Interim African Elephant Management Plan
AUTHORISATION

The Interim African Elephant Management Plan for the Sabi Sand Wildtuin was drafted by Dr. Mike Peel and Edwin Pierce and recommended by the Reserve Management, a multi-disciplinary team consisting of:

<table>
<thead>
<tr>
<th>NAME</th>
<th>POSITION AND ORGANISATION</th>
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</thead>
<tbody>
<tr>
<td>Mr. Iain Mackenzie</td>
<td>Chairman, Sabi Sand Wildtuin</td>
</tr>
<tr>
<td>Mr. David Powrie</td>
<td>Warden, Sabi Sand Wildtuin</td>
</tr>
<tr>
<td>Mr. Edwin Pierce</td>
<td>Ecologist, Sabi Sand Wildtuin</td>
</tr>
<tr>
<td>Mrs. Loma Powrie</td>
<td>Financial Manager, Sabi Sand Wildtuin</td>
</tr>
</tbody>
</table>

The Reserve Management was supported by external members, consisting of the following in alphabetical order:

<table>
<thead>
<tr>
<th>NAME</th>
<th>POSITION AND ORGANISATION</th>
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<tbody>
<tr>
<td>Mr. Johan Eksteen</td>
<td>Manager: Scientific Services, MTPA</td>
</tr>
<tr>
<td>Dr. Marisa Coetzee</td>
<td>Senior Manager: Park planning and Co-management, SANParks</td>
</tr>
<tr>
<td>Dr. Mike Peel</td>
<td>Rangeland Ecologist, Agricultural Research Council (ARC)</td>
</tr>
</tbody>
</table>
This Interim African Elephant Management Plan for the Sabi Sand Wildtuin is recommended for approval by:

<table>
<thead>
<tr>
<th>NAME &amp; TITLE</th>
<th>SIGNATURE</th>
<th>DATE</th>
</tr>
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<tbody>
<tr>
<td>Mr. Iain Mackenzie</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chairman of the Board,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sabi Sand Wildtuin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mr. Guy More</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chairman of the Ecological Committee,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sabi Sand Wildtuin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

And approved by:

<table>
<thead>
<tr>
<th>NAME &amp; TITLE</th>
<th>SIGNATURE</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Jan Muller</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior Manager,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wildlife Protection Services, MTPA.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mr. Glenn Phillips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managing Executive,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kruger National Park.</td>
<td></td>
<td></td>
</tr>
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</table>
ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to all those who contributed to this Interim African Elephant Management Plan, including members of the public and the following individuals:

- Mr. Johan Eksteen, Manager Scientific Services, MTPA.
- Mr. Jan Muller, Senior Manager: Wildlife Protection Services, MTPA.
- Mr. Louw Steyn, Control Nature Conservator, MTPA.
- Dr. Marisa Coetzee, Senior Manager: Park planning and Co-management, SANParks.
- Dr. Sam Ferreira, Large Mammal Ecologist, SANParks
- Dr. Markus Hofmeyr, Head of Department: Veterinary Wildlife Services.
- Mr. Nick Zambatis, Manager: Biodiversity Conservation, SANPARKS.
- Mr. Steven Whitfield, Section Ranger: Tshokwane Section.
- Mr. David Powrie, Warden, Sabi Sand Wildtuin.
- Mrs. Loma Powrie, Financial Manager, Sabi Sand Wildtuin.
- Mr. Endri Steyn, Head of Ranger Services, Sabi Sand Wildtuin.
- Mrs. Candice Pierce, Conservation Officer, Sabi Sand Wildtuin.
EXECUTIVE SUMMARY

The Sabi Sands Wildtuin is a reserve that is only fenced off on the Western boundary, while the North-eastern, Southern and Eastern boundaries are open directly to the Kruger National Park (KNP) and Manyeleti Game Reserve (MGR). As a result, careful consideration needs to be taken when assessing the possible removal of any animal within the reserve. The elephant population of the SSW has however maintained its positive growth trend, increasing from 60 animals in 1993 to 1121 animals in 2015. The highly palatable grass composition, excellent tree cover and the availability of year round water, has further attributed to an increase in animals moving between the SSW, KNP and Manyeleti. Drought conditions, together with high numbers of buffalo and impala have further exasperated the situation, placing added pressure on an already stressed system.

Furthermore, the elephant population seem to be aided by the availability of fresh drinking water and adequate browsing, attributes the SSW possesses even under drought conditions. High numbers of elephants and drought pressure needs close monitoring and management to prevent any intra and interspecific mortalities. As according to the Mala Mala—Sabi Sand Wildtuin Complex Management Plan, the reserve is managed for ecotourism and the conservation of biodiversity and it is extremely important to ensure that all species within the reserve are conserved and a process of adaptive management is implemented.

Management of the elephant population will be done in accordance to adaptive management techniques. If the elephant population continues to show a positive growth trend, whilst having a negative effect on the environment, the elephant population management strategies presented in this document will need to be pursued. All revenue obtained through the live sale or culling (last resort) of elephants with be returned to the Sabi Sand Wildtuin’s Nature Conservation Trust and be used for conservation related activities such as game acquisitions and animal interventions. It is important to note that the overall numbers of elephants will not only determine capture and translocation, but also the ratios and population densities of all the herbivores within the reserve.

Keywords: Elephant; Kruger National Park; Manyeleti Game Reserve; adaptive management, live sales, culling, Sabi Sand Wildtuin Nature Conservation Trust.
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### ABBREVIATIONS

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<th>Abbreviation</th>
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<tr>
<td>ADA</td>
<td>Animal Diseases Act, 1984 (Act No. 35 of 1984)</td>
</tr>
<tr>
<td>DEA</td>
<td>Department of Environmental Affairs</td>
</tr>
<tr>
<td>FPA</td>
<td>Fire Protection Association [in terms of the National Veld and Forest Fire Act, 1998 (Act No. 101 of 1998)]</td>
</tr>
<tr>
<td>MM</td>
<td>Mala Mala Game Reserve</td>
</tr>
<tr>
<td>MM-SSW</td>
<td>Mala Mala-Sabi Sand Wildtuin Complex</td>
</tr>
<tr>
<td>MTPA</td>
<td>Mpumalanga Tourism and Parks Agency / Provincial Conservation Authority</td>
</tr>
<tr>
<td>NEMBA</td>
<td>National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)</td>
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<tr>
<td>PAMP</td>
<td>Protected Area Management Plan</td>
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<td>SANParks</td>
<td>South African National Parks</td>
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<td>SSW</td>
<td>Sabi Sand Wildtuin</td>
</tr>
<tr>
<td>TPC</td>
<td>Threshold of Potential Concern</td>
</tr>
<tr>
<td>VCA</td>
<td>Veld Condition Assessment</td>
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Section A
General Information & Inventory

1. General Aspects

The management authority of the Sabi Sand Wildtuin is the Sabi Sand Wildtuin Executive Committee. This interim elephant management plan is a strategic document, endorsed by the SSW Executive Committee, that provides the framework for the interim management of the elephant population within the protected area. It informs management at all levels, from the Warden to support staff within the SSW.

1.1 Names of Nominees and Reserve Managers

1.1.1 Nominees

The nominees listed below represent the individual properties associated within the Sabi Sand Wildtuin.

de Kock, S
Bailes, TL
Becker, D
Brink, C
Lewis, D
Cresswell, V
Feuth, H
Wilkens, H
Wilkens, N
Meyer, H
Brown, J
Davis, M
Saad, S
Kruger, P
Frankel, S
Parrymore, H
Gutsche, P
Saunders, CL
Dos Santos, C
Simaan, G
Napier, R
Kruger, L
Loon, H
van Niekerk, J
Moolman, J
Mackenzie, IA
Marais, MG
More, GR
Notten, D
Robson, T
Swart, E
Taylor, A
Varty, D
Wessels, MM
Cruse, D
Olbrich, B

1.1.2 Reserve Managers

Mackenzie, IA  Chairman - Sabi Sand Wildtuin Executive Committee
More, GR  Chairman - Sabi Sand Wildtuin Ecological Committee
Powrie, DA  Warden - Sabi Sand Wildtuin
1.2 Postal Address

Sabi Sand Wildtuin
P.O. Box 105
Skukuza
1350

1.3 Telephone & Fax Number

Sabi Sand Wildtuin Office Telephone Number: (013) 735 5102
Sabi Sand Wildtuin Office Fax Number: (013) 735 5994

1.4 Farm Names

The Sabi Sand Wildtuin was gazetted as a game reserve in 1965. During this process the Mala Mala Game Reserve was part of the association and therefore likewise gazetted as a game reserve, under the Sabi Sand Wildtuin. Mala Mala Game Reserve however withdrew from the Sabi Sand Wildtuin Association in 2005, to stand alone as a separate private game reserve.

Table 1 The various properties associated with the MM-SSW Complex, 2015.

<table>
<thead>
<tr>
<th>Member</th>
<th>Property</th>
<th>Entity</th>
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<td>N’wandlamhlharhi Community</td>
<td>Iyrefield (Pty) Ltd 343KU</td>
<td>MalaMala (Pty) Ltd</td>
<td>2.976.1432</td>
</tr>
<tr>
<td>N’wandlamhlharhi Community</td>
<td>MalaMala 341KU</td>
<td>MalaMala (Pty) Ltd</td>
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<td>MalaMala (Pty) Ltd</td>
<td>1.376.9984</td>
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<tr>
<td>N’wandlamhlharhi Community</td>
<td>Ptn 1 Charleston 378KU</td>
<td>MalaMala (Pty) Ltd</td>
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<tr>
<td>N’wandlamhlharhi Community</td>
<td>Remainder Charleston 378KU</td>
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<td>N’wandlamhlharhi Community</td>
<td>Ptn 7 Toulon 383KU</td>
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<tr>
<td>de Kock, S</td>
<td>Arethusa 241KU Rem</td>
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<td>Bailes, TL</td>
<td>Ravenscourt 257KU Ptn 2</td>
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<td></td>
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<td>Castleton 260KU</td>
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<td>Becker, D</td>
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<td>Nkorho Game Farm (Pty) Ltd</td>
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<tr>
<td>Name</td>
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<td>Company Name</td>
<td>Amount</td>
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<td>---------------</td>
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<td>---------------------------------------------------</td>
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<tr>
<td>Brink, C</td>
<td>Gowrie 342KU Ptn 4</td>
<td>Snolele (Pty) Ltd</td>
<td>309.00</td>
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<tr>
<td>Lewis, D</td>
<td>Buffelsheok 340KU Ptn 14, 15, 16</td>
<td>Vernal (Pty) Ltd</td>
<td>385.00</td>
</tr>
<tr>
<td>Dannhauser K</td>
<td>Buffelsheok 340KU Ptn 11, 12, 13</td>
<td>Danngaard (Pty) Ltd</td>
<td>385.00</td>
</tr>
<tr>
<td>Feuth H</td>
<td>Arathusa 241KU Ptn 5</td>
<td>MCE Dannhauser Family Trust</td>
<td>868.00</td>
</tr>
<tr>
<td>Dannhauser PJ</td>
<td>Buffelsheok 340KU Ptn 7, 8, 9, 10</td>
<td>P.J. Dannhauser Bosveld (Pty) Ltd</td>
<td>514.00</td>
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<tr>
<td>Wilkens H</td>
<td>Dudley 360KU Ptn 8</td>
<td>Lusilekker (Pty) Ltd</td>
<td>644.10</td>
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<tr>
<td>Wilkens N</td>
<td>Dudley 360KU Ptn 5</td>
<td>Sandriver Boerdery (Pty) Ltd</td>
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### Mala Mala–Sabi Sand Wildtuin Complex Members

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### Hectares

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<tr>
<td>Mala Mala-Sabi Sand Wildtuin Complex</td>
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1.5 Property Extent

The Sabi Sand Wildtuin (SSW) is located in the eastern Lowveld of South Africa to the east of the Drakensberg escarpment on the western boundary of the Kruger National Park. Mala Mala covers an area of some 131.84 km² or 13,184 ha, whilst the SSW covers an area of some 494.81 km² or 49,481 ha. The two reserves combined cover an area of approximately 626.65 km² or 62,665 ha in total.

1.6 Land Use

1.6.1 Sabi Sand Wildtuin

The expectations of the owners of MM and the owners of the SSW are generally expressed in the vision and objectives for the MM-SSW Complex. This can be summarised as follows:

- Owners expect a well-managed, well-protected natural area that satisfies the owners, their families and guests’ desire to have a rich wildlife experience,
- Owners expect their property value to be maintained through sound management and protection.

In terms of the SSW, the draft plan was submitted in its entirety to the Ecological Subcommittee and Executive Committee for review and comment. The Ecological Subcommittee was mandated by members at an Extraordinary General Meeting to undertake this review on behalf of the SSW membership.

1.6.2 Neighbours – Kruger National Park, Manyeleti Game Reserve & Sabie Park

Neighbouring land users to the east, north-east and south of the MM-SSW Complex exercise the same type of land use, namely conservation, ecotourism and recreation and their interests and concerns mostly coincide with those of MM and SSW.
1.6.3 Neighbours – Local Communities

The area to the north-west and west of the SSW consists of communal rangelands which generally have a dense human population, while MM does not have a direct boundary with any communal area. The neighbouring local communities are expected to have the following main interests and concerns:

- The SSW-MM Complex may be an area from where dangerous wildlife disperses onto community land causing damage to crops (elephant), preying on livestock (lion), spreading diseases to livestock (buffalo) and endangering the lives of community members (elephant, lion and leopard). It is thus important that the integrity of the perimeter fence of the SSW is maintained and regularly checked,
- MM and SSW is seen as a potential source of employment, and
- The MM-SSW complex harbours a range of natural resources of interest to local communities (thatching grass, firewood, medicinal plants etc.),
- A number of NGOs and Lodges within the SSW support community development projects.

1.7 Researchers & Authors – Information

<table>
<thead>
<tr>
<th>Name &amp; Surname:</th>
<th>Dr. Mike Peel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position Occupied:</td>
<td>Agricultural Research Institute</td>
</tr>
<tr>
<td></td>
<td>– Specialist Scientist</td>
</tr>
<tr>
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</tr>
<tr>
<td></td>
<td>Nelspruit 1200</td>
</tr>
<tr>
<td>Telephone Number:</td>
<td>(013) 753 7147</td>
</tr>
<tr>
<td>Fax Number:</td>
<td>(013) 753 7039</td>
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<tr>
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<td></td>
<td>Skukuza 1350</td>
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<tr>
<td>Telephone Number:</td>
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</tr>
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<td>Fax Number:</td>
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1.8 Proximity to Settlements

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1.9 Expansion Strategy

The Sabi Sand Wildtuin is the oldest private game reserve in South Africa (1948). Originally established with the purpose of expanding the conservation footprint of Kruger National Park onto privately owned land, SSW is made up of a group of 32 landowners who collectively manage 49,500 ha adjacent to Kruger National Park. As such, SSW forms an important buffer to South Africa’s most important protected area – providing anti-poaching, ecosystem management and tourism promotion services to support the sustainability of the wildlife economy against ongoing threats.

Traditionally SSW has played a conservation management role, but has recognised the relevance of socio-economic issues and has since expanded its focus to address local socio-economic challenges in partnership with neighbouring communities. As mentioned previously, neighbouring the reserve are numerous rural villages which are beset with poverty and hardship. The area is part of the Bushbuckridge municipal region in Mpumalanga, South Africa, which has been declared a presidential poverty node. These communities face poverty, HIV, AIDS, severe water shortages, poor sanitation, overwhelmed education services, poor matric results, high levels of unemployment and lack of skills and capacity. However, these communities do have valuable human and natural resources which, with some help, have the potential to transform livelihoods throughout this region.
The SSW has always seen the community as an integral part of the reserve and community upliftment and land incorporation has been an important objective since the founding of the reserve in the late 1940’s. As we are all aware, the process of land incorporation is a slow one, as communities comprise of several different stakeholders with several different needs, farmers verse potential businessmen and women, young verses old, each identifying different ways in which the reserve could fulfil their needs. Through stakeholder analysis, land incorporation and co-management of Lisbon Estate, communal land to the west of SSW’s Lisbon Property, as indicated on the “Proposed Community Land Incorporation” Map (Figure 4.0, page 45) was identified. This section of communal land has thus been earmarked as a potential communal property to be incorporated into the SSW. The pilot project will be seen as the catalyst for further community land incorporation into the SSW, a very exciting process for both SSW Members and Management.

1.9.1 SSW Policy

The policy of the SSW with regard to its neighbouring and nearby communities is to:

- Assist, through the development and management of the Reserve, in improving the quality of life of the disadvantaged communities living nearby;
- Preference will be given to indirect rather than direct interventions (facilitation and provision of opportunities rather than outright financial support or resource utilisation);
- Transfer of knowledge, skills and opportunities towards strengthening Small Medium and Micro Enterprises (SMME) development will be favoured.

1.9.2 Management Policy

The policy translates as follows in practice:

- Employment opportunities will preferably be made available to people living nearby;
- Purchases of goods will as far as possible be sourced locally;
- Services, particularly those that are labour intensive, such as clearing of firebreaks, road construction, road maintenance, fence maintenance, bush clearing, erosion reclamation, seed collection and re-seeding, will as far as possible, be sourced locally;
- Skills transfer to SMME’s and in particular the setting up of current and previous employees as independent service providers will be encouraged;
- Leveraging any donor or government intervention in terms of community conservation or environmental education;
• Supporting and promoting community conservation actions on land bordering the SSW.

The above must all take place within the constraints of available funding and managerial resources.

1.10 Specifications of the Perimeter Fence

The western boundary fence of the SSW is electrified according to the following standards:

• On the inward side of the fence, there are 8 electrified strands and 7 earthed strands structured in the following manner:
  o Each strand has a diameter of 2.24mm,
  o The lower meter of the fence is comprised of a 45-degree apron erected approximately 40 cm from the base of the fence line. This apron comprised of 4 electrified and 4 earthed strands,
  o The upper meter of the fence is comprised of one triple offset bracket, with a double double offset bracket below and above.

• On the outward side of the fence, there are 4 electrified strands and 3 earthed strands structured in the following manner:
  o Each strand has a diameter of 2.24mm,
  o A top 45-degree offset is attached to the 2m Y-standard. It measured approximately 45cm and overhangs the outside of the reserve. This offset is comprised of 3 electrified and 3 earthed strands,
  o The remaining electrified strand can be located on a single offset bracket approximately 1.8m from the base of the fence.

• The fence is comprised of Y-standards and steal wire and 10 cm bonnox fence from the base to a height of approximately 2m.
• The lower meter of fence is fortified with razor wire for security purposes.
• A minimum voltage of 6000V is maintained throughout the 72 km SSW fence line.
• 36 energisers, producing on less than 6 joules, power the fenceline.
• Danger signs indicating electrified fencing are displayed at regular intervals along the fence line and the danger surrounding elephants is displayed at all SSW entrance gates.
Figure 1   Photographs indicating the design of the SSW western fenceline.
1.11 SWOT Analysis of the SSW

The classic Strengths, Weaknesses, Opportunities and Threat analysis, with a focus on those aspects related to the SSW’s management, was applied as it provides a useful tool to identify those aspects that need to be addressed through management.

From the SWOT analysis, the following vital attributes can be identified as key to the SSW, its conservation, its management and its development:

- Large, diverse area that is mostly natural;
- Semi-arid climate with large, mostly unpredictable and certainly unavoidable, variations that have major impacts on vegetation dynamics, carrying capacity of wildlife and on management requirements;
- Ecological functioning for certain attributes is at a spatial scale that is smaller than that of large conservation areas such as the KNP;
- Diversity of owners and diversity of opinions;
- Pressure by external stakeholders on decision-making.

In order to implement an effective adaptive management plan for Elephant within the SSW it is essential to have a Mission statement for the reserve and to set clear objectives for the management of the reserve as a whole.

1.12 Reserve Mission

According to the Proposed Management plan the reserve objectives are as follows:

- The SSW is committed to the conservation of biodiversity for the sake of posterity, and to manage its assets as a sustainable resource to serve the ecological, social and economic interests of the Lowveld;
- The SSW landscape will be developed to maintain the faunal and floral assemblages, ecological processes, cultural resources and landscape characteristics representative of the area, to foster international co-operation for the further development of the Greater Limpopo Transfrontier Conservation Area (GLTFCA), and offer long-term benefit to the people of the area;
- To conserve a wide diversity of indigenous species and their associated habitats using sustainable utilisation principles (Leibnitz, Peel, de Villiers & Venter, 1993).
1.13 Reserve Objectives

The primary objective of the SSW is to provide for ecologically and aesthetically sustainable (non-consumptive and consumptive) use of the area for its owners, based on wildlife focused recreation and tourism.

1.14 Elephant Management Objectives

Extrapolated from the Vision and Management Goals of the Sabi Sand Wildtuin, the key objectives relating to the management of elephants in the reserve are to:

- Maintain the population in a state where positive elephant-associated ecological processes are maintained and impacts on biodiversity are not threatened, i.e. Vulture, raptor and ground hornbill nesting sites,
- Manage the population to optimise their value as a tourist attraction,
- Manage the population to optimise their value as a catalyst in respect of commercial and co-management partnerships, and
- Ensure that risks to human life, infrastructure and livelihoods are minimised.

1.15 Ecological Management Objectives

Aspects that are dealt with in detail are soils, fire management, bush encroachment, and water provision, with the primary objectives for these aspects consisting of:

- Minimising the rate of accelerated erosion;
- Conserving indigenous plant populations and a representative variety of habitats occurring in the SSW through:
  - Use of fire by management;
  - Control of bush encroachment;
  - Control of alien plants;
  - Ensuring sustainability of consumptive utilisation.
- To provide water for animals in places and for periods which are to approximate as closely as possible the natural past distribution of water without affecting adversely the hydrology and consequent ecology of the reserve and to maintain natural water bodies in such a condition so as to support the naturally occurring species linked to such bodies.
1.16  Ecological Monitoring and Research

Ecological monitoring and research are closely linked to the above:

1.16.1  Monitoring

To detect or warn of changes which conflict with the management objectives:

- To evaluate the success of management actions which have been implemented; and
- To generate relevant key questions for research

1.16.2  Research

To ensure that relevant, applied research projects are undertaken in the reserve:

- Research should emphasise gaining a predictive understanding of ecosystem functioning which can serve as feedback for an adaptive management programme; and
- Determining optimal levels for the sustainable utilisation of the natural resources.

The ecological research and monitoring programme is well developed on SSW. The programme encompasses an environmental, vegetation and animal component.
2 Ecological Aspects

2.1 General Climatic & Hydrological Data

2.1.1 Rainfall

Precipitation in the SSW is low and erratic, characteristic of semi-arid savannas: a hot, wet season of 5-7 months (October to April) and the remainder of the year being dry. The vegetation is under moisture stress which is generally severe and of long duration. Rainfall, including total amount, distribution over a season, runoff, infiltration, storage in the soil profile, evaporation from the soil surface, uptake and transpiration, is important in determining the nature of the vegetation of an area.

The mean annual rainfall decreases from around 620 mm in the south to around 570 mm in the north of the SSW. More specifically the following are the means for some stations with more than 20 years of data (Peel & Stalmans, 2010):

Table 2 Average rainfall recorded within the Mala Mala-Sabi Sand Wildtuin Complex, according to sector weather stations.

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<tr>
<td>Metsi Picket</td>
<td>Western</td>
<td>568 mm</td>
<td>16 years</td>
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<td>Rhino Park Picket</td>
<td>North-western</td>
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<tr>
<td>Gowrie Gate</td>
<td>Northern</td>
<td>570 mm</td>
<td>28 years</td>
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Figure 2 Graph illustrating the seasonal variation in yearly rainfall recorded at Sabi Sand Wildtuin’s Shaws Gate, 1982/83 – 2013/14.
Table 3  
Table indicating the rainfall received within the Sabi Sand Wildtuin, 1982 – 2015.

<table>
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<td>64</td>
<td>Drought</td>
</tr>
<tr>
<td>1998/99</td>
<td>881</td>
<td>147</td>
<td>Very wet</td>
</tr>
<tr>
<td>1999/00</td>
<td>1304</td>
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<td>629</td>
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</tr>
<tr>
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<tr>
<td>2002/03</td>
<td>233</td>
<td>39</td>
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</tr>
<tr>
<td>2003/04</td>
<td>589</td>
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</tr>
<tr>
<td>2004/05</td>
<td>377</td>
<td>63</td>
<td>Drought</td>
</tr>
<tr>
<td>2005/06</td>
<td>882</td>
<td>147</td>
<td>Very Wet</td>
</tr>
<tr>
<td>2006/07</td>
<td>589</td>
<td>98</td>
<td>Close to expected</td>
</tr>
<tr>
<td>2007/08</td>
<td>550</td>
<td>92</td>
<td>Dry</td>
</tr>
<tr>
<td>2008/09</td>
<td>713</td>
<td>118</td>
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</tr>
<tr>
<td>2009/10</td>
<td>659</td>
<td>108</td>
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</tr>
<tr>
<td>2010/11</td>
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<td>Close to mean</td>
</tr>
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<td>2011/12</td>
<td>852</td>
<td>139</td>
<td>Very wet</td>
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<tr>
<td>2012/13</td>
<td>627</td>
<td>103</td>
<td>Close to mean</td>
</tr>
<tr>
<td>2013/14</td>
<td>737</td>
<td>121</td>
<td>Wet</td>
</tr>
<tr>
<td>2014/15</td>
<td>388</td>
<td>63</td>
<td>Drought</td>
</tr>
</tbody>
</table>

*The mean is updated annually so the previous year’s % figures will vary slightly as the mean changes.*
2.1.2 Temperature

The SSW has hot summers and mild to cold winters. Summer temperatures range between 18° C and 45° C while winter temperatures range between 8° C and 23° C. The mean highest monthly temperature is around 40° C while the lowest mean minimum temperature is around 0° C (Schulze, 1975).

2.1.3 Topography

The area is gently undulating, interspersed with koppies (the Rykoppies Dyke in particular). Altitude in the SSW varies between 518 metres above sea level (m.a.s.l.) on Wallingford in the west to 420 m.a.s.l on Gowrie in the north-east to 305 m.a.s.l on Toulon in the south-east. The SSW lies in a topographic position which can be described as lying between the Lowveld and the foothills of the Drakensberg (Peel & Stalmans, 2010).

2.1.4 Hydrology

The perennial Sabi River flows along the boundary for about 12km. The Sand River traverses the centre of the reserve, entering in the North West on Exeter and exiting in the south east on Toulon some 52km later. The Phungwe enters the SSW on Arathusa and exits in the south west, flowing south through Marthly to within about 500m from the Sand River. It then turns roughly north for about 500m and then turns east south east until it enters the Sand on Mala Mala. The approximate position of other smaller named drainage lines taken from the 1:50 000 cadastral maps (1988) are shown in Figure 2.0, page 31 (Peel & Stalmans, 2010).

2.2 Geology

The Lowveld is underlain by the basement gneisses and granites. Using Walraven (1989) the area can be described as follows: A central band running from close to the eastern boundary to the western boundary is dominated by medium to coarse grained, sphene bearing tonalite. Forming an approximate U-shape around the latter is a series classified as quartz-microcline-plagioclase-biotite migmatite and gneiss with mafic and ultra-mafic xenoliths. Local re-crystallisation occurs in the south on Kingstown.

A tongue of light grey, medium grained biotite gneiss with coarse grained quartz veldspar leucosomes traverses the area from the north-eastern corner of Exeter through the northern section of Othawa, the
centre of Arathusa, north-eastern corner of Marthly and narrowing to a point in the central area of Eyrefield (Mala Mala). The eastern section of Arathusa, almost the whole of Gowrie and the northern section of Eyrefield is classified as grey to pale brown, medium- to coarse grained quartz-feldspar-biotite gneiss with subordinate mafic to ultramafic xenoliths. An area underlain by granophyric quartz quartz gabbro (Sabi Sands Granophyre) dominates the central and eastern section of Kingstown. The origin of these rocks is unclear but it may be that the SS granophyre represents some marginal interaction facies between the surrounding Nelspruit suite and gabbroic rocks which formerly overlay the granophyre but which have been removed by erosion.

In the vicinity of the old railway line on Dudley (its western boundary) and Sparta (and its western boundary), Castleton (eastern and a large portion of the central area) and Alicecot as well as in a narrow band on Ravenscourt (eastern boundary stretching to the northern boundary), a band through the south and west of Othawa and through the north eastern corner of Exeter we find what is termed Timbavati Gabbro, a medium- to coarse-grained gabbro, olivine gabbro and quartz gabbro. These are basic rocks with an irregular outcrop pattern distinguished by a clearly recognizable vegetation type.

A very prominent dyke, consisting of fine to medium grained, hybridized gabbro, with abundant inclusions of acid rocks extends in a west-east direction across the granites and gneisses of the pre-Transvaal basement. This dyke protrudes prominently above the flat topography formed by the granite and gneiss. In the SSW it stretches in a narrow band from Wallingford in the west, where it is most pronounced, through Ravenscourt, Marthly and into Marthly and Eyrefield in the neighbouring Mala Mala Reserve (Peel & Stalmans, 2010).

2.3 Soils

In semi-arid regions there is usually a good correlation between geological formation, soil type and vegetation type. This implies that the soil and parent rock from which the soil is formed exercise a strong influence on grazing management.

Soil affects the supply of water and nutrients to the plant. The soil moisture regime, a primary determinant of savanna dynamics and by extension vegetation composition, is influenced by four factors other than the pattern and amount of rainfall namely, infiltration, percolation, root extraction and evaporation (O'Connor, 1985).
The soils of the SSW occur in distinctive catenary sequences on granitoid rocks. Their formation is a result of the following processes:

a) The mobilisation and eluviation of clay particles and soluble weathering products from porous soils in upland positions by rain water;
b) The lateral downward transportation of these components under the influence of gravitation to footslope positions, where they are redeposited to form impermeable clay horizons. At this point the ground water is forced to the surface, thus forming waterlogged zones (seepage lines) during the rainy season which more or less follow the contours (Venter, 1986). Thus a general catenary sequence from crest to valley bottom, determined by the sequence of soil complexes (i.e. sandy, hydromorphic, duplex and alluvial) and associated vegetation composition, is repeated regularly across the hills and valleys.

Although these catenary sequences associated with granite-gneiss is representative of the area, the presence of gabbro intrusions and dolerite dikes causes a marked change in soil patterns. These metamorphic units generally weather into clayey structured fertile soils which differ from the normal granite-gneiss pattern (Peel & Stalmans, 2010).

2.4 Vegetation Description

The Mala Mala-Sabi Sand Wildtuin Complex falls within the one biome and one bioregion: The Savanna Biome; and the Lowveld Bioregion. According to Mucina and Rutherford (2010) the MM-SSW Complex falls mainly within the Granite Lowveld (SVI 3) vegetation type, occurring at altitudes of about 250 - 700 m and is characterised by tall shrubland with few trees to moderately dense low woodland on the deep sandy uplands with Terminalia sericea, Combretum zeyheri and C. apiculatum and ground layer including Pogonarthria squarrosa, Tricholaena monachne and Eragrostis rigidior. A small area in the west of the reserve at an altitude of about 600 - 1000 m, falls within the Legogote Sour Bushveld (SVI 9) vegetation type, occurring on gently to moderately sloping upper pediment slopes with dense woodland including many medium to large shrubs often dominated by Parinari curatellifolia and Bauhinia galpinii with Hyperthelia dissolute and Panicum maximum in the undergrowth.
Important taxa of the Granite Lowveld (SVI 3) bioregion include:

- Tall trees: *Acacia nigrescens* and *Scleropyra birrea* subsp. *caffra*,
- Small trees: *Acacia nilotica*, *Albizia harveyi*, *Combretum apiculatum*, *C. imberbe*, *C. zeyheri*, *Ficus stuhlmannii*, *Peltophorum africanum*, *Pterocarpus rotundifolius*, *Terminalia sericea*, *Acacia exuvialis*, *A. gerrandi*, *Bolusanthus speciosus*, *Cassia abbreviata* subsp. *beareana*, *Combretum collinum* subsp. *sulunse*, *Dalbergia melanoxylon*, *Gymnosporia glaucocephylla*, *Lannea schweinfurthii var. stuhlmannii*, *Pavetta schumanniana*, *Plectoniella armata* and *Terminalia pruniodes*,
- Tall shrubs: *Combretum hereoense*, *Dichrostachys cinerea*, *Euclea divinorum*, *Strychnos madagascariensis*, *Gardenia volkensii*, *Hibiscus micranthus* and *Tephrosia polystachya*,
- Low shrubs: *Abutilon austro-africanaum*, *Agathisanthemum bojeri*, *Aptosimum lineare*, *Barlearia elegans*, *Clerodendrum ternatum*, *Commiphora africana*, *Grossypium herbaceum* subsp. *africana* and *Panvonia burchelli*,
- Woody climber: *Sphedamnocarpus pruiens* subsp. *pruiens*,
- Herbaceous climber: *Rhynchosia totta*,
- Succulent herbs: *Orbea rogersii* and *Stapelia leendertzia*.

Important taxa of the Legogote Sour Bushveld (SVI 9) include:

- Tall trees: *Pterocarpus angolensis*, and *Sclerocarya birrea* subsp. *caffra*,
- Small trees: *Acacia davyi*, *A. sieberiana* var. *woodii*, *Combretum zeyheri*, *Erythrina latissima*, *Parinari curatellifolia*, *Terminalia sericea*, *Trichilia emetica*, *Verononia amygdalina*, *Acacia caffra*, *Antidesma venosum*, *Erythroxylum emarginatum*, *Faurea rochetiana*, *F. saligna*, *Ficus burikei*, *F. glumosa*, *F. glumosa*, *F. ingens*, *F. petersii*,...
Heteropyxis natalensis, Peltophorum africanum, Piliostigma thonningii, Pterocarpus rotundifolius and Schotia brachypetala,

- Succulent tree: Euphorbia ingens,
- Tall shrubs: Diospyros lycioides subsp. sericea, Erythroxylum delagoense, Olea europaea subsp. africana, Pachystigma macrocalyx, Pseudarthria hookeri var. hookeri and Rhus pentheri,
- Low shrubs: Diospyros galpinii, Flemingia grahamiana, Agathisanthemum bojeri, Eriosma psoraleoides, Gymnosporia heterophylla, Hemizygia punctata, Indigofera filipes, Myrothamnus flabellifolius and Rhus rogersii,
- Succulent shrubs: Aloe petricola, Euphorbia vandermerwei and Huernia kirkii,
- Woody climbers: Acacia ataxacantha, Bauhinia galpinii, Helinus intergrifolius and Sphedannocarpus pruriens subsp. pruriens,
- Graminoids: Bothriochloa bladhii, Cymbopogon caesius, C. nardus, Hyparrhenia cymbaria, H. poecilotricha, Hyperthelia dissolute, Panicum maximum, Andropogon schirensis, Paspalum scrobiculatum and Schizachyrium sanguinum,
- Herbs: Gerbera ambigu, G. viridifolia, Hemizygia persimilis, Hibiscus sidiformis, Ocimum gratissimum and Waltheria indica,
- Succulent herbs: Orbea carnosa subsp. carnosa, Stapelia gigantean and Aloe simii,
- Geophytic herbs: Gladiolus hollanidii and Hypoxis rigidula.

The equivalent vegetation types as described by Acocks (1988) are Arid Lowveld (Veld Type 11) and Lowveld (Veld Type 10), as well as a small section of Lowveld Sour Bushveld (Veld Type 9) in the west of the reserve. According to Low and Rebelo’s (1996) classification, the reserve comprises of Mixed Lowveld Bushveld (Type 19) and Sour Lowveld Bushveld (Type 21). Although the above vegetation descriptions provided an accurate and easily recognised framework for the habitat delineation within the reserve, the actual mapping is too coarse to be useful at the reserve scale. As a result, a more fine-scale adapted classification of the vegetation of the MM-SSW Complex is used for the management of the reserve and the identification of sensitive habitats. The adapted description of these vegetation types is as follows (Figure 13):

- **Marula/Combretum sand savanna.** This habitat type is situated on the crests of the hills and is dominated mainly by mesophyllous woody species such as marula (Sclerocarya birrea caffra), large-fruited bushwillow (Combretum zeyheri), weeping bushwillow (Combretum collinum), red bushwillow (Combretum apiculatum), silver cluster-leaf (Terminalia sericea),
kiaat (*Pterocarpus angolensis*), round-leaved kiaat (*Pterocarpus rotundifolius*), green thorn (*Balanites maughamii*), buffalo thorn (*Ziziphus mucronata*), white raisin (*Grewia bicolor*) and silver raisin (*Grewia monticola*). Woody species that are less common but regarded as key species are wild pear (*Dombeya rotundifolia*), false current resin (*Ozoroa insignis*), sourplum (*Ximenia caffra*), zebra wood (*Delbergia melanoxylon*), spineless monkey orange (*Strychnos madagascariensis*) and common spike thorn (*Maytenus heterophylla*).

The grass species *Panicum maximum* appears to dominate in shaded areas beneath the tree canopies. Other common grass species are *Panicum coloratum*, *Digitaria eriantha*, *Melinis repens*, *Perotis patens*, *Pogonarthria squarrosa*, *Eragrostis rigidior* and *Aristida* spp. The grass species *Chloris roxburghiana* and *Cenchrus ciliaris* are often associated with termitaria.

Contour seeplines on the upper slopes below the crests often form the boundary to the marula/Combretum habitat type, and in the undisturbed state consist of a narrow band of temporary waterlogged grassland that approximately follows the contours. The key grass species in this zone are *Eragrostis gummiflava*, *Panicum maximum*, *Digitaria eriantha* and *Themeda triandra*. However, the majority of contour seeplines have been disturbed by roads and overgrazing that resulted in an encroachment of woody species from above and below the seepline. Large stands of *Terminalia sericea* growing on a seepline is an important indicator of a disturbed seepline. *Combretum zeyheri* also encroaches from the crest onto the seepline, while red thorn (*Acacia gerrardii*), common false thorn (*Albizia harveyi*) and sickle bush (*Dichrostachys cinerea*), are common invaders from the slope. Grass species such as *Hyperthelia dissoluta*, *Aristida meridionalis*, *Brachiaria nigropedata*, *Perotis patens*, *Cynodon dactylon* and *Pogonarthria squarrosa*, are also indicators of a disturbed seepline.

- **Grassland savanna clearings.** These are areas that have previously been cleared of many of the small trees and shrubs in an attempt to recreate grassland savanna conditions, and are mainly situated along seeplines extending down to the footslopes. Once the contour grassland seeplines were disturbed they were encroached by woody species. This changing vegetation structure pattern where woody vegetation invades open grasslands was termed "bush encroachment" (Strang, 1982; West, 1947). This prompted several land owners to reclaim those areas that had been subjected to this process by means of a bush clearing program.

Although the soil type and vegetation of these areas are quite variable, the basic vegetation structure is similar in that they are characterised by grassland dotted with shrubs and relatively...
large trees. The trees and shrubs commonly found in this habitat type are: silver cluster-leaf (on seeplines); marula; zebra wood; knobthorn (*Acacia nigrescens*); red bushwillow; leadwood (*Combretum imberbe*) (on footslopes); weeping wattle (*Peltophorum africanum*); buffalo thorn; flaky thorn (*Acacia exuvialis*); white raisin; and silver raisin. The more important grass species include: *Aristida congesta; Aristida stipitata; Panicum maximum* (under tree canopies); *Heteropogon contortus; Urochloa mosambicensis; Eragrostis rigidior; Pogonarthria squarrosa; Dactyloctenium spp; Digitaria eriantha; Themeda triandra*; and *Eragrostis superba*.

- **Mixed tree savanna.** These areas are usually situated on the midslope down to the drainage lines and are characterised by a combination of mesophyllous, microphyllous and nanophyllous woody species with marula, *Combretum* spp. and *Acacia* spp. dominating. The mixed tree savanna areas are fairly heavily wooded with good grass cover. The more common woody species are marula, weeping bushwillow, red bushwillow, knobthorn, zebra wood, sickle bush, weeping wattle, round-leaved kiaat, flaky thorn, common spike thorn, red thorn, scented thorn (*Acacia nilotica*) and *Grewia* spp. Common grass species include *Themeda triandra, Digitaria eriantha, Panicum maximum, Panicum coloratum, Urochloa mosambicensis, Eragrostis rigidior, Aristida spp, Bothriochloa insculpta* and *Eragrostis superba*.

- **Calc brack thicket.** These areas are situated on the footslopes on sodic duplex soils close to the Sand river basin. They are characterised by short grass, bush clumps and savanna mosaics. The most important woody species that form bush clumps often associated with termitaria are magic guarri (*Euclea divinorum*), tamboti (*Spirostachys africana*), lowveld milkberry (*Manilkara mochisia*), jacket plum (*Paplea capensis*), tree fuschia (*Schotia brachypetala*), dwarf boer-bean (*Schotia capitata*), common spike thorn, porcupine bush (*Dinocanthium hystrix*), kooboo-berry (*Cassine aethiopica*) and Transvaal saffron (*Cassine transvaalensis*). Other trees that often intersperse these bush clumps are knobthorn, scented thorn, red thorn, caterpillar pod (*Ormocarpum trichocarpum*) and leadwood. The two grass species *Sporobolus nitens* and *Enteropogon monostachyus* appear to dominate in this habitat type with the latter colonising under tree canopies and the former in sunny exposed areas between bush clumps. Other common grasses are *Panicum maximum, Urochloa mosambicensis, Themeda triandra, Digitaria Eriantha, Aristida congesta* and *Eragrostis superba*.
- **Riverine thicket.** This habitat type forms a narrow band of riparian vegetation along the major rivers and drainage lines incorporating the Sand River and its major tributaries. Tall trees such as jackal-berry (*Diospyros mespiliformis*), sycamore fig (*Ficus sycomorus*), tree fuschia, leadwood, matumi (*Breonia salicina*), red ivory (*Berchemia zeyheri*), sausage tree (*Kigelia africana*) and brack thorn (*Acacia robusta*), are common along the riverines. Common trees and shrubs that usually form the lower canopies of this habitat are apple-leaf (*Lonchocarpus capassa*), black monkey thorn (*Acacia burkei*), tamboti, buffalo thorn, russet bushwillow, green thorn, scented thorn, red spike thorn (*Maytenus senegalensis*), lavender fever-berry (*Croton gratissimus*), fever-berry (*Croton megalobotrys*), wild date palm (*Phoenix reclinata*), pride-of-De Kaap (*Bauhinia galpinii*) and potato bush (*Phyllanthus reticulatus*).

The dominant grass species of the riverine thicket are *Panicum deustum*, *Panicum maximum*, *Cenchrus ciliaris*, *Eragrostis* spp, *Urochloa mosambicensis* and *Cynodon dactylon*. The reed *Phragmites mauritianus* forms dense stands within the river beds.

- **Knobthorn turf savanna.** Although this habitat type occurs on red turf and black turf soils the vegetation on both soil types is similar. These areas are essentially dominated by knobthorn trees and white raisin bushes, and the grass species *Thedema triandra* and *Setaria incrassata*. Other woody species such as scented thorn, sickle bush, round-leaved kiaat and magic guarri often form dense thickets in some of these areas. Some of the grasses often associated with these thicket areas are *Aristida* spp, *Eragrostis* spp, *Cymbopogon* spp, *Bothriochloa insculpta* and *Sporobolus nitens*.

- **Turf grassland.** This is open grassland savanna woodland dominated by trees such as marula, knobthorn, tree wisteria (*Bolusanthus speciosus*) and apple-leaf. The grass species *Thedema triandra* dominates, however, it may be replaced in some areas by *Cymbopogon* spp. and *Bothriochloa insculpta*. The woody species: sickle bush; round-leaved kiaat; white raisin; red spike thorn; and russet bushwillow also occur in this habitat type, but are usually stunted.

- **Riverine floodplain.** The large trees found in the riverine thicket areas are absent in the riverine floodplains. These areas are relatively flat and dominated by the wild date palm and lala palm (*Hyphaene coriacea*). The woody shrub species are similar to those found in the riverine thicket habitat but their canopy cover is reduced. The grass species of the riverine floodplains are also similar to those found in the riverine thicket.
• **Rocky outcrops.** The woody species common in this habitat type are marula, cabbage tree (*Cussonia spicata*), Transvaal candelabra tree (*Euphorbia cooperi*), red bushwillow, knobthorn, common star-chestnut (*Sterculia rogersii*), lavender tree (*Heteropyxis natalensis*) and mountain karee (*Rhus leptodictya*). The dominant grass species is *Panicum maximum*.

2.5 Preferred Management Density of Elephants

The annual aerial census was first undertaken in 1979 and again in 1982 and from 1990 it was undertaken on a yearly basis. The census involves using a helicopter to fly 500 m transects across the entire reserve. This activity takes place at the end of winter, usually the last week of August. The removal of the veterinary fence between the SSW and KNP in 1993 proved to be very favourable with the elephant population. Their numbers drastically increased from 60 individuals in 1993 to 1231 individuals in 2015, with a highest peak of 1421 individuals during 2007. Elephant densities have thus gone form 0.12 elephant/km² in 1993 to 2.49 elephant/km² in 2015. Kruger National Park Management raised a concern when elephant densities within the KNP reached 0.56 elephant/km², this was during the 2004 elephant symposium at Pilanesberg National Park.

The density of elephant using aerial census data from 2005 to 2015 indicates that 95% of the elephants counted over a 10-year period only utilized approximately 45% of the total area of the SSW. The highest densities, as expected, are along the perennial Sabie and Sand Rivers, as well as the various available water sources. This distribution illustrates the reliance of elephants on water in the dry period. Using the available data and distribution records of elephant within the SSW, the Management of the SSW intends to manage the elephant population at a density of approximately 1.50 elephant/km², a total of approximately 1000 individuals.
2.6 Game Species & Numbers Present on Property

Historically, the MM-SSW complex is expected to have carried a full complement of the megafauna traditionally associated with savanna ecosystems. A range of large grazers and browsers historically occurred in the region (du Plessis 1969).

Table 4 Herbivore species which historically occurred within the MM-SSW complex (Rautenbach 1982; Smithers 1983).

<table>
<thead>
<tr>
<th>Species</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>African elephant – <em>Loxodonta africana</em></td>
<td>Impala - <em>Aepyceros melampus</em></td>
</tr>
<tr>
<td>Black rhinoceros - <em>Diceros bicornis minor</em></td>
<td>Klipspringer - <em>Oreotragus oreotragus</em></td>
</tr>
<tr>
<td>Blue wildebeest - <em>Connochaetes taurinus</em></td>
<td>Kudu - <em>Tragelaphus strepciseros</em></td>
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<tr>
<td>Burchelle’s Zebra - <em>Equus burchelli</em></td>
<td>Nyala - <em>Tragelaphus angasii</em></td>
</tr>
<tr>
<td>Bushbuck - <em>Tragelaphus scriptus</em></td>
<td>Roan antelope - <em>Hippotragus equinus</em></td>
</tr>
<tr>
<td>Bushpig - <em>Potamochoerus porcus</em></td>
<td>Sable antelope - <em>Hippotragus niger</em></td>
</tr>
<tr>
<td>Cape buffalo - <em>Syncerus caffer</em></td>
<td>Steenbuck - <em>Raphicerus campestris</em></td>
</tr>
<tr>
<td>Common reedbuck - <em>Redunca arindinum</em></td>
<td>Tsessebe – <em>Damaliscus lunatus</em></td>
</tr>
<tr>
<td>Eland - <em>Taurotragus oryx</em></td>
<td>Warthog - <em>Phacochoerus aethiopicus</em></td>
</tr>
<tr>
<td>Giraffe – <em>Giraffa camelopardalis</em></td>
<td>Waterbuck - <em>Kobus ellipsiprymnus</em></td>
</tr>
<tr>
<td>Grey duiker - <em>Sylvicapra grimmia</em></td>
<td>White rhinoceros – <em>Ceratotherum simum</em></td>
</tr>
<tr>
<td>Hippopotamus - <em>Hippopotamus amphibious</em></td>
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The reliable counting of wild animals on a game ranch is one of the cornerstones of effective wildlife management. However, it is extremely difficult to obtain accurate figures of any wild animal population. Except when it is really necessary to know exactly how many animals of each species occurs on a ranch, it is better to do repeatable or precise counts rather than to attempt accurate counts. Precise counts are a reliable determinant of trend in population growth. Such trends are valuable for management decisions. Furthermore, these trends also help to monitor the pressure of use on habitat.
Table 5  Aerial census results for the MM-SSW complex (2012 – 2015).

<table>
<thead>
<tr>
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<th>MM-SSW Complex</th>
<th>Mala Mala</th>
<th>Sabi Sand Wildtuin</th>
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<td>Blue Wildebeest</td>
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<td>Bushbuck</td>
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<td>1296</td>
<td>1306</td>
</tr>
<tr>
<td>Giraffe</td>
<td>224</td>
<td>245</td>
<td>201</td>
</tr>
<tr>
<td>Hippopotamus</td>
<td>282</td>
<td>297</td>
<td>299</td>
</tr>
<tr>
<td>Impala</td>
<td>10262</td>
<td>13993</td>
<td>13633</td>
</tr>
<tr>
<td>Klipspringer</td>
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</tr>
<tr>
<td>Kudu</td>
<td>986</td>
<td>1089</td>
<td>1095</td>
</tr>
<tr>
<td>Nyala</td>
<td>432</td>
<td>487</td>
<td>374</td>
</tr>
<tr>
<td>White Rhinoceros</td>
<td>272</td>
<td>260</td>
<td>251</td>
</tr>
<tr>
<td>Steenbuck</td>
<td>46</td>
<td>47</td>
<td>41</td>
</tr>
<tr>
<td>Warthog</td>
<td>307</td>
<td>351</td>
<td>299</td>
</tr>
<tr>
<td>Waterbuck</td>
<td>522</td>
<td>553</td>
<td>481</td>
</tr>
<tr>
<td>Burchelle's Zebra</td>
<td>700</td>
<td>688</td>
<td>595</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>19539</td>
<td>23084</td>
<td>21535</td>
</tr>
</tbody>
</table>
2.7 Sensitive Habitats & Species

There are no verified plant species within the MM-SSW Complex with IUCN Threatened or Endangered status, however, specimens of the species listed below have been collected within the protected area in the past.

Table 6 A list of plant species of conservation concern that are likely to occur in the MM-SSW Complex.

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>IUCN Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyphostemma hardyi</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Eulophia coddii</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Gladiolus pretoriensis</td>
<td>Vulnerable</td>
</tr>
</tbody>
</table>

Several species within the MM-SSW Complex are of conservation concern. These species and IUCN status can be located in the table below.

Table 7 The species occurring in the MM-SSW Complex that are of conservation concern.

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Species</th>
<th>IUCN Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acinonyx jubatus</td>
<td>Cheetah</td>
<td>Mammal</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Ceratotherium simum</td>
<td>White rhinoceros</td>
<td>Mammal</td>
<td>Near-threatened</td>
</tr>
<tr>
<td>Diceros bicornis minor</td>
<td>Black rhinoceros</td>
<td>Mammal</td>
<td>Near-threatened</td>
</tr>
<tr>
<td>Loxodonta africana</td>
<td>African elephant</td>
<td>Mammal</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Panthera leo</td>
<td>African lion</td>
<td>Mammal</td>
<td>Globally Vulnerable</td>
</tr>
<tr>
<td>Smutsia temminckii</td>
<td>Pangolin</td>
<td>Mammal</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Gyps africanus</td>
<td>White-backed vulture</td>
<td>Bird</td>
<td>Endangered</td>
</tr>
<tr>
<td>Necrosyrtes monachus</td>
<td>Hooded vulture</td>
<td>Bird</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Terathopius ecaudatus</td>
<td>Bateleur</td>
<td>Bird</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Aquila rapax</td>
<td>Tawny eagle</td>
<td>Bird</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Opsaridium peringueyi</td>
<td>Southern dwarf minnow</td>
<td>Fish</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Serranochromis meridianus</td>
<td>Lowveld largemouth</td>
<td>Fish</td>
<td>Endangered</td>
</tr>
<tr>
<td>Ceriagrion suave</td>
<td>Damselfly Species</td>
<td>Insect</td>
<td>Endangered</td>
</tr>
<tr>
<td>Crocodylus niloticus</td>
<td>Nile crocodile</td>
<td>Reptile</td>
<td>Near-threatened</td>
</tr>
</tbody>
</table>
2.8 Disturbed & Degraded Areas

The management and rehabilitation of disturbed and degraded areas is an extremely important objective of the Sabi Sand Wildtuin. However, SSW association members and Mala Mala Game Reserve owners, as well as their respective property management teams, are responsible for the management and rehabilitation of disturbed and degraded areas on their respective properties. The members of the Sabi Sand Wildtuin Management are however strongly advised that the recommendations and guidelines described in the MM-SSW Joint Management Plan are followed, implemented and monitored.

2.9 Available Water

A recent assessment of the distribution of water within the SSW was undertaken to understand the impact of artificial and natural water. A total of 255 dams and pans were recorded and verified during the waterhole analysis, of which 94 or 36.8% were natural and 161 or 63.2% were artificial. A total of 133 or 52% of these contained water as at February 2016. As much as 63.4% of artificial dams and pans contained water, whereas only 32.9% of natural pans contained water. These results can however be expected, as at least 112 artificial and natural dams and pans are supplied with water. Interestingly, 29 or 18% of the 161 artificial waterpoints containing water were classified as “full” suggesting daily water supply.

The average nearest neighbour distance between all waterpoints was 656.1 m, between artificial waterpoints was 818.1 m and between natural pans was 1023.1 m. Thus in effect the average nearest neighbour distance between natural waterpoints is reduced by approximately 36% by the presence of artificial water. The impact of the artificial water distribution on the overall water distribution is also clearly evident when comparing the overall water distribution with the natural water distribution. The artificial water is also more clustered than the natural water and the high densities of artificial waterpoints are often in close proximity to many of the camps. The distribution of natural water on the other hand is more random and is to a large extent dependent on rainfall, although the water permeability of various soils and the wallowing actions of the larger herbivores also play a major role and could result in some clustering of natural pans.

The distribution of the distances to water within the SSW based on data from the August 2015 annual aerial census is illustrated in Figure 9.0. As much as 34408 ha or 69.5% of the SSW is within 1 km of a waterhole, 42442 ha or 85.8% is within 2 km of a waterhole and 47314 ha or 95.6% is within 3 km of a waterhole. This excludes the proximity of waterholes to the perennial Sabie and Sand Rivers.
Within the Kruger National Park (KNP), which is closest to a natural system in the lowveld, there are areas that are more than 8 km from water. Although we cannot compare the KNP with the SSW since they have different management objectives, this does give some idea by comparison of how dense the water distribution is and of how the area within the SSW has deviated over time from a natural system.
2.10 Maps

Figure 3  Map illustrating the location of the Mala Mala / SSW complex in relation to the Kruger National Park and other Lowveld protected areas, 2016.
Figure 4   Map illustrating the farms that have been amalgamated to form the Mala Mala-Sabi Sand Wildtuin Complex.
Figure 5  Map illustrating the infrastructure present on the Mala Mala-Sabi Sand Wildtuin Complex.
Figure 6  Map illustrating the potential areas and areas approached to incorporate into the Mala-Mala-Sabi Sand Wildtuin Complex.
Figure 7  Map illustrating the topographical variation of the Mala Mala-Sabi Sand Wildtuin Complex.

Sabi Sand Wildtuin | Interim Elephant Management Plan, 2016
Figure 8  Map illustrating the hydrology of the Mala Mala / Sabi Sand Wildtuin Complex, 2016.
**Figure 9**  Map illustrating the geological composition of the Mala Mala / Sabi Sand Wildtuin Complex, 2016.
Figure 10  Map illustrating the various soil types of the Mala Mala-Sabi Sand Wildtuin Complex.
Figure 11  Map illustrating the distribution of artificial waterholes within the Mala Mala-Sabi Sand Wildtuin Complex.
Figure 12 – Map illustrating the vegetation types of the Mala Mala-Sabi Sand Wildtuin Complex, according to Mucina & Rutherford, 2010.
Figure 13  Map illustrating fine-scale vegetation classification of the Mala Mala-Sabi Sand Wildtuin Complex.
Figure 14  Map illustrating the sensitive areas located within the Mala Mala-Sabi Sand Wildtuin Complex.
Section B
Management Goals & Objectives

3 Habitat

3.1 Veld Condition Monitoring Methods & Time Schedules

The ecological monitoring programme within the MM-SSW complex is aimed at furthering understanding of savanna functioning and providing sound guidelines for land users and policy makers to assist in contributing to the economic development, in harmony with social and environmental needs, of the region. The results indicate how rainfall, soil, herbivory, fire and grass/woody ratios influence the composition and cover of the herbaceous layer, an aspect which is often limiting in these grazer-dominated systems (Peel et al. 2005). This analysis is used to propose broad guidelines for herbivore stocking density in areas of varying ecological potential and introduces the importance of controlling species mixes.

Herbaceous production varies as a function of the season, recent rainfall and defoliation in relation to the abundance value of species. In areas where a low erratic rainfall is experienced, a long run of data may be necessary to show anything other than the dependence of herbaceous production on precipitation. An estimate of herbaceous production as reflected in herbaceous standing crop is also important when making decisions regarding burning and fodder flow.

Belt transects are positioned to cover the major vegetation types throughout the MM-SSW complex. Transects are located within 20m of the roads edge, to negate time wasting when relocating, but are positioned far enough away to avoid any negative or positive effect as a result thereof. A Global Positioning System (GPS) is used to record the location of each transect. The following aspects are measured during the vegetation analysis of the ecological monitoring programme:
3.1.1 The Herbaceous Layer

Each transect is 100 m in length and is clearly marked. The following parameters are measured at each transect:

- The herbaceous species nearest to each meter mark;
- The nearest perennial species to the meter mark;
- The distance to 1 and 2 above (if nearest is not a perennial as an index of basal cover);
- The tuft diameter of the recorded species (as an index of the maturity of the herbaceous species);
- The tuft diameter of 1 and 2 above (if nearest is not a perennial species);
- A vertical projection above each meter mark determined the percentage canopy cover at the site.

Measurement of the nearest annual and perennial species is done for the following reasons:

- The opportunistic life cycle of annuals often results in the annual colonising a bare patch between the transect line and a perennial. By measuring only, the nearest plant, one may get the impression that the perennial has disappeared whereas what has actually happened is that an annual has just grown between it and the transect line. It is therefore apparent that the distance to annuals is less than to perennials. An increase to the nearest plants obviously indicates a decline in basal cover, whereas a decrease in the distance indicates an increase in cover; and
- Because of their persistent nature, perennial grasses have greater diameters than annuals. This has important consequences especially in terms of erosion, with larger tufted plants binding the soil and halting water run-off more efficiently than smaller tufted plants.

3.1.2 The Woody Layer

Each transect is 100 m in length and is clearly marked. The following parameters are measured at each transect:

- All woody species within the belt transect (100m x 2m);
- Number of stems per rootstock;
- Species per height class (0-1m, 1.1-2m, 2.1-5m, >5m);
- Canopy spread cover (vertical projection above the line and the species);
- Elephant impact per site (Dominant species; where possible 10 individuals/height class; 7-point scale of impact; impact classes (branches, uprooted, bark, stems, dead, no impact).
3.1.3 Trends in Herbaceous Layer Parameters

Long-term data indicates that the herbaceous layer in the MM-SSW complex has been maintained in a favourable condition, with regards to the measured parameters. The landscape has generally high proportions of perennial grass species, good cover and a mean standing crop of approximately 2 980 kg ha\(^{-1}\) over the past 15 years.

Recent data collected during the annual ecological surveys throughout the MM-SSW complex is as follows:

- Herbaceous species composition - Figure 15,
- Herbaceous species cover (distance) – Figure 16,
- Herbaceous species cover (tuft) – Figure 17, and
- Herbaceous standing crop – Figure 18.

**Figure 15**  Graph illustrating the proportion of perennial grasses recorded within the Mala Mala / Sabi Sand Wildtuin complex, 1989/90 – 2013/14.
Figure 16  Graph illustrating the perennial grass cover (distance) trends recorded within the Mala Mala / Sabi Sand Wildtuin complex, 1989/90 – 2013/14.

Figure 17  Graph illustrating the perennial grass cover (tuft) trends recorded within the Mala Mala / Sabi Sand Wildtuin complex, 1989/90 – 2013/14.
3.2 Rehabilitation Programme for Degraded Areas

The resource management and use described below are recommendations put forward by the management authority of the MM-SSW Complex, namely the management of the Sabi Sand Wildtuin. However, SSW association members and Mala Mala Game Reserve owners, as well as their respective property management teams, are responsible for the resource management on their respective properties. The members of the Sabi Sand Wildtuin Management are however strongly advised that the recommendations and guidelines described below are followed, implemented and monitored.

3.2.1 Soil Management

The loss of topsoil is chronic and irreversible. Every patch of bare exposed soil surface, or network of erosion gullies, represents lost productivity, in terms of both forage and habitat. The environmental inhospitality of the exposed earth prevents the establishment of the protective plants that are food, cover and shade for many organisms.

The capability of the soil to resist water erosion is dependent on soil particle size, chemistry and organic content, as well as the nature and extent of the vegetation cover. Sandy soils have a relatively large pore space, which gives them a greater capacity for water infiltration than silty or clay soils. With their smaller pore
spaces, silty and clay soils are prone to rapid run-off flow with lower rainfall infiltration. This rate of overland flow is likely to increase as the slope angle increases. Rainfall events in arid areas are often intense and usually exceed the infiltration rate. This results in overland run-off flows which attain much higher velocities than non-arid areas. Erodability of the soil by wind is determined by the speed, turbulence, frequency, duration and direction of the prevailing winds. Soil surface erodibility by wind is also influenced by physical soil attributes like particle size, cohesiveness, moisture content, organic matter, the presence of stones and rocks and the nature and type of vegetation cover.

Soil removal by wind and water is a part of a natural geomorphological process, the inevitable and universal process of landmass erosion. The erosion of the ancient parent rock is slow and results in the formation of the soils that support and maintain the plants which protect it. Under natural conditions a fragile balance exists between the rate of soil formation and the rate at which it is degraded or eroded. In contrast to this natural process, the rate of soil erosion can be enormously speeded up or accelerated through the activities of man. Under these conditions soil is removed much faster than it can be formed, most often resulting in the loss of valuable life giving topsoil. Accelerated soil erosion usually occurs when there is a change in plant cover, which changes the rate of rainfall infiltration and run-off.

The human activities that most commonly lead to wind erosion are those that change or remove the protective vegetation cover and those that destabilize the natural soil surfaces, such as earth moving, land clearing, ploughing, burning, overgrazing, mining, trampling by domestic stock and even off-road vehicle use. The compaction, crusting and sealing of soil surfaces diminish water infiltration capacity and increase surface run-off, which often leads to soil erosion. Compaction, crusting and sealing also impede seedling growth and root penetration and retard oxygen and carbon dioxide interchange with plant roots. The sealing of surfaces can be caused by physical trampling, but is most commonly caused by the clogging of soil pores by fine-grained silt and clay particles dispersed by raindrop impacts.

Overgrazing of vegetation by wildlife is often accompanied by the effects of trampling and compaction. The most common consequence of overgrazing, however, is a dramatic decrease in vegetation cover which leads to accelerated erosion of the soil surface by water and wind (Coetzee, 2010). The MM-SSW complex is located in a semi-arid savanna ecosystem. A semi-arid savanna is dry wooded grassland where the rainfall is usually restricted to 5 or 6 months of the year and which ranges typically from 250 mm to 650 mm per annum. Rainfall in these areas is exhibiting increasing signs of variability. Moisture, or lack thereof, limits the production of grazing and browse for game, and an integrated land management plan should be aimed at conserving soil moisture by minimising rainfall runoff into drainage lines and maximising rainfall penetration into the soil.

The primary soils objective is to minimise the rate of accelerated erosion through the following approach:
3.2.1.1  Erosion Reclamation - Objectives

- To identify and control (if practicable), or at least minimize, accelerated erosion, and
- To identify and attend to erosion which is threatening unique, valuable or sensitive features.

3.2.1.2  Erosion Reclamation - Actions

- Identify and map gully erosion into bottomlands,
- Identify and map extensive sheet eroded areas and erosion from sodic patches,
- Draw up a priority programme for erosion reclamation as part of the integrated habitat rehabilitation programme,
- Stabilize headward gulley erosion into bottomlands, and
- Reduce water run-off and increase infiltration on sodic patches and sheet eroded areas.

3.2.1.3  Roads and Tracks - Objectives

- To identify areas of active erosion resulting from the road and track network and (if practicable) to prevent, or at least minimize, such erosion by the correct alignment, drainage and, if required, closure and reclamation of roads and tracks,
- To maintain all roads and tracks in a state which minimizes their impact on surrounding hydrology, soil erosion, and biologically sensitive areas, and
- To provide an all-weather, low impact road system that allows for the achievement of objectives and for effective reserve management.

3.2.1.4  Roads and Tracks - Actions

- Conduct a detailed and systematic assessment of roads and tracks,
- Map areas of active erosion and recommend appropriate measures to minimize these,
- Prioritize roads and tracks for erosion reclamation measures,
- Reroute roads and tracks which are placed on sodic areas, other erodible soils and on active seeplines.

3.2.1.5  Quarrying & Borrow Pits - Objectives

- Utilize quarry material for the surfacing of key road and tracks with the minimum of disturbance to the environment and to the aesthetics of the MM-SSW complex.

3.2.1.6  Quarrying & Borrow Pits - Actions

- Identify sources of quarry outside of the MM-SSW complex which can be utilised, thus employing contractors to bring in suitable quarry material for key roads and tracks,
- Where applicable, investigate the use of the surplus gravel from the pits dug to dispose refuse,
- If no other alternative can be found, then identify suitable quarry site/s within the MM-SSW complex.
3.3 Fire Management

Fire plays a role as a management tool in rangelands, because it acts as a landscape level as a disturbance agent for creating diversity in time and space. There are three basic approaches to burning: avoiding burning, applying prescribed burning, and leaving fires to natural causes. In veld management, fire is mainly used as a tool for:

- Providing nutritious grazing be removing the moribund plant material that has accumulated from previous seasons,
- Managing undesirable woody or herbaceous invasive plants or weeds that reduce the productivity of the grass layer, and
- Making firebreaks and burning portions of an area to stimulate grazing pressure in underutilized areas.

Other uses of fire are to manipulate plant populations; to maintain and create habitat for animals; to decrease the height of browsable material; to increase biotic and habitat diversity; to kill ectoparasites; to contribute to nutrient cycling; to protect property; and to reduce fire hazards.

The effect of a fire varies with its frequency, intensity, the season of burning, and how many woody plants are killed.

Fire Frequency
To maintain optimum productivity, field experience has shown that natural veld should be burned when a fuel load of not more than 4000 kg/ha is reached. The frequency of fires may vary from annual burns on high-rainfall sour veld, to a burn every three to four years on mixed veld, to even longer or not at all on arid sweet veld.

Fire intensity
The intensity of a fire is influenced by the fuel load, the fuel moisture content, the relative humidity of the air, the ambient temperature and the wind regime. A headwind or downwind is required to remove accumulated organic material. It is therefore recommended that, if possible, headfires be applied to the grass layer when the ambient temperature is below 20 °C, the relative humidity of the air is below 50% and the soil surface is moist. These conditions will help to keep the intensity of the fire low at ground level and thus cause the least damage to the grass layer.
To control undesirable plants or encroaching bush up to a height of 3 m, one needs the following conditions to ensure a high fire intensity: there should be a fuel load of more than 4000 kg/ha, and ambient temperature of 25 °C or higher, a relative humidity of 30% or less, and a wind speed of up to 20 km per hour. These conditions generally occur between 11:00 and 15:00 in late spring before the rainy season starts.

**Burn season**
The timing of a burn should be such that the veld is able to recover as quickly as possible. The physiological condition and phonological state of the grass plants at the time of the burn rather than the burning season determines the degree of the damage done by fire. Research has shown that there is no difference between the effect of a fire in the middle of winter and one immediately after the first spring rains have fallen. During winter the grass plant is dormant, and therefore removing above-ground material at that stage causes no harm.

### 3.3.1 Fire Management - Primary Objectives

- To control the use of fire so that it can fulfil its role as a driving force in the MM-SSW complex, to maintain grass layer vigour and promote diversity, and
- To achieve the above within the constraints of legal provisions regarding the use of fire and the requirement of ensuring the safety of people, infrastructure and property. In this regard the national Veld and Forest Fire Act (1998) must be adhered to.

### 3.3.2 Fire Management - Secondary Objectives

- To maximise heterogeneity by spreading the use of fire across the year and by varying ignition points and extent of fires away from fixed blocks,
- To introduce a degree of laissez faire that will benefit diversity but that may also reduce management input costs and manpower requirements,
- To remove excessive litter and old growth in order to maintain a diverse and vigorous herbaceous sward,
- To retard woody plant growth, and
- To reduce the risk of detrimental wild and/or arson fires.
3.3.3 Fire Management - Actions

- Monitor fuel loads, proportion of moribund grass during a pre-burn survey for late season fires (July to September),
- Implement a burning programme,
- Monitor the effect of control burns during a post-burn survey and insure adequate data recording. The following data is essential: Location of the fire with and accurate GPS map of the burnt area, date and time of the fire, weather conditions including temperature, wind speed and humidity, veld conditions, cause of the fire, nature of the fire and fire danger index,
- Record and map burns annually and integrate information on past burning,
- Clear peripheral and strategic internal fire breaks as a high priority,
- Ensure that staff receive adequate training with particular focus on personal safety and fire behaviour,
- Ensure an emergency fire plan is in place to handle any unplanned fires.

3.4 Water Provision

The living requirements of wild animals include food, cover and water. The sub-division of land and the fencing off of conservation areas in the Lowveld began in the late 1960’s. This broke the natural east-west herbivore migration and, because many of the fenced off areas did not have perennial water, artificial water points had to be constructed. The result was a network of artificial water points in the Lowveld supplying excessive surface water in these areas.

The Sabie River, flowing on the southern border of the reserve is the largest water source in the SSW but the Sand River which flows all year in favourable seasons is the most important in terms of its location and in that it forms a primary water source for living organisms within the MM-SSW complex, as well as providing water for several of the lodges and private camps within the reserve. A number of smaller drainage lines such as the Msutu, Tsogwane and Mobeni have shown encouraging water retention into the late winter season in recent years.

The erection of the Kruger Park boundary fence in the early 1960’s and the sub-division and fencing off of land for commercial cattle ranching, and over the past few decades’ various forms of wildlife utilisation, meant that animals were restricted to areas that were seasonally waterless. With fencing it became necessary to provide water artificially year round in areas where water was only seasonally available in the past. This resulted in an eruption of water dependent animal species such as impala and wildebeest, increased concentrations of animals and grazing, trampling, dunging and urination.
which affects water infiltration, run-off, grass cover, species composition, the tree:grass ratio, and ultimately biodiversity and carrying capacity (depending on the set objectives) particularly on units much reduced in size.

So while the provision of water is essential for most game species, it has been shown that species that require medium to tall grasses, i.e. common reedbuck, roan, sable and tsessebe, decline under such conditions. The ideal primary water objective would be to provide water for animals in places and for periods which approximate as closely as possible the natural past distribution of water without affecting adversely the hydrology and consequent ecology of the reserve and to maintain natural water bodies in such a condition so as to support the naturally occurring species linked to such bodies.

3.4.1 Water Provision for Animal Species - Objective

- To provide water for animals in places and for periods which are to approximate as closely as possible the natural past distribution of water without affecting adversely the hydrology and consequent ecology of the reserve.

3.4.2 Water Provision for Animal Species - Actions

- Reach agreement for a water supply management programme for animals,
- Make an inventory of and map natural perennial and non-perennial water sources, and existing artificial points including the current status of each water point,
- Assess the longer term effect of artificial water provision on habitats in the reserve,
- Take management actions to close down overutilized water points.

3.4.3 Rainfall - Objective

- To monitor the effect of rainfall on the vegetation of the reserve

3.4.4 Rainfall - Actions

- Collect rainfall data at least on a monthly basis,
- Summarize and use for interpretation of savanna system functioning on an annual basis.
3.5 Population Management of Other Wildlife Species

The concept of ‘carrying capacity’ is a vague one with many definitions and it is difficult to determine in heterogeneous environments experiencing variable environmental and resource conditions (Peel et al. 1998). It should therefore not be considered as a static figure but must reflect climatic conditions and influence of management practices followed.

Within the context of the MM-SSW complex, ‘ecological carrying capacity’ is loosely defined as the population size of a species in an area as determined by the capacity of that area to support the individuals in that population and enable them to reproduce (adapted from Caughley 1979 and Grossman 1984). The assessment of carrying capacity looks at ecological carrying capacity. Management decisions as to stocking rate may however be based on economic carrying capacity that looks at higher production levels (which can be attained by stocking at lower than ecological carrying capacity).

Traditionally, carrying capacity has been expressed as the number of hectares required to support an Animal Unit (ha LAU-1). This has several shortcomings including the fact that the unit decreases in magnitude as animal numbers increase (Peel et al. 1999). The term is also not linearly related to the number of animals on an area of land and further the Animal Unit also ignores dietary differences. The use of animal biomass (kg km-2) is preferred from a methodological viewpoint.

Recent work by Peel et al. (2005) was used to determine appropriate stocking rates for the SSW. Principal driving determinants (rainfall; geology; soil; tree density and canopy cover; animal numbers and feeding classes; fire) of vegetation structure and function in the Lowveld savanna in South Africa were grouped to establish their influence on the limiting herbaceous layer. Grass type, abundance and cover were examined (450 sites; c. 4,000 km2). Using ordination, the variation and differences in the herbaceous-response variables viz. perennial composition and cover allowed for the broad environmental grouping of areas of similar ecological potential. We demonstrated that areas of higher ecological potential carried higher densities of large herbivores without detrimentally affecting herbaceous composition and cover.
The MM-SSW complex was shown to have an inherently higher carrying capacity than the areas further to the north. The work done by Peel et al. (2005) shows that appropriate stocking rates, depending on veld condition, for these areas can safely be adjusted upwards to levels between the Coe et al. (1976) upper guideline, a new mean guideline and the agricultural guideline.

The stocking rate within the MM-SSW complex has increased markedly since the 1990’s and is currently above the guideline. These data largely reflect the influx of elephant into the MM-SSW complex following the removal of the western boundary fences. When we remove the rhino, hippo and elephant from the stocking rate calculations (essentially the non-prey species) we see that the prey biomass is similar and much lower.

The ability of elephant and impala to both graze and browse makes them such successful competitors. The very high elephant density requires monitoring. Impala make up a significant proportion of the herbivore biomass but perform an important ‘buffer’ role in the presence of increasing predator densities. This means that due caution should be exercised when deciding on impala removals based on veld condition. The low number of wildebeest highlights the latter statement and with the ‘boom and bust’ nature of warthog fluctuations, the situation in feeding class 2 is critical. The proportional representation of the feeding classes in the various reserves is illustrated in Table 5.

Table 8    Proportional representation of the feeding classes within the Mala Mala / Sabi Sand Wildtuin complex, 2015.

<table>
<thead>
<tr>
<th>Feeding Class</th>
<th>Comments regarding proportions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Slightly low</td>
</tr>
<tr>
<td>2</td>
<td>Critically low</td>
</tr>
<tr>
<td>3</td>
<td>Very high</td>
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<td>4</td>
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Note: Feeding class 1 = bulk grazers; 2 = concentrate grazers; 3 = selective feeders; 4 = browsers.
For the effective management of a game reserve, it is vital that animals are counted on a regular basis. These estimates are critical for calculations relating to herbivore carrying/grazing capacity and stocking rate and the effect of their utilisation on the habitat. No form of wildlife management is possible without reliable information regarding herbivore numbers. Different animals have different effects on the vegetation, and as a result, it is important to determine the proportion of the various feeding classes on SSW. The 2015 game count numbers were used to calculate stocking rates, feeding class ratios (Figure 19 to 22) and to examine herbivore trends (Figures 23 to 24) and projections.

Work by Peel, Kruger and Zacharias (2005) shows that appropriate stocking rates, depending on veld condition, for these areas should be placed between the agricultural guideline of 5 000 kgkm-2 and the Coe et al. (1976) upper guideline (5 424 kgkm-2). This figure needs re-visiting in the light of the fact that under current favourable conditions there seems not to be deleterious effect of high stocking rates on the condition of the veld. On the other hand, if we have a poor season the situation can switch quickly with food shortages and concomitant animal die-offs.

The stocking rate on SSW increased from the early 1990’s from close to the guideline to well above the guideline from around 2000 onwards. When one examines the SSW alone, after stabilising between 2008 and 2010 the stocking rate has started to increase again and after a decline in 2014 increased once again to well above the guideline and among the highest levels since the aerial game counts were started (Figure 23). While it appears that the stocking rate of herbivores in the SSW is high, this is misleading because the major reason for the increase is the continued high numbers of elephant present. With the removal of the fence between the KNP and the SSW in 1993 there has been a dramatic increase in the number of elephant in the area. This expansion of range by the elephant from the KNP is natural but under present conditions there is a concern that there is over utilisation of habitat and potential resource degradation and related impact on the survival of other species within the SSW.

The need for active management must be considered a possibility if the resource is negatively impacted. To illustrate in some way, the contribution of elephant to the herbivore population, a stocking rate scenario is presented for “prey” species only (rhino, hippo and elephant are excluded as they are rarely preyed upon in the SSW) (Figure 23 second series). An examination of “prey” alone indicates a relatively stable prey biomass between 2007 and 2011 with a continued increase in 2012 and 2013 and 2015 (linked to an increase in buffalo numbers). The previous upward trend in the prey population since 2006 was halted with a decline in 2014 due to lower numbers of buffalo (which move in and out of the area) and general concerning declines in waterbuck, zebra, wildebeest, giraffe
and nyala. There appears to be much movement between the SSW, Mala Mala, Manyeleti and KNP in response to stressed grazing and reduced water sources.

The projections for 2016 result in a stocking rate that continues to be well above the guideline. The need for active management remains crucial and consideration should be given to intensively managing the numbers of high impact animals such as buffalo, impala and elephant. There are currently no proposed elephant removals, but a point has been reached where consideration must be given to managing this species within the greater areas of which the SSW is a part. The positive elephant trend does however mean that consideration must also be given to the relocation of animals during 2016. Further consideration also needs to be taken with regards to elephant’ relocations when one considers the current drought conditions, water and grazing availability in the SSW and the continuous threat of poaching.

With regards to feeding classes, bulk grazers (Feeding Class 1) proportions are still at levels below the guideline. Selective grazers (Feeding Class 2) proportions remain at critically low levels, while browsers (Feeding Class 4) proportions stabilised but remain at very low levels. Mixed feeders (Feeding Class 3) proportions declined marginally, but remain at levels that are far above the guideline figure. Using the Feeding Class method therefore, the major areas of concern are Classes 2 and 4 (well below) and Class 3 (well above) the guideline.

The overall and prey biomass is high and largely reflects the favourable range conditions in recent years. Predation is having an impact on stocking rate levels, but as previously stated the current high stocking rates means we have reached a point where management will have to discuss scenarios around animal management with limited grazing and browsing reserves. Buffalo and impala in particular require consideration for removal. These would be animals not removed by predation but considered necessary for removal for ecological reasons.
Figure 19  Graph illustrating the population growth trends of feeding class 1 species within the Mala Mala / Sabi Sand Wildtuin complex, 1994 – 2015.

Figure 20  Graph illustrating the population growth trends of feeding class 2 species within the Mala Mala / Sabi Sand Wildtuin complex, 1994 – 2015.
Figure 21  Graph illustrating the population growth trends of feeding class 3 species within the Mala Mala / Sabi Sand Wildtuin complex, 1994 – 2015.

Figure 22  Graph illustrating the population growth trends of feeding class 4 species within the Mala Mala / Sabi Sand Wildtuin complex, 1994 – 2015.
Figure 23  Graph illustrating the herbivore biomass within the Mala Mala / Sabi Sand Wildtuin complex, 1990 – 2015.

Figure 24  Graph illustrating the feeding class mixes within the Mala Mala / Sabi Sand Wildtuin complex, 1990 – 2015.
Game count information was used to assess trends of individual species and of overall stocking rates for SSW. The new and existing information was combined into an objective view on habitat suitability for individual species and potential carrying capacity within a multi-herbivore system. The estimated carrying capacity figures were put into perspective by comparing them with the broad limits obtained using known predictive relationships with rainfall (Coe et al. 1976) and more recent research findings of Peel, Kruger & Zacharias (2005).

**Figure 25**  Variance in population numbers of various herbivores in the SSW, 2005 – 2015.
3.6 Preferred Management Density

The severity of elephant impact, ranked on an eight-point scale indicates that new impact on trees sampled was once again relatively low, with 90% of trees sampled showing no signs of new impact respectively (mean 89% range 74% - 97%) (Figure 5). The spike in 2012/13 was maintained in the 18% impact class (2% impact) and with slight increases in the 38% and 63% classes (2.3 and 2.9% respectively) which while still relatively low, must be monitored. There was 0.3% tree mortality measured (mean 1.2%). The issue of area selection is not reflected in these broad scale studies.

In terms of percentage damage per height class, Figure 6 indicates continued and increased selection for the 2-5m and >5m height classes within the reserve. The percentages of trees impacted in height class 3 (2-5m) was 20% (mean 20% range 10% - 32%) and class 4 (>5m) was 24% (mean 22% range 17% - 32%). The impact on height classes 1 (0-1m) and 2 (1.1-2m) was relatively low. As previously stated, the tree layer dominated by a single height class is problematic (homogenous).

Figure 28 shows the percentage of trees sampled per species, which were impacted upon. The degree of impact was relatively stable as can be seen by the following: *Sclerocarya birrea* 17% (mean 17% range 4% - 37%), *Combretum zeyheri/collinum* 10% (mean 17% and range 10% - 35%), *C. apiculatum* 18% (mean 14% range 4% - 29%), *C. hereroense* 16% (mean 10% range 3% - 16%), *C. imberbe* - (mean 11% range 6% - 18%), *Acacia nigrescens* 18% (mean 14% range 9% - 18%), *A. burkei* - (mean 9% range 5% - 14%), *Euclea divinorum* 9% (mean 10% range 4% - 22%), *Albizia harveyi* 10% (mean 18% range 2% - 41%), *Dalbergia melanoxylon* 11% (mean 9% range 2% - 18%), *Ziziphus mucronata* 14% (mean 14% range 2% - 26%) and *Dichrostachys cinerea* 8% (mean 11% range 2% - 33%).

The relative percentage of all tree species sampled that have been impacted upon is presented in Figure 29. *C. apiculatum* 13% (mean 19% range 10% - 29%), *Acacia nigrescens* 18% (mean 14% range 6% - 29%), *Terminalia sericea* 13% (mean 10% range 4% - 28%), *Sclerocarya birrea* 8% (mean 5% range 1% - 12%), *Combretum hereroense* 8% (mean 5% range 1% - 13%), *Euclea divinorum* 4% (mean 3% range 1% - 6%), *Dalbergia melanoxylon* 3% (mean 3% range 1% - 6%), *A. gerrardii* - (mean 6% range 1% - 9%) and *Grewia* spp. 2% (mean 5% range 1% - 12%). The relative impact on mixed Acacia made up some 6% of total impact.
**Figure 26**  Severity of elephant impact within the Sabi Sand Wildtuin. Orange bar represents 2014 – 2015.

**Figure 27**  Elephant impact by height class. Orange bar represents 2014 – 2015.
Figure 28  Percentage elephant impact on selected tree species within the Sabi Sand Wildtuin.

Figure 29  Relative percentage of major species impacted upon within the Sabi Sand Wildtuin.
The favourable run of rainfall years appears to have resulted in the elephant population focusing on the grass layer with less impact on the tree layer. There will however in all likelihood be an increase in the amount of elephant impact following the dry 2014/15 season.

Grass standing crop is a function of herbaceous production and represents the portion of production that remains after the various forms of utilisation. The grass standing crop at the end of the 2014/15 summer season can be said to have been moderate-high. The relationship between grass production and standing crop is accentuated with recent favourable rainfall seasons resulting in an increase in grass standing crop due to a favourable perennial composition and cover, and improved soil moisture conditions that promote grass growth. The dry 2014/15 season has been buffered by these previous favourable seasons. The direct relationship between grass production and rainfall is accentuated in dry and particularly drought years where, despite a favourable perennial composition and cover, there just is not enough soil moisture to promote substantial growth.

Grass standing crop measurements have important implications for grazing and fire management. The impact of mega-herbivores such as elephant and buffalo and smaller abundant herbivores such as impala must be considered here as declines in the grass layer indicate that while rainfall drives the system, grazing pressure can ultimately compromise the composition and vigour of the individual grass plants.

Elephant are unlikely to be constrained by the food resource in this area, but two issues in particular need to be kept in mind:

- Competition with other herbivores keeping in mind the objective of providing a high quality game viewing experience, and
- Male territorial behaviour.

The density of elephant using aerial census data from 2005 to 2015 indicates that 95% of the elephants counted over a 10-year period only utilized approximately 45% of the total area of the SSW. The highest densities, as expected, are along the perennial Sabie and Sand Rivers, as well as the various available water sources. This distribution illustrates the reliance of elephants on water in the dry period. Using the available data and distribution records of elephant within the SSW, the Management of the SSW intends to manage the elephant population at a density of approximately 1.50 elephant/km², a total of approximately 1000 individuals.
Figure 30  Map indicating the distribution of elephant within the Sabi Sand Wildtuin, 2015.
Figure 31   Map indicating the distribution of elephant within the Sabi Sand Wildtuin, in relation to the distribution of artificial waterholes, 2015.
Table 9  Table indicating the elephant population growth within the Sabi Sand Wildtuin, 2005 - 2015.

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Figure 32  Graph indicating the population growth of elephant within the Sabi Sand Wildtuin, 1991 - 2015.
4 Information Pertaining to Elephants

4.1 Control of Elephant Population Size

The management of elephant within the SSW will be done in conjunction with management actions in the KNP, Manyeleti Game Reserve, Mala Mala Game Reserve and the Private Reserves making up the Associated Private Nature Reserve (APNR). The following strategies are available for elephant management, of which a combination might be implemented.

4.1.1 Leave the System – “Do Nothing”

The option to do nothing and monitor the situation can be a decision in itself and can allow nature to continue in a flux, the precautionary measures that must be taken with this decision are, very close monitoring of both the system and all other species to ensure that the heterogeneity and biodiversity are not compromised. The recolonization of elephants from Olifant’s Section to Skukuza Section, a distance of approximately 120km, took roughly 33 years, from 1909 to 1942. The SSW is now an integral part of the Greater Kruger National Park. Elephant populations have increased drastically since 1992, but these populations might disperse naturally with time. If we would like numbers to self-regulate we will however need to create environment that puts pressure on the elephants. As a result, if we decide on the “Do Nothing” option, we should manage the system to naturally place pressure on the elephant population.

4.1.2 Waterhole Management

A total of 255 dams and pans have been recorded and verified during the 2016 waterhole analysis. 94 or 36.8% were natural and 161 or 63.2% were artificial. A total of 133 or 52% of these contained water as at February 2016. As much as 63.4% of artificial dams and pans contained water, whereas only 32.9% of natural pans contained water. The spatio-temporal responses of elephants to distribution of resources and disturbances affect the intensity with which elephants use landscapes, which in turn affect their associated impacts on other conservation values (Smit and Ferreira, 2010). Therefore, plant species that are sensitive to elephant damage have a greater chance of survival in an area of less density. Removal of water from that area will decrease the density and therefore decrease the impact on the plant (Brits et al., 2002).

Furthermore, musth bulls tend to associate with breeding herds towards the end of the wet season. With this said, decreasing the amounts of water points will result in diminishing water supplies, this
in turn will result in an increase in musth bulls associating with breeding herds in close proximity to riparian zones, as herds often occupy the riparian areas. This will result in younger and non-musth bulls avoiding the conflict and moving to other areas, thus relieving the pressure on the vegetation. As a result, the strategic closing of water points in areas with sensitive vegetation, high elephant densities, or a low number of large trees will help alleviate pressure on the vegetation.

4.1.3 Bees and Bio-Boundaries

The restriction of elephant movement usually involves the erection of fences and other barriers, with theses fences or barriers often prove inadequate or implausible to restrict the animal movements. Consequently, the use of “Biologically relevant boundaries, or Bio-boundaries”, has been investigated as an alternative method of deterring wild animals from potential conflict causing areas (Jackson et al., 2012). These artificial boundaries are created using biologically relevant signals that deter animals from moving into an area or crossing the “boundary”. There are a number of forms of bio-boundaries that can be implemented. Using natural scent marking deterrents such as simulating intraspecific competition by creating artificial territories, or through mimicking interspecific competition, such as using beehives. These deterrents rely on negative experiences that swarms of bees have submitted elephants in the past, to prevent elephants from utilizing a particular area (King et al., 2011). These methods are however purely experimental and have not been tried in the field at length. Nevertheless, they do offer a somewhat more natural alternative to disturbance, with little visual pollution.

4.1.4 Translocation

Translocation has successfully been carried out in the SSW in previous years and although numbers of elephants removed were not high it may have had a role in disturbing the elephants in the area. There are a number of points to consider in translocation. Firstly, it is important not to remove all the older bulls as the need for dominance in the hierarchy is most important. Family groups must all be removed together, and remain together. Translocation is a costly and cumbersome task and there is very little market for elephant, as there are few conservation areas in Southern Africa that can accommodate more elephant. The opportunity to supply areas outside of southern Africa still exists but at a large expense. This option should still be explored as the increase in poaching for ivory is a concerning factor and translocation could be a possibility to save a dwindling population should poaching continue to increase at this rate.
4.1.5 Habitat Restriction

The restriction of elephants from a sensitive area through the use of fencing is an option that has been used successfully in other reserves such as Phinda Private Game Reserve and Addo Elephant National Park. This process is costly, with initial erection and on-going maintenance costs, but has the added advantage of creating a research site to evaluate the effects of excluding elephants over time. Using a 2 strand electrical fence is the most practical method, as it allows other herbivores, with the exception of giraffe, access to the area. There are however considerations that must be taken into account when considering this option. Firstly, fencing can obstruct the movement patterns and migratory routes of large mammals resulting in the grouping of animals against the fenceline (Whyte and Joubert, 1988). This process can accentuate negative effects on vegetation and potentially homogenise impacts across the fenced-in landscape. Secondly, the erection of a fence will restrict utilization within the fenced area, but it will not decrease the numbers of elephants in the surrounding area, nor regulate population numbers. Another technique of fencing, on a more intensive scale, is to attempt to reduce debarking of tall trees, by placing chicken mesh around trees. This method has been successfully used to protect nesting trees of vultures in the Timbavati Private Nature Reserve.

4.1.6 Contraception

The method of contraception has been tested and provides an option to control birth rates with hormones and their derivates, or with immuno-contraceptives (Pimm and van Aarde, 2001). However, the ethical debate regarding contraception is an issue that cannot be over looked. To date, the trials on elephants have not demonstrated any aberrant or unusual behaviour within the medium-term and during sustained use of PZP on the experimental herds. There is also no evidence to suggest that the PZP vaccine has any adverse effects on the behaviour of matriarchal groups or bulls with important reproductive behaviours such as mate selection and bull dominance.

The efficiency of PZP and the delivery method is more suited to smaller confined populations. There is however testing underway of a ‘one-inoculation’ vaccine which should be available shortly. This mould make it possible to do indiscriminate contraception in an open population. This method may prove costly due to the delivery method but the increase in calving intervals will decrease the growth rate of the population.
4.1.7 Culling

Culling is stipulated in the norms and standards and a final resort for population control and it is important that all other options are explored before this is undertaken. Culling disrupts a population and as a result can cause immigration into the areas (van Aarde, 2007). The low densities in the culled areas, causes an influx of other elephants and therefore is not a permanent solution. Culling in 1995 in Hwange National Park saw an increase in elephant in 6 years of nearly double (Van Aarde, 2007). Selective culling targeting bulls or animals of certain age classes also may distort age structures and enhance, rather than suppress growth rates (Gordon et al., 2004).

The advantages of culling are the financial implications with both the option of hunting as well as mass culling and utilization of the products. The opportunity to create local community enterprise from culling is a factor to consider, however it should not cloud the ecological judgement.

4.1.8 Precautions

All management actions should continuously be reviewed to take into account factors such as management decisions made by neighbouring reserves, wet and dry rainfall cycles, including drought, and finally climatic change and changing of seasonal patterns. The population of elephant is currently at its highest due to the free movement of elephant to and from KNP. Activities undertaken in neighbouring reserves also needs to be monitored, as these applied pressures results in changes in behaviour across the landscape. Artificial water point closures could further increase the elephant density in the SSW, if it has not done so already. This pressure will be exasperated in dry periods and will have a detrimental effect during drought periods, when pumped water points are the only source of water.

4.2 Measures to Prevent Poaching

The objective for the protected area aims to provide a safe and secure environment for people, fauna, flora and property within the reserve. This objective is achieved by determining the risks and threats and the implementation of a comprehensive security operation to address identified risks and threats.

Security management, and more specifically anti-poaching, is essential in an environment that holds species such as elephant, lion and rhinoceros. South Africa and the rest of Africa have seen an exponential increase in elephant and rhinoceros poaching. Farms and reserves with these species have been forced to shift all available resources and funds into protecting these animals. The SSW...
is no different with a significant proportion of its budget being spent on security operations, in an attempt to create a safe haven for both species. Our mission is to ensure that poaching is almost eradicated from the SSW and to set an example for other farms and reserves.

There is presently a low level of snaring and the frequency of housebreaking and burglaries has also decreased. Security threats must be assessed on an ongoing basis to ensure an adequate response to prevailing threats. Such assessments and planning will determine what the combination of security staff and technology should be used to achieve best results.

Rhino losses to poaching within the protected area reduced by 78% from 2013 to 2015, whilst we are yet to face any form of elephant poaching. Although it is not desirable to lose any animals to poaching, this number has been well contained in comparison to losses in other areas.

4.2.1 Security Staff Strength and Deployment

The SSW security operation currently consists of about 120 personnel (SSW, NRS, K9 Conservation and Noctuam). This includes posts from field teams, specialist technical roles and sufficient management capacity to effectively direct and control the operation. The SSW compliment will be increased with more posts by March 2016.

The security department receives support from the infrastructure (maintenance, workshop) and business services (finance, admin and HR) departments to ensure effective operation of the division.

4.2.2 Security Staff Capacity, Training and Equipment

The capacity of all staff involved in security is assessed. Any deficiencies identified should be remedied as soon as possible. With respect to the current staff it is recommended that:

- The minimum level of training for field rangers must be equivalent to NQF (National Qualifications Framework) level 2. This accommodates a person with no formal education but with appropriate experience and skills. This level of training is provided in courses presented by the Game Rangers Association of Africa and South African Wildlife College,
- All levels of leadership staff must receive appropriate training. It is also imperative that re-training exercises are run several times a year. These should vary from helicopter training, tracking and follow-up exercises to participating in road blocks with the South African Police Services,
- All patrols must be able to make radio communication with their superiors,
- All staff are taught how to react to potentially dangerous situations with potentially dangerous game, and
- All security staff carrying firearms must be in possession of a certificate of competence for the type of firearm, and must adhere to all regulations of the Firearms Control Act.

4.2.3 Protection Monitoring

The effectiveness of any patrolling system can only be evaluated if the degree of measurable effort is compared against measurable results. There needs to be a detailed briefing before any patrol, OP (Observation Post) or roadblock is conducted. There should be a detailed debrief on its completion. All incidents are recorded and communicated to SSW central Operations room, who then manage the incidents by making use of the correct channels. All data that is collected is analysed and used for future planning.

4.2.4 Intelligence Gathering

Combating poaching involves pre-emptive action as much as collection of information and reaction to incidents. The establishment of an information and intelligence system beyond the boundaries of the SSW is important and this needs to be integrated with the Kruger National Park, neighbouring reserves and the South African Police Services (SAPS).

The SSW has partnered with the Game Reserves United (GRU) programme, as another source of information gathering. The SSW has also joined forces with the Kruger National Park and is part of the Kruger National Park Joint Operations Centre (KNP JOC). Regular meetings are held with all stakeholders, including the SAPS, GRU, Nature Conservation Authorities, the KNP and other private stakeholders.

4.3 Provision of Adequate Insurance

The Elephant population within the Mala Mala / Sabi Sand Wildtuin Complex are not insured as they form part of the Greater Kruger National Park system. The Mala Mala / Sabi Sand Wildtuin Complex does however have liability insurance against claims related to elephant/human conflict.
4.4 Contingency Plans – Problem Elephants

4.4.1 Damage Animal Control Procedures

Elephants causing damage falls into two categories – those leaving the protected area and posing potential threat to human life or causing damage to property including crops, and those posing threats to staff and tourists when entering lodges, private camps or staff villages. Elephants inside the SSW may also pose threats to people taking part in tourist activities such as game drives and guided walks.

4.4.2 Damage Causing Elephants Inside the SSW

Elephants entering staff villages, lodges and private camps will be chased out using several means and is the responsibility of the property owner, lodge / camp manager and SSW Management. Incidences should be reported to SSW Management who will then decide on the most appropriate means of action. Repeat offenders, defined as an identifiable elephant that regularly enter lodges, private camps and staff villages during the day and pose a threat to human life will be euthanized following approval by Mpumalanga Tourism and Parks Agency (MTPA). An elephant that has posed a threat to human life (e.g. turning over a vehicle) or caused death of a human will also be euthanized, if the culprit can be located. In this case, approval from MTPA is required. Elephants if wounded or killed in self-defence when human life is endangered in the daily operations of field staff within the SSW, will be reported through the formal reporting structures of the SSW.

4.4.3 Damage Causing Elephants Outside the SSW

Elephants leaving SSW, particularly into areas owned by local traditional communities, falls under the jurisdiction of the Local Provincial Authority, MTPA. All complaints will be investigated by the provincial authority involved with wildlife management. An Official will be dispatched to the scene, whom will evaluate the scene based on the following criteria:

- Other possible stake holders (landowners, relevant management authorities of protected areas, relevant provincial departments or agencies),
- Number of elephants involved,
- Injury or loss of life of people and livestock and damage to crops or property,
- Potential danger to human lives, livestock or crops,
- Human population, infrastructure and cultivated land status of the area,
- Time of day,
- The landscape and topography of the area,
The distance to the protected area from which the elephant came,
The general weather conditions,
Specific individual involved, e.g. an exceptionally large tusker.

All the above factors will determine the final decision in terms of the action to be taken. In the event of the relevant Provincial Issuing Authority not being able, for whatever reason, to respond to a specific complaint, SSW at its discretion will act to resolve the issue after consulting with the relevant Provincial Issuing Authority. To this end a standing permit may be issued to selected officials of the SSW with the required skill and experience.

In dealing with the situation, the above-mentioned officials must consider the following options, in the sequence listed below:

a) Chase offending animals back to the protected area where they allegedly escaped from and repair of the fence to prevent animals from escaping;
b) Capture and translocation if feasible;
c) If the above two options are not feasible, euthanasia will be the last resort.

Whatever the decision taken on the ground, it must be sanctioned by MTPA. As soon as practical, the official involved in the action must submit a report containing relevant information to the applicable parties, i.e. Kruger National Park, MTPA and SSW Management, of the outcome of the operation. Before animals are chased back into the protected area, the persons responsible for the management of these areas must be notified of the intention to do so, as well as the date, time and place where this will take place. If required, due to the very real threat of foot and mouth disease and bovine TB and the high probability of an outbreak and the subsequent serious consequences thereof, the SSW will make its helicopter available to deal with the case. In the event of the SSW helicopter not being available, one of three local helicopter charters may be contracted to assist with the incident, cost against the Sabi Sand Wildtuin’s account.

4.4.4 Jurisdiction Over Escaped Wounded Elephants

In the event of a damage causing elephant being wounded and it moves out of the area of jurisdiction of either the Management or Issuing Authority, the authority responsible for the initial action will report such incident to the relevant authority. Disposal of the carcass will be at the discretion of the relevant authority responsible for the area of jurisdiction.
4.4.5 Compensation

In terms of the National Environmental Management: Biodiversity Act, 2004 (Act No 10 of 2004) Draft National Norms and Standards for the management of Damage-Causing Animals in South Africa, paragraph 19 state that each conservation agency may develop a compensation strategy for the payment of compensation to a person who has experienced damage caused by a damage causing-animal. Such a strategy could consider, but not limited to, the following criteria to determine under which circumstances compensation could be paid:

a) Financial cost to implement to compensation strategy;
b) Type of compensation (monetary, meat, skins);
c) Possible reduction in the occurrence of damage as a result of compensation;
d) Negligence;
e) Proposed management methods already implemented;
f) Consultation with the relevant effected parties;
g) Insurance of the person who experienced the damage.

In case of the SSW, compensation is primarily through making available elephant carcasses to the owner of the land on which an individual was culled.

4.4.6 Disposal of Carcasses

The tusks will be removed. If the elephant was culled within the boundaries of a provincial or privately owned protected area, the tusks will remain the property of the Provincial Issuing Authority. If the elephant was culled outside of a protected area, the tusks will remain the property of the relevant province in which the elephant was culled. The meat will remain the property of the owner of the land on which the elephant was culled. If the elephant was culled in a tribal area, the meat will be utilized by the local community.
4.4.7 Responsible Persons – Problem Elephants

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<td>Mr. Louw Steyn</td>
<td>MTPA</td>
<td>Control Nature Conservator</td>
<td>083 626 6892</td>
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<tr>
<td>Mr. Jan Muller</td>
<td>MTPA</td>
<td>Senior Manager: WPS</td>
<td>083 626 6313</td>
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<tr>
<td>Dr. Ferreira du Plessis</td>
<td>MTPA</td>
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<td>082 901 3172</td>
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<tr>
<td>Mr. David Powrie</td>
<td>SSW</td>
<td>Warden</td>
<td>079 946 7433</td>
</tr>
<tr>
<td>Mr. Edwin Pierce</td>
<td>SSW</td>
<td>Ecologist &amp; Operations Manager</td>
<td>078 804 0347</td>
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<tr>
<td>Dr. Silke Pfitzer</td>
<td>Wildlife Vets</td>
<td>Practice Veterinarian</td>
<td>071 361 7676</td>
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<tr>
<td>Mr. Bjorn Nel</td>
<td>Wildlife Vets</td>
<td>Game Capture &amp; Manager</td>
<td>082 779 1470</td>
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<tr>
<td>Dr. Bjorn Reininghaus</td>
<td>State Veterinarian</td>
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4.5 Threat Analysis & Security Plan

The objective for the protected area aims to provide a safe and secure environment for people, fauna, flora and property within the reserve. This objective is achieved by determining the risks and threats and the implementation of a comprehensive security operation to address identified risks and threats.

Security management, and more specifically anti-poaching, is essential in an environment that holds species such as elephant, lion and rhinoceros. South Africa and the rest of Africa have seen an exponential increase in rhino and elephant poaching. Farms and reserves with these species have been forced to shift all available resources and funds into protecting these animals. The SSW is no different with a significant proportion of its budget being spent on security operations. Our mission is to ensure that poaching is almost eradicated from the SSW and to set an example for other farms and reserves.

There is presently a low level of snaring and the frequency of housebreaking and burglaries has also decreased. Security threats must be assessed on an ongoing basis to ensure an adequate response to prevailing threats. Such assessments and planning will determine what the combination of security staff and technology should be used to achieve best results.
Rhino losses to poaching within the protected area reduced by 78% from 2013 to 2015. Although it is not desirable to lose any animals to poaching, this number has been well contained in comparison to losses in other areas. This small success can be attributed to several factors which the SSW has implemented to stop the rhinoceros poaching surge. These have also allowed for the protection of elephants within the reserve, namely:

- Increased security at all SSW access gates, to search people and vehicles,
- The operational times for all SSW gates has also been decreased in an attempt to reduce late night traffic. Gates are now only open to general traffic from 06h00 to 22h00 as opposed to the previous hours of 05h00 to 23h00,
- Along with these changes in gate times a SSW curfew has also been implemented. This further limits late night traffic and allows anti-poaching units to focus on possible threats,
- No unauthorised traffic permitted on the reserve – all entries have to be authorised in advance by lodge management or landowners. Staff members without staff cards are also not permitted on the reserve. A biometrics access control system for all staff working on the reserve has been implemented.
- Implementation of the SSW Deception policy in which staff members working within its boundaries are required to undergo polygraph tests relating to poaching involvement in accordance with a carefully regulated policy to ensure fairness.
- SSW properties, including the SSW Management, have fitted tracking devices to vehicles. This has allowed monitoring of vehicle movements by reserve and property managers alike.
- The boundary fence, has been upgraded from a game fence specification to a security fence specification. The upgraded fence is now an effective security barrier with advanced warning capabilities. Further upgrades are in process.
- The SSW anti-poaching team is deployed to monitor fence lines, increasing presence and monitoring signs of incursions. A process undertaken 24 hours a day.
- Ntomeni Ranger Services were employed by SSW in December 2013, to conduct extended clandestine patrols inside the reserve to further strengthen anti-poaching responses.
- A new radio system was installed which utilizes 4 repeaters. This has meant that communications have improved drastically, allowing us to use handheld radios on 96% of the reserve,
- An anti-poaching helicopter has been deployed on the SSW since October 2014 to support security.
- Security is co-ordinated through a 24 hour, 365 days per year control room, which acts as the command and control centre for security operations on the SSW.
These changes have made it extremely difficult for poachers to enter the reserve to undertake their operations, and through a process of adaptive management we intend to continually develop security effectiveness.

4.5.1 Access Control

Access control is currently practiced at the following manned gates:

- Shaws Gate;
- Newington Gate;
- Gowrie Gate;
- Dumphins Pedestrian Gate and
- Toulon Gate.

Access through designated access points and through unauthorised breaches of the perimeter are strictly monitored and controlled. A detailed set of Standard Operating Procedures (SOP) regulates access to the reserve and each entry is assessed for compliance. This SOP is regularly reviewed and updated when necessary to provide for emerging requirements.

These management mechanisms effectively control access to the protected area. This ensures permitted access is legitimate and that attempts of unauthorised access are rapidly identified and responded to.

4.5.2 Security Staff Strength and Deployment

The SSW security operation currently consists of about 120 personnel (SSW, NRS, K9 Conservation and Noctuam). This includes posts from field teams, specialist technical roles and sufficient management capacity to effectively direct and control the operation. The SSW compliment will be increased with more posts by March 2016.

The security department receives support from the infrastructure (maintenance, workshop) and business services (finance, admin and HR) departments to ensure effective operation of the division.
4.5.3 Security Staff Capacity, Training and Equipment

The capacity of all staff involved in security is assessed. Any deficiencies identified should be remedied as soon as possible. With respect to the current staff it is recommended that:

- The minimum level of training for field rangers must be equivalent to NQF (National Qualifications Framework) level 2. This accommodates a person with no formal education but with appropriate experience and skills. This level of training is provided in courses presented by the Game Rangers Association of Africa and South African Wild Life College;
- All levels of leadership staff must receive appropriate training. It is also imperative that re-training exercises are run several times a year. These should vary from helicopter training, tracking and follow-up exercises to participating in road blocks with the South African Police Services;
- All patrols must be able to make radio communication with their superiors;
- All staff are taught how to react to potentially dangerous situations with potentially dangerous game;
- All security staff carrying firearms must be in possession of a certificate of competence for the type of firearm, and must adhere to all regulations of the Firearms Control Act.

4.5.4 Protection Monitoring

The effectiveness of any patrolling system can only be evaluated if the degree of measurable effort is compared against measurable results. There needs to be a detailed briefing before any patrol, OP (Observation Post) or roadblock is conducted. There should be a detailed debrief on its completion. All incidents are recorded and communicated to SSW central Operations room, who then manage the incidents by making use of the correct channels. All data that is collected is analysed and used for future planning.

4.5.5 Intelligence Gathering

Combating poaching involves pre-emptive action as much as collection of information and reaction to incidents. The establishment of an information and intelligence system beyond the boundaries of the SSW is important and this needs to be integrated with the Kruger National Park, neighbouring reserves and the South African Police Services (SAPS).
The SSW has partnered with the Game Reserves United (GRU) programme, as another source of information gathering. The SSW has also joined forces with the Kruger National Park and is part of the Kruger National Park Joint Operations Centre (KNP JOC). Regular meetings are held with all stakeholders, including the SAPS, GRU, Nature Conservation Authorities, the KNP and other private stakeholders.

4.5.6 Standard Operating Procedures

Standard Operating Procedures have been compiled to handle all major conflict and danger situations, such as armed contact, wounded personnel, etc. These SOP’s are updated every year.

4.6 Future Monitoring

4.6.1 Thresholds of Potential Concern (TPC’s)

The Kruger National Park provides some valuable pointers to Thresholds of potential concern (after Whyte, Biggs, Gaylard and Braack (1999). These include:

- A management policy where the animal populations on SSW are managed according to measured impacts on ecological parameters rather than on absolute animal numbers (SSW currently in a strong g position in this regard);
- Continuing with management policy until there is clear evidence that the prevailing densities are having a negative impact on one or more important defined ecological parameter;
- The above can be referred to as a "Threshold of Potential Concern" which is basically those upper and lower levels along a continuum of change in a selected environmental indicator which, when reached, prompts an assessment of the causes which led to such an extent of change, and results in either:
  - Management action to moderate such cause(s); or
  - Re-calibration of the threshold to a more realistic or meaningful level.

TPC's should initially be established at somewhat arbitrary levels on "best-available-knowledge-and-experience". It is absolutely necessary when deciding to use such TPC's that it must be accompanied by monitoring at appropriate intervals, and that there must be considerable understanding of the factors causing change in the parameter being monitored. This is currently being done in the SSW. TPC's have the advantage that management has definite proactive objectives or parameters within which to manage a system, in contrast to previous practices where reactively managed events or processes to minimize or avoid crises (Peel & Stalmans, 2010).
4.6.2 Monitoring Elephants in the SSW Will Include:

The monitoring should be twofold, aimed at the animal and at the plant component respectively.

4.6.2.1 The Animal

- Assessing ‘carrying capacity’ - stocking rates and species mix ratios are determined for SSW from game count data in conjunction with the ongoing vegetation-monitoring programme. Pro-active management of the elephant population should then be undertaken in order to minimise the loss of rare and expensive animals through density-dependent competition,
- Elephant movements (seasonal distribution) and feeding behaviour is to be monitored so that management action can be taken timeously in the event of excessive impact on the vegetation,
- Faecal analysis - Protein is the most common nutrient that limits animal performance and survival. Faecal protein, measured as faecal Nitrogen (N), gives an idea of what the animal is able to select. The measurement is correlated with forage digestibility, dietary protein, phosphorous concentration and weight change. Phosphorous (P) is commonly limiting during dry periods in particular. P deficiencies generally lead to reduced reproduction rates. The higher the palatability of the plants the higher the protein and phosphorous concentrations and digestibility. Environmental conditions affect N and P concentrations and rainfall in particular is correlated to their availability. We would therefore determine whether:
  - Minimum guideline levels for protein and phosphorous are being met at critical times of the year,
  - Guideline limits are not being met more than twice annually,
  - There is a general downward trend in consecutive years,
  - Observe trends in conjunction with the other ecological monitoring programmes and to implement management action if necessary,
4.6.2.2 The Vegetation

The types and degree of impact need to be stipulated and TPC’s may include the following defining parameter limits (Peel & Stalmans, 2010):

- Grass/tree/bare ground ratios - set minimum limits for critical vegetation parameters e.g. never lower than X% of its highest ever value and never higher than Y% its lowest ever value for the area – this would need to be set up for the SSW,
- Percentage perennial grasses – look at very broad scale – This is done on each of the ARC vegetation monitoring sites in the SSW,
- Percentage bare ground should not exceed X% or be less than Y% in any area (maybe differentiate between granite and clay) - This is done on each of the ARC monitoring sites in the SSW,
- Tree density (bush encroachment) – Partly covered by the above and by structure (below) - covered in the ARC vegetation monitoring programme,
- Tree structure / age class – look at structure in 4 height classes – monitor for homogenisation of structure e.g. a change from 4 to 2 classes – currently covered in the ARC vegetation monitoring programme, and
- Soil measurements – investigate Landscape Function Analysis.
5 Financial Aspects

5.1 Live Sales

All revenue obtained through the live sale of elephants within the SSW with be returned to the Sabi Sand Wildtuin’s Nature Conservation Trust and be used for conservation related activities such as game acquisitions and animal interventions. It is important to note that the overall numbers of elephant will not only determine capture and translocation, but also the ratios and population densities of all the herbivores within the reserve.

5.2 Culling

As with live sales of elephants, the revenue obtained through any culling operations within the SSW, with be returned to the Sabi Sand Wildtuin’s Nature Conservation Trust and also be used for conservation related activities such as game acquisitions and animal interventions. Revenue could be obtained through the sale of culling by-products, such as meat and skins. These by-products will only be sold, once the relevant permits have been obtained and under the supervision of MTPA and the State Veterinarian. The eleven communities surrounding the SSW will be given preference to any sales of by-products.

5.3 VAT Registration & Banking Details

Below are the banking details and VAT registration details of the Sabi Sand Wildtuin Nature Conservation Trust:

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REFERENCES


O’Connor T.G. 1985. A synthesis of field experiments concerning the grass layer in the savanna regions of southern Africa. SANS report 114. CSIR, Pretoria.


ANNEXURE I
CONFIRMATION – SABI SAND WILDTUIN MANAGEMENT AUTHORITY

Date 01 June 2016

To: MTPA / KNP Management
From: Iain Mackenzie
Title: Chairman: Sabi Sand Wildtuin Executive Committee

CONFIRMATION

Re: SSW Assigned Management Authority

This correspondence serves as confirmation that the Sabi Sand Wildtuin Protected Area is managed by the Sabi Sand Wildtuin Association represented by the Executive Committee. This committee is elected by the members of the Sabi Sand Wildtuin at the yearly Annual General Meeting, to represent the members and take decisions pertaining to the management and membership of the Sabi Sand Wildtuin

Yours Sincerely,

_____________________________
Mr. Iain Mackenzie
SSW Executive Committee Chairman
ANNEXURE II
ENDORSEMENT – MALA MALA GAME RESERVE

Date 07 June 2016

To: MTPA / KNP Management
From: Wayne Boyd
Title: Operations Manager: Mala Mala Game Reserve

ENDORSEMENT

Re: SSW Interim African Elephant Management Plan

This correspondence serves as endorsement of the Sabi Sand Wildtuin Interim African Elephant Management Plan by the Owners and Management of the Mala Mala Game Reserve.

Yours Sincerely,

______________________________
Mr. Wayne Boyd
Mala Mala Operations Manager
ANNEXURE III
SAFETY – WHEN DEALING WITH WILD ELEPHANTS

1. Elephants are wild animals and can be very dangerous if not treated with respect and caution.
2. The responsibility of safe encounters with elephants lies entirely in the hands of the field guides and land owners.
3. High standards of guest and staff safety should be maintained at all times.
4. Guides should be adequately qualified and experienced to protect the guests:
   a. Recommended qualification FGASA Level II, Trails Guide.
5. The following are recommended specifically:
   a. All tourist facilities and amenities should be ring fenced with an electric fence,
   b. All staff villages should be ring fenced with an electric fence,
   c. When river frontage occurs and electrified cable fence should be erected to keep elephants out of lodges and camps,
   d. All sewage ponds and rubbish facilities must be ring fenced with an electric fence.
6. Regarding reserve vehicles, the following is recommended:
   a. All vehicles must be reliable and in good running mechanical condition and be fitted with adequate spare wheels and repair kits,
   b. Functional radios are essential,
   c. Well prepared and rehearsed emergency action plan,
7. When guests drive their own vehicles, the following should be supplied:
   a. Information on the potential danger of elephants (i.e. cows and calves, musth bulls),
   b. Information on how to identify, approach and behave near breeding herds and bulls in musth,
   c. Strict regulations of how to behave near wild elephants:
      i. Not to drive off-road,
      ii. Not to follow elephants,
      iii. To respect the elephants at all times,
      iv. To always allow them right of way,
      v. Not to cut off their path especially when more than one vehicle is present,
      vi. Not to unnecessarily increase noise emitted by the vehicles engine, and
      vii. Not to leave the vehicle.