken as well.

5.9 Erosion control

Very little man made erosion occurs in MNP, but some areas do pose a threat to become a problem. Mapping of erosion and identifying the degree of erosion is of the utmost importance. It is recommended that roads not to be built in such a manner to enhance erosion of the area (see section 5.5). Rehabilitatoin techniques includes

gabions (wire-mesh filled with rocks), lined with bidem (a type of cloth), which catch fine soil particles, be used to curb further erosion of existing areas. After the mapping results of the erosion, the current management plan for rehabilitation of erosion should be revised.

Table 5.2 Occurrence of lightning fires in MNP.

YEAR	FACTOR	AREA BURNT km²
1988	Lightning	290,51 km²
1990	Lightning & manmade	260,00 km²
1991	Lightning	25,15 km²
1992	Lightning	290,51 km²
1994	Lightning	65,95 km²
1995	Lightning	440,00 km²
1996	Manmade	30,00 km²