

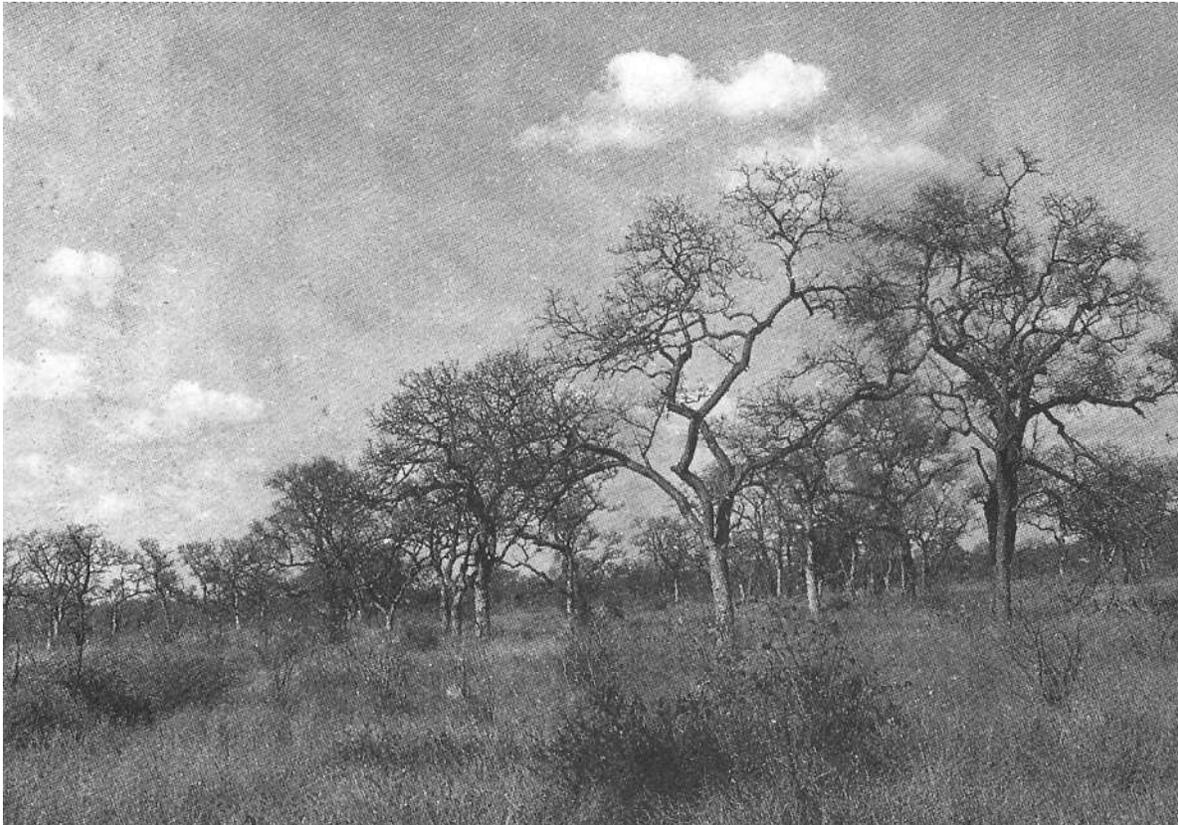
**Land Management Action Plan:
Olifants River Reserves (North & South)
as part of
Balule Nature Reserve**

“PROJECT HARMONY”

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September 2019

Revised January 2020



Arid Lowveld as Acocks saw it before 1950

DECLARATION

This document has been prepared as a joint plan covering two properties in the Balule Nature Reserve (BNR) under agreement of their Boards.



Approved for submission on _____ day of _____ 2020 at a duly constituted meeting of the Board of Olifants River Game Reserve (ORGR)

Chairman: Ian Everett Penhale _____

and



Approved for submission on _____ day of _____ 2020 at a duly constituted meeting of the Board of Olifants North Game Reserve (ONGR)

Chairman: Rob Garmany _____

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LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| APNR – Associated Private Nature Reserves | ONGR – Olifants North Game Reserve |
| ARC – Agricultural Research Council; | ORGR – Olifants River Game Reserve |
| BNR – Balule Nature Reserve | ORR – Olifants River Reserves |
| BOT – Balule Outreach Trust | PA – Protected Areas |
| BRREP – Black Rhino Range Extension Program | PPE – Personal Protective Equipment |
| CLO – Community Liaison Officer | PZ – Pete Zacharias |
| EMP – Environment Management Plan | RG – Rob Garmany |
| GKNP – Greater Kruger National Park | SMF – Science Management Forum |
| IP – Ian Penhale | TNR – Thornybush Nature Reserve |
| JP – Joe Pearson | TOR – Terms of Reference |
| KNP – Kruger National Park | TPC – Thresholds of Potential Concern |
| KPNR – Klaserie Private Nature Reserve | TPNR – Timbavati Private Nature Reserve |
| K2C – Kruger to Canyons | UPNR – Umbabat Private Nature Reserve |
| MP – Mike Peel | |
| NL – Nick Leuenberger | |

DISCLAIMER

Any reference to any proprietary product, process or item is not to be taken as an endorsement or indictment by either of the Boards of Olifants North Game Reserve (ONGR) and Olifants River Game Reserve (ORGR) nor the Authors.

ACKNOWLEDGEMENTS

We thank Messrs Ian Penhale, Rob Garmany and their Board Members Louise Cleary (ORGR), Kenny Jones and Colin Patrick (ONGR), Wardens Ian Nowak (Balule), Joe Pearson (North) and Nick Leuenberger (South) for initiating this project, for your support and enthusiasm and in striving ‘to do things right’ in managing the combined Olifants River Reserves (ORR) based on a living data base.

1 LAND MANAGEMENT ACTION PLAN FOR OLIFANTS RIVER RESERVES (ORR): BALULE NATURE RESERVE (BNR)

1.1 Executive Summary

The Boards of ORGR (Olifants River Game Reserve (South)) and ONGR (Olifants North Game Reserve (North)) agreed to pursue a combined management plan as far as is possible. For aspects of this plan that affect both reserves, they are referred to here as ORR (Olifants River Reserves). This plan serves to feed into the Balule Nature Reserve (BNR) plan currently in review with the Chairman (Peel *in review*). This plan for ORR is aimed at the landowners of ORR in general but for action by the Boards who are responsible for decision making relating to ecological issues in consultation with the respective Wardens (responsible for veld management on ORR). Coordination with BNR plan (once completed and approved) and the plan for the Associated Private Nature Reserves (APNR) rests via the liaison structures under the Warden of Balule. The document is presented as follows:

- Part 1 – Executive Summary
- Part 2 – Background to the plan as it relates to ORR, the current Associated Private Nature Reserves (APNR) plan (Peel 2009) and the Balule Nature Reserve (BNR) plan (Peel *in review*);
- Part 3 – The structure of the Land Management Action Plan stating the need for achievable objectives, highlighting important management issues and considering existing and proposed projects;
- Part 4 – Linkages between the ORR plan and the current APNR plan (Peel 2009) and the BNR plan (Peel *in review*);
- Part 5 – Project plans, ongoing and proposed for ORR; and
- Part 6 – Technical guidelines presented for management relating, in particular, to: Soils – erosion and roads; Vegetation – fire management, restoration, bush thinning and alien vegetation; and water).

It is important to understand that the development of a Land Management Action Plan is not a once off activity but a continuous process, which should remain a key focus of all ORR members, as led by their Boards. Within the framework of the plan, there are a number of important principles that apply:

- We should set short, medium and long term objectives and implement these changes in accordance with our sustainable management plan, all of which are constrained by cost, time and season;
- Whilst, the impact of any management activity may take a long time to provide tangible results, good or bad, the benefits of a well-defined plan curbs the need for *ad hoc* practices and knee-jerk responses;
- In many instances there is a broad set of potential activities we could embark on, on which many experts may differ. Ultimately, the approach taken remains the decision of the ORR Boards in conjunction with their members but, importantly, any activity should not be knowingly ecologically detrimental;
- Without a base line reference, ongoing monitoring and good record keeping of management activities, they become wasteful and ineffective, as we cannot objectively assess the outcomes to determine whether the management actions should continue, be expanded, refined, changed or abandoned – this is akin to the extensive data kept by large corporations from which they derive their Strategic Business Intelligence and will be familiar to most members of ORR;
- Ecosystems are in a continual state of flux or change – even without the intervention of man – but an effective management plan reduces the negative impact of short-term human interventions; and
- This system is broadly influenced at two scales; 1) globally, where we deal with issues such as climate change; and 2) locally, where we deal with management issues such as artificial water points, bush encroachment, rehabilitation, etc.

2 BACKGROUND TO THE LAND MANAGEMENT ACTION PLAN

2.1 Why a Management Plan?

Privately owned Protected Areas (PA) are playing an increasingly important, and near critical, role in the management and conservation of South Africa's natural resources and biodiversity. It is not enough to just “manage” and management activities must be undertaken with a purposeful long-term objective in mind. Effective wildlife management requires a multi-faceted plan that is objectives driven. The management plans for the individual APNR reserves are compiled in terms of the National Environment Management: Protected Areas Act No. 57 of 2003 (NEM: PAA) and are presented as an adjunct to the Associated Private Nature Reserves (APNR) Management Plan (Peel *et. al.*

2009). The APNR Management Plan, which has been approved by the relevant authorities in the Mpumalanga and Limpopo Provinces, currently provides the overarching principles and guidelines for the management of the greater protected area (Section 6 - Peel *et. al.* 2009 updated; Section 1 - BNR plan - Peel *in prep.*).

In this context, the ORR plan forms part of a hierarchy of plans that are integrated to meet legislative obligations as well as providing integrated management tools at the level of the geographic region known as the APNR, a 270 000 ha conservation area sharing a 85 km open boundary with the central part of the KNP (Figure 1).

Structure for plans for Project Harmony

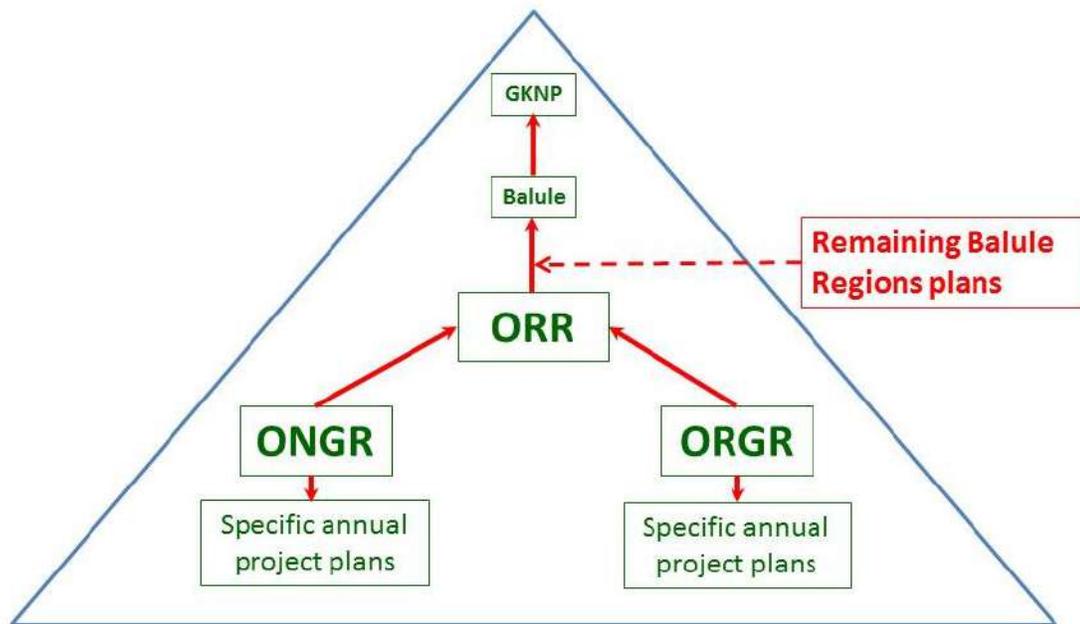


Figure 1 The relation between the Olifants River Reserves (ORR) planning process to that of the Greater Kruger National Park (GKNP).

2.2 Conservation Objectives

Conservation objectives can be defined in different ways depending on the main emphasis placed on the area. The ORR were not originally formed with the main objective of conserving a tract of land and its natural biodiversity, as National and Provincial Parks are. Rather, the objective has been one of setting aside a natural area for the enjoyment and

benefit of its owners – (Section 6 - Peel *et. al.* 2009; Sections 2, 3 and 9 BNR plan - Peel *in prep.*).

Under this scenario, where the area is managed mainly for the sustainable use of natural ecosystems, the broad objectives may be articulated as suggested by Hocking *et al* (2000) in Peel & Rossaak (Klaserie Private Nature Reserve - KPNR *in review*), Peel & Anderson (Timbavati Private Nature Reserve - TPNR *in review*), Peel (Thornybush Nature Reserve – TNR *in review*) and Peel (Balule Nature Reserve - BNR, Umbabat Private Nature Reserve-UPNR, all *in prep*) as follows:

- To protect and maintain the biological diversity and other natural values of the area in the long term;
- To protect the natural resource base from being alienated for other land-use purposes that would be detrimental to the area’s biological diversity and ecosystem services;
- To promote sound management practices for sustainable production purposes; and
- To contribute to regional and national development.

2.3 Primary Objectives

The primary objective of the ORR is to provide for ecologically and aesthetically sustainable (non-consumptive) use of the area for its owners, based on wildlife focussed recreation. While there is hunting on the greater BNR and APNR, no hunting is done on ORR (Section 6 - Peel *et. al.* 2009; Sections 2 and 4 BNR plan - Peel *in prep.*). The hunting regions within the BNR do, however, pay a percentage or agreed sum for the animals hunted to a central BNR account. This then benefits all member reserves equally as this amount offsets the central budget and thus reduces the levies which are applied on a pro rata basis based on area. For the ORR the following may be considered as the ‘Primary Objective’: **“Enjoy an exceptional bushveld experience, in its entirety, in a manner which respects the environment, being ecologically sensitive and sustainable, in order to retain and enhance the experience and the associated property value”** (after Griffiths *pers. comm.*). This is in line with the BNR’s primary objective and incorporates some of the values found in the set of secondary objectives below. The leadership of ORR has named their planning process “Project Harmony” and will strive to achieve “Responsible Stewardship” in every endeavour and to become a regional leader in conservation management.

2.4 Description of Olifants River Reserves (ORR)

The ORR comprise two Share Blocks, covering about 9 800 ha (ONGR c. 3 030 ha; ORGR c. 6 739 ha)(Appendix 1.1 & 1.2), located in the central north BNR which is a member of the APNR and in turn forms part of the Greater Kruger National Park (GKNP) system (Figure 2). A Co-Management Agreement between BNR and ORR provides for the delegation of the Management Authority to be shared equally between the Parties - the BNR Executive and the ORR Boards of Directors. The Parties are jointly responsible for ONGR's compliance with the objectives of NEMPAA Clause 2 and the BNR Management Plan, as described below.

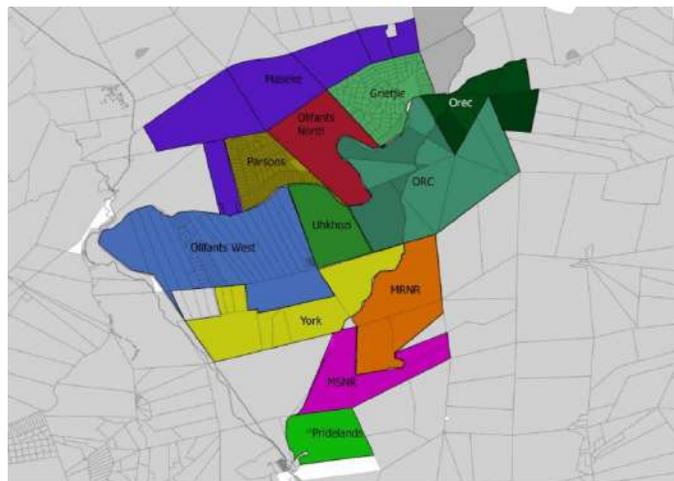


Figure 2 The location of the Olifants River Reserves (Olifants North and ORC) in relation to the extent of the Balule Nature Reserve (map courtesy of Craig Spencer).

The BNR is party to and supports the Kruger to Canyons (K2C) Biosphere Reserve, GKEPF, the Black Rhino Range Extension Program (BRREP), the Ground Hornbill Reintroduction Project, the Maseke Community Game Reserve and Elephants Alive.

The ORR falls within the Olifants River Rugged Veld ecological zone. They are characterized by incised areas that flank the Olifants River with undulating topography and generally very shallow, stony and gravelly soils, with frequent rock outcrops. The underlying geology consists mainly of granitoid rocks with pegmatite dominant. Because of the coarse nature of this rock type, several sites where mica and feldspar have been mined in the past, are still visible.

The Olifants River has floods that are seldom always predictable. It is also dependant on water releases from dams upstream over which ORR have no control. High siltation, low water flows, eutrophication and heavy metals contribute to make it one of the most polluted rivers in the country. Annual rainfall figures show cycles that are becoming more unpredictable (Figure 3).

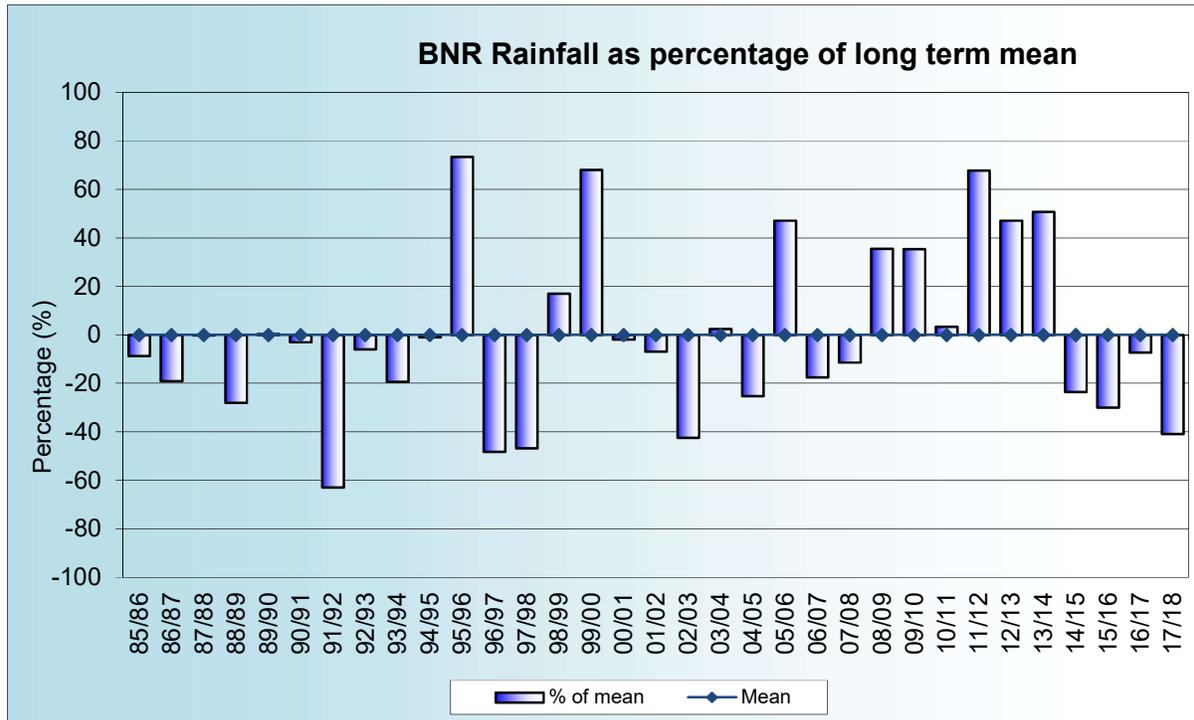


Figure 3 The rainfall patterns on Balule Nature Reserve from 1985 to 2018.

From the early 1930s the area comprising ORR was used for livestock, primarily cattle, until around 1970 (many of these land units were far too small to be economically viable and poor farming practices, e.g. cropping marginal lands, was the likely result). There are some open areas that need to be investigated as ‘old lands’. Roughly 40 years ago (1980), once ‘game farming’ was recognised as a formal part of the economy, the area started developing to serve wildlife and nature-based recreational tourism. The fences between the originally defined APNR and the Kruger National Park (KNP) were dropped in the early 1990s and between the APNR and BNR in 2004.

The properties have developed markedly in terms of infrastructure and now comprises or contains the following (Table 1):

Table 1 The current (2019) infrastructure of Olifants River Reserves (ORR)

| Item | North (ONGR) | South (ORGR) |
|---|--|--|
| Full shares | 50 | 49 Units own all 6 Shares |
| Standing units | 49 (A = 12; B = 37) | 85 |
| Awaiting development | 1 | 0 |
| Airstrip | 1 decommissioned use neighbours | 1 |
| Roads (km) | 85 | 223 |
| Tracks (km) | >5 | >9 |
| Borrow pits | 8 | 9 |
| Artificial water points | 5 | 9 (Double Dam is Natural) |
| Solar boreholes | 3 | 9 |
| Eskom boreholes | 4 | 6 |
| Member houses | 50 | 85 |
| Staff houses | 7 x semi-attached (13 staff); 1 building @ gate (3 staff); 2 x management houses | 24 Junior Units and 3 Management Units (Top Staff village: 6 blocks with 2 units each, Workshop: 4 Units. Bottom Village: 2 Blocks with 4 units each.) |
| Shares | 50 @ 6/member = 300 | 510 (85 Units with 6 Shares Available per Unit) |
| Three-year average occupancy | 16.2% | 12% |
| Total members | ¹ Users 99; Super-users 39 | 336 (Users 164; 7 Super Users, 164 Family Users) |
| Number of staff resident | 20 | 35 Resident & 10 Temporary (30 Permanent Junior Staff, 10 Temp Juniors, 5 Management) |
| Protected area (PA) status | Approved 2019 | Approved 1993 |
| ¹ Super-users pay a per visit levy for <6 visit per year | | |

The land owners use ORR for nature-based tourism, using sustainable and environmentally sound principles. There are two aspects to the properties' development, each with their own timeframes but with certain interdependencies:

- Building projects, comprising various maintenance and construction projects; and

- The development and management of the property itself in terms of vegetation, roads, water and fauna.

It must be noted that, to the extent that ORR is part of the BNR/APNR/KNP system, direct management of fauna must be conducted within the context of the greater protected area. Other management activities such as water provision and burning should also be addressed in consultation with the greater BNR/APNR/KNP plans. Detail is included in Part 4 which indicates how the ORR plan links to the BNR Management Plan.

The person/s responsible for veld management (primarily the Warden and his team) should use the entire plan as a reference document. Once agreed on, each project should be presented on a Gantt chart showing the agreed sequence and timing of implementation. Implementation risks and the required monitoring are presented in Part 5 where some proposed project topics are also presented. These are largely to complement the BNR and APNR plans and ORR-specific project work plans will be developed later. In Part 5 the focus ranges from issues relating to information required to implement a management decision (e.g. to thin bush or not) to technical issues (e.g. bush thinning techniques). This is a living document and specific issues (e.g. costs of projects) or deviations that arise will be added to the Land Management Plan as required.

3 THE LAND MANAGEMENT ACTION PLAN

This section moves from broad statements of objectives to specific objectives for important ecological parameters and finally to actual project identification (Part 3.1 and Parts 4 and 5)(Appendix 1.1 & 1.2). Part 3 provides a manageable framework within which developmental projects can be undertaken and prioritised over the next five years (identification, initiation and/or expansion of the projects that need to be discussed and prioritised is therefore essential – action Board, Warden and landowners (Consultants as a resource if required).

3.1 Ecological Monitoring and Research

Monitoring and research are essential to provide the guidelines and data to inform management of the ecosystem and its components as well as to assess the success or otherwise of any management actions (Section 16 - Peel et. al. 2009; Sections 2, 3 and 5 (BNR plan - Peel in prep.). Such information provides a better understanding of the ecosystem and the interactions within it. To achieve 'best practice' in the management of ORR requires continuous monitoring of current management practices and the formulation, testing and refining of new ones. Monitoring and understanding is also necessary in the social and economic fields that form an important part of ORR and the BNR and APNR's objectives. The policy is to:

- Encourage and facilitate appropriate ecological and socio-economic research and monitoring that is necessary for the effective management of ORR (in the context of the APNR and greater conservation estates); and
- Ensure that all data and information gathered either from a formal research or monitoring programme, or that result from historical enquiry, are properly archived and stored in a form that is easily accessible for future use by at least two staff, to ensure succession planning.

Should ORR choose to host any research or collaborate with ongoing research, it is recommended that the following conditions should apply to any research and monitoring activities on ORR, including monitoring for management:

- All research and monitoring undertaken on ORR should be approved by the reserve's delegated representatives (and preferably with approval of the BNR, APNR and the Science Management Forum (SMF));
- Research and monitoring must provide inputs that contribute towards an understanding of the ORR system (within the APNR and greater KNP) and provide answers for the effective management of the property and facilitate decision making;
- ORR leadership and management, with input from an ecologist and other relevant stakeholders, will identify the issues that need to be addressed and will prioritise these for prospective researchers;
- Researchers, wherever possible, should be independent to ensure objectivity;
- Researchers should preferably be affiliated to a recognized institution or at least have a track record in research and monitoring;
- Research and monitoring projects must have clearly defined goals and the plan for any project should be approved by ORR and the APNR (Science Management Forum (SMF)) before it commences.
- Researchers should be contractually obliged to provide regular written progress reports and copies of their final report to the ORR management team (with copies to the APNR & Greater KNP) and to abide by an appropriate code of conduct;
- Researchers and research activities must respect the privacy and nature experience of individual Members, their families and guests;
- A centralized database should be designed and maintained for the storage and filing of data. It should be maintained to the following standards:
 - Both hard copy and electronic copies will be kept;

- The database must be readily accessible to all internal and external stakeholders;
- The data will be stored and presented in formats that are easily interpreted and appreciated by all stakeholders, especially decision makers; and
- Data collected are promptly stored and filed in the centralized data system (immediately after collection).

It needs to be appreciated that participating in research programmes can be used to leverage data that helps the reserve make management decisions, e.g. vegetation and animal surveys. Individual single species (Autecological) research does not necessarily add significant management value but does provide members with potentially high interest activities and 'ownership' of a better understanding of the role of species in their ecosystem.

3.2 Action Plan for the Effective Management of ORR – 2019-2023

The action plan described here (Table 2) provides a framework and as such is relatively generic. Issues that are common to both sections of the ORR are dealt with here. Projects that are specific to each section of the ORR will be dealt with elsewhere (see Appendix 1.1 (ONGR) & 1.2 (ORGR) for details specific to each reserve).

This Action Plan has been compiled by Mike Peel (MP) and Pete Zacharias (PZ) in consultation with the Chairpersons Messrs Ian Penhale (IP) and Rob Garmany (RG), Wardens Messrs Joe Pearson (JP) and Nick Leuenberger (NL). The approach is based on the general context of the needs for sound land management in the BNR, a day workshop and on field visits in September 2019 to look at specific challenges. The ORR Boards and Wardens, together with the consultants, have to provide input around specific issues within the plan. As this is structured as a living document, more people may be added where necessary and if additional expertise or service providers are needed.

References to ‘land owners’ here (Table 2) refers to the opportunity to introduce a formal use of ‘citizen science’ whereby the members (land owners and members in Table 2) can provide input to the data sources used for management decisions. Such approaches are useful in transferring ownership of the plan from the Board and Wardens to the full membership. However, decisions and all action remain the preserve of the Warden, as directed by the Board.

Table 2 A planning framework for specific projects for the sustainable management Olifants River Reserves proposed in September 2019

| OVERALL OBJECTIVE | SPECIFIC OBJECTIVE | PROJECT | RESOURCE | FIRST REPORT BACK (tick indicates completion) |
|--------------------------|---------------------------|----------------|-----------------|--|
|--------------------------|---------------------------|----------------|-----------------|--|

| OVERALL OBJECTIVE | SPECIFIC OBJECTIVE | PROJECT | RESOURCE | FIRST REPORT BACK (tick indicates completion) |
|--|---|---|---|--|
| 1. MISSION OBJECTIVES SETTING UP OF MANAGEMENT PLAN see Part 4 | Primary: Responsible Stewardship of all of ORR. | | Responsible ORR Board, Warden/s, (Consultants as required) | Dec 2019 |
| | Secondary: Strive for 'Project Harmony' to ensure Member expectations are compatible with sustainable management. | | Responsible ORR Board, Warden/s, (Consultants as required) | Dec 2019 |
| | To set up a plan for the effective management of ORR. | To provide a management plan to the Board for approval. | Consultants | by early October 2019 |
| | | To set up a detailed management plan based on the framework presented here. | Chairmen, Wardens then to Consultants. | by early November 2019 |
| | | To set up an initial action plan for the implementation of the management plan on an annual basis. Budget indications. | Chairman, Wardens and Consultants. Chairman, Board Wardens | by early December 2019 |
| 2. RESEARCH AND MONITORING see Section 3.1 | To conduct such research as is necessary for the effective management of the reserve and to achieve the objectives set for the reserve; Monitoring – To detect or warn of changes which conflict with the management | To evaluate the success of management actions which have been implemented (monitoring). | Wardens & Consultants to identify sites for ecological monitoring and submit proposal and costing to ORR Boards As above | Annual from summer 2020 |

| OVERALL OBJECTIVE | SPECIFIC OBJECTIVE | PROJECT | RESOURCE | FIRST REPORT BACK (tick indicates completion) |
|--|--|---|--|---|
| | objectives; Research – To ensure that relevant, applied research projects are undertaken in the reserve. | To generate relevant key questions for monitoring and research. | | As above, annual from summer 2020 |
| Present and future management programme | | | | |
| 3. SOILS – To minimise the rate of accelerated soil erosion | | | | |
| Erosion reclamation | To identify and control (if practicable), or at least minimise, accelerated erosion; To identify and attend to erosion which is threatening unique, valuable or sensitive features. | Identify and map gully erosion into bottomlands and draw up a priority programme for erosion reclamation as part of the integrated habitat rehabilitation programme. (Map – provided by ORR for Consultants' review). Identify and map extensive sheet eroded areas and erosion from sodic patches. (Map). | Warden/s & Consultants – from map - identify sites for rehabilitation, prioritise and submit proposal and costing for the work. Warden/s & Consultants to ORR Boards. | From January 2020 - Implement proposed Project 1 - Monitoring cross cutting SOILS, VEGETATION, FAUNA, WATER Reporting every Quarter |
| Roads and tracks - (includes erosion from roads and tracks and communication links) including river crossings. | To identify areas of active erosion resulting from the road and track network and (if practicable) to prevent, or at least minimise, such erosion by the correct alignment, drainage system and (if necessary), closure and reclamation of | Map areas of active erosion and recommend appropriate measures to minimise erosion. | Warden/s to Consultants – from map - identify sites for rehabilitation, prioritise and submit proposal and costing for the work to responsible ORR Boards. | Ongoing as quarterly reports from January 2020. |

| OVERALL OBJECTIVE | SPECIFIC OBJECTIVE | PROJECT | RESOURCE | FIRST REPORT BACK (tick indicates completion) |
|---|---|--|--|--|
| As above and NB for river crossings. | roads and tracks. To maintain all roads and tracks in a state which minimises their impact on surrounding hydrology, soil erosion, and biologically sensitive areas; To improve existing roads and provide an all-weather, low impact road system that allows for the achievement of objectives and for effective reserve management. | Prioritise roads and tracks for erosion reclamation measures. | From the above. | Ongoing as quarterly reports from January 2020. |
| Quarrying (borrow pits) | Utilise quarry material for the surfacing of key road and tracks with the minimum of disturbance to the environment and to the aesthetics of ORR. To identify spent borrow pits and rehabilitate these. | Identify sources of quarry outside ORR which can be exploited; Assess the quality of available quarry material. Identify and map borrow pits to be fully or partially closed and rehabilitate these. | Warden/s to responsible ORR Boards–. Wardens to plan and cost. Consultants to provide specification for earthworks and rehabilitation. | As necessary. Ongoing from November 2019. |
| 4. VEGETATION – To conserve the indigenous plant populations and as wide a variety of habitats occurring in the reserve. | | | | |
| Vegetation monitoring - (including brief habitat | To facilitate a predictive understanding of the dynamics of specific plant species and | Monitor the effect of management and environment | Wardens & Consultants | Annual as agreed continuing summer 2020. |

| OVERALL OBJECTIVE | SPECIFIC OBJECTIVE | PROJECT | RESOURCE | FIRST REPORT BACK (tick indicates completion) |
|--|--|--|--|--|
| description). | <p>the vegetation as a whole in particular in its relation to climate, soils, herbivory, bush control and fire.</p> <p>To detect changes in the vegetation which conflict with the management objectives; and</p> <p>To quantify the status and relative trend of rare and endangered plant species.</p> | <p>on vegetation composition and structure; and</p> <p>Monitor the extent and effect of the habitat rehabilitation programme.</p> <p>As identified by the Wardens</p> | | |
| Fire management – Including firebreaks | <p>To remove excessive litter and old growth in order to maintain a diverse and vigorous herbaceous sward when possible;</p> <p>To retard woody plant growth (achieve a good top-kill of encroaching woody plant species); and</p> <p>To retard or reduce the risk of detrimental wild and/or arson fires.</p> | <p>Assess the potential for use of fire in achieving objectives - measure standing crop.</p> <p>From the above</p> <p>From the above</p> | <p>Warden/s, BNR, ARC¹ s & Consultants as required.</p> | <p>Ongoing from Winter 2020.</p> <p>Pre-burn survey if required in early winter.</p> <p>From the above</p> <p>From the above</p> |
| Control of indigenous problem species. | <p>To maintain woody plant densities at levels which maximise grass production (by minimising woody/grass competition) where needed;</p> <p>To reverse bush encroachment on areas which were previously open woodlands</p> | <p>Identify sites that were previously open and that will respond to bush thinning in terms of grass returns.</p> <p>Review the success of coppice control where applicable.</p> | <p>Wardens</p> <p>Wardens to consultants – from map – prioritise and</p> | <p>Ongoing from 2020.</p> <p>Annual reporting.</p> |

| OVERALL OBJECTIVE | SPECIFIC OBJECTIVE | PROJECT | RESOURCE | FIRST REPORT BACK (tick indicates completion) |
|--------------------------------------|---|---|---|--|
| | (Review historical air photography to determine areas for attention); To create preferred habitat for grazers; To increase the visibility of large herbivores to enhance game viewing; Target those woody plant species and age classes actually responsible for man-induced encroachment (structural considerations). | Continue with the integrated habitat management programme; Record all animal species seen on pre-determined routes containing thinned and un-thinned vegetation. Evaluate success from monitoring exercise and continue, adjust or cease work | submit proposal and costing for the work to responsible ORR Board Member. | |
| Control of alien species | To control, and eradicate if practicable, plants which are alien to the reserve, particularly those which threaten the indigenous vegetation; Prevent further infestations. | Map location and extent of existing alien plant infestation; Prioritise species which invade rapidly and have a wide distribution; Monitor results | Wardens – from map - identify sites for treatment, prioritise and submit proposal and costing for the work to responsible ORR Board. Consultants where required. | Ongoing – report quarterly |
| Sustainable Consumptive utilisation. | To encourage human use of indigenous vegetation while keeping it to a level which has no appreciable effect on the population dynamics of the species involved and the dynamics of associated species. | Determine the amount of firewood available from the habitat rehabilitation programme or any 'sacrifice' areas. Assess key species, their conservation status and the | Wardens. Consultants to provide details as required. | Ongoing – report annually |

| OVERALL OBJECTIVE | SPECIFIC OBJECTIVE | PROJECT | RESOURCE | FIRST REPORT BACK (tick indicates completion) |
|--|---|--|--|---|
| | | extent to which they can be harvested sustainably; Make available indigenous medicinal plants/other plant products (e.g. thatching grass) which are available on a sustainable utilisation basis. | | |
| 5. WATER – To maintain natural water bodies in such a condition so as to support the naturally occurring game species linked to such bodies. | | | | |
| Water provision for animals | To provide water for animals in places and for periods which approximate, as closely as possible, the past natural distribution of water without affecting adversely the hydrology and consequent ecology of ORR. | Make inventory and map natural perennial and non-perennial water sources; Take necessary management actions to manage water points. | Wardens Warden/s. Consultants to provide details as required. | Ongoing with decisions linked to annual monitoring programme. |
| Rainfall | To monitor the effect of rainfall on the vegetation of the reserve. | Set up a network of weather stations. Collect rainfall on a regular basis (at least monthly); | Wardens. Consultants to advise. | Daily/Monthly – ongoing. |
| Water use - human | To monitor water use by human consumption. | Undertake resource monitoring to determine sustainable extraction rates. | Wardens - Monitor and register river and borehole abstraction and discharge (Department of Water Affairs) Warden/s, responsible | Ongoing (bi-weekly) |

| OVERALL OBJECTIVE | SPECIFIC OBJECTIVE | PROJECT | RESOURCE | FIRST REPORT BACK (tick indicates completion) |
|---|---|--|--|--|
| | | Set targets in terms of human consumption per person per day. | ORR Board Member. | |
| 6. FAUNA – To conserve a wide diversity of naturally occurring indigenous animal species in the reserve without causing a long-term deterioration in the veld condition resulting from accelerated soil loss, bush encroachment and/or an unfavourable shift in the grass species composition and/or cover. | | | | |
| Population monitoring | To quantify presence absence and relative abundance of selected species; To quantify other population parameters (such as sex and age structure) which will help in understanding the population dynamics of key species; Faecal analysis | Landowner project. Identify species of concern, collect pooled sample, air dry, place in brown paper bag with species, date, and reserve information. To ARC - analyse for Nitrogen (assess nutrition in terms of protein in diet) and Phosphorous (lactation, survival). Participate in ARC regional project at c. R 150 per sample). | Wardens /landowners Wardens to collect samples. Consultants to analyse via ARC. | Monthly – proposed Project Two collections, selected species - end summer and end winter. |
| 7. POLLUTION – To minimise all forms of pollution and their effects on the reserve. | | | | |
| Litter and refuse | To minimise the effect of litter and refuse on the reserve and on the owners and guests by refining and maintaining an efficient refuse removal and disposal system; and | A review of the Rules for members and shareholders is required to ensure the aspects here are sufficiently controlled. | Responsible ORR Board Member, Wardens | Ongoing Board member to be identified to advise and monitor project (could be a suitably experienced member |

| OVERALL OBJECTIVE | SPECIFIC OBJECTIVE | PROJECT | RESOURCE | FIRST REPORT BACK (tick indicates completion) |
|--------------------------|---|--|---|--|
| | Minimise any form of health risk emanating from refuse. | Need to be linked to Community Outreach Projects. | | seconded for this purpose). |
| Water pollution | To identify and remove sources of pollution on the reserve's water. | Monitor water quality. | Wardens, responsible ORR Board Member, Board. | Ongoing – report immediate |
| Light pollution | To identify and remove sources of light pollution in the reserve. | Monitor light pollution sources: e.g. naked lights, no lights above 3 m off the ground, place light fixtures to reduce reflected light. | Wardens, responsible ORR Board Members. Board to determine and approve policy. | Ongoing – report immediate |
| Visual | To identify and remove sources of visual pollution in the reserve. | Monitor visual pollution sources: Use of natural colours in lodges, total height of buildings less than 8 m, glass doors and windows under roof overhang/shaded to prevent reflection of the sun. | Wardens, responsible ORR Board Member, Board. Board to determine and approve policy. | Ongoing – report immediate |
| Noise | To identify and remove sources of noise pollution in the reserve. | Monitor noise pollution sources: e.g. equipment selected for efficiency, new equipment replacement policy, shield noisy equipment, muffle all combustion engines, use of berms to attenuate noise. | Warden/s, responsible ORR Board Member, Board. Board to determine and approve policy. | Ongoing – report immediate |

| OVERALL OBJECTIVE | SPECIFIC OBJECTIVE | PROJECT | RESOURCE | FIRST REPORT BACK (tick indicates completion) |
|---|--|--|--|---|
| Hydrocarbons | To safely manage and remove hydrocarbons on site. | Monitor hydrocarbon pollution and sources: e.g. refuelling over spill trays or over impermeable surface, oil separation/trap system, spill kits on site with bio-ameliorant, oil traps checked and oil removed and disposed of, spill trays with shavings and/or sawdust. | Warden/s, responsible ORR Board Member, Board. | Ongoing – incidents reported immediately. Routine monthly report to Board. |
| 8. UNIQUE, VALUABLE AND SENSITIVE FEATURES | | | | |
| | To identify unique, valuable or sensitive features in order to zone them as special zones and give them adequate protection where necessary. | Map location and extent of unique, valuable and sensitive features and zone as special zones; e.g. 'iconic trees'. | Wardens, landowners. | Ongoing |
| ¹ ARC – Agricultural Research Council; | | | | |

4 LINKING THE ORR LAND MANAGEMENT PLAN TO THE OVERARCHING BNR AND OTHER APNR RESERVE MANAGEMENT PLANS

Where relevant, cross references to actions outlined in Part 3 of this plan with the BNR (and other APNR reserves) management plans are made. This section is not intended to be an exhaustive link between the ORR plan and the overarching BNR (and other reserves) management plan but rather serves as a cross reference with the relevant section in the BNR plan (Peel *in prep.*), the Klaserie Private Nature Reserve plan (KPNR - Peel & Rossaak *in review*), Timbavati Private Nature Reserve plan (TPNR plan - Peel & Anderson *in review*), Umbabat Private Nature Reserve (UPNR plan - Peel *in prep.*) and Thornybush Nature Reserve (TNR plan - Peel *in review*).

4.1 Secondary Objectives

Conservation and Primary Objectives are presented in Section 2 of this plan. The following presents several potential secondary objectives (from Section 6 - Peel *et. al.* 2009; Sections 2, 3 and 4 - BNR plan - Peel *in prep.*):

- To manage the ecosystem, landscapes and species populations, so that a meaningful contribution will be made towards their conservation;
- To cost-effectively restore and conserve the landscapes, ecosystems and biodiversity in a productive and aesthetic state that will achieve the primary objective and be considered to be sustainable within the climatic and geological constraints of the area (recognising that the 'pristine' state is not achievable and we accept a functional ecosystem in an improved state within a dynamic system);
- To make investment opportunities available that are compatible with the primary objective and involve the participation of members of the local community wherever appropriate;
- Where possible, to provide direct employment to local communities;

- To manage the reserve so that, without compromising the ecological and aesthetic objectives, the economic viability and investment value of the properties are at least maintained; and
- To enlarge ORR's sphere of influence by collaborating with adjoining properties where the objectives and management are similar and in line with those of the BNR.

Within the localised objectives as set out by ORR the landowners recognise the need to interact with the neighbours (Figure 2), as well as comply with or conform to the legal obligations of their constitutions and the various acts under which they operate *inter alia*:

- The Company's Act;
- Protected Areas Act;
- Biodiversity Act;
- Veterinary Acts; and
- Soil Conservation Act 76 OF 1969 as amended
- Other environment related legislation.

In accomplishing these objectives, 'Best Practices' will be implemented in natural resource management and in forming constructive and beneficial relationships with the neighbouring reserves, communities and conservation bodies.

4.2 Zonation and Land-Use Categories

The zonation criteria for consideration at ORR are as follows (from Section 6 - Peel *et. al.* 2009; Section 7 - BNR plan - Peel *in prep.*):

- 'High Intensity Leisure' – an area characterised by a substantially modified natural environment. Sights and sounds of man are readily evident and concentration of users is often moderate to high. Such areas include private lodges, club houses, staff housing, office, workshop and storerooms at the headquarters, airstrip and gate areas of ORR;
- 'Low intensity leisure' zone – occupies the larger part of ORR and includes the surrounds of private lodges;

- ‘Quiet’ zone – areas that by virtue of their isolation or sensitivity should not be readily traversed by vehicle except for management purposes (these provide critical refugia for animals); and
- ‘Sacrifice zones’ – areas that are effectively destroyed and lose their ecological integrity but are required to ensure responsible stewardship e.g. roads, borrow pits, bridges, parking areas, etc.

Translating this zonation scheme into a map format will require a comprehensive mapping of all existing housing and lodging as well other infrastructure. Special or sensitive areas need to be delineated based on agreed objective criteria. Much of the basis of this is already available.

4.3 Present and Future Management Programme

4.3.1 Soils

The ORR are 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. Generally, rainfall in these areas is exhibiting increasing signs of variability and extremes (with predictions, due to climate change, of many years of below average rainfall being the rule rather than the exception). 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 by retaining water on the landscape.

The following is taken from Section 10.2 (in Peel *et. al.* (2009) and Sections 2, 4, 6 and 9 (BNR plan - Peel *in prep.*) and presented in Part 3 of this document:

- Erosion reclamation;
- Roads and tracks (Includes erosion from tracks and communications); and
- Quarrying (Borrow pits).

4.3.2 Vegetation

The biotic state variable of interest in this section is the vegetation comprising the woody and herbaceous layers as influenced by soil physical and chemical properties including soil moisture (rainfall is an indirect measure of soil moisture). The response of the vegetation to any additional management actions, such as increased herbivory (re-stocking) and/or fire, needs to be assessed in relation to rainfall and soil type.

The following is taken from Section 10.2 (in Peel *et. al.* (2009) and Sections 2, 3, 4, 5, 7 and 9 (BNR plan - Peel *in prep.*) and presented in Part 3 of this document:

- Vegetation monitoring (including habitat description);
- Fire management (including firebreaks);
- Control of indigenous problem species;
- Control of alien species; and
- Consumptive utilization.

4.3.3 Water

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 1960s. Prior to this, dividing the land into small units for domestic livestock and agriculture was in place since the 1930s. This was accompanied by unrealistic or unsustainable numbers of grazers being confined to defined areas. Compounded, these land use practices 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 an abundance of artificial uncoordinated water points in the Lowveld, supplying excessive surface water in these areas where water was only seasonally available historically (KNP has 1 water point per 51 440 ha and Balule I per 332 ha). This resulted in an eruption of water-dependent species such as Impala and Wildebeest, increased concentrations of animals and grazing, trampling, dunging and urinating which affects water infiltration, runoff, grass cover, species composition and the tree:grass ratio. Ultimately biodiversity and carrying capacity (depending on the set objectives) decline, particularly on units much

reduced in size or re-scaled. In addition, the change in the architecture of the vegetation renders the habit unsuitable for water-independent species such as roan (*Hippotragus equinus*) and sable (*Hippotragus niger*).

The impact of this is best illustrated by the example of Sable. It is reported that in the 1930s, the Gravelotte area had populations of 30 to 40 thousand Sable and they were shot for rations in those years (Mentis 2005). Today the population of Sable in South Africa is considerably reduced and is described at <7000 for all of South Africa, including breeding operations (Sable antelope 2019). As a consequence of the habitat change, brought about by the provision of water, the distribution of Sable has considerably reduced (Figure 4).

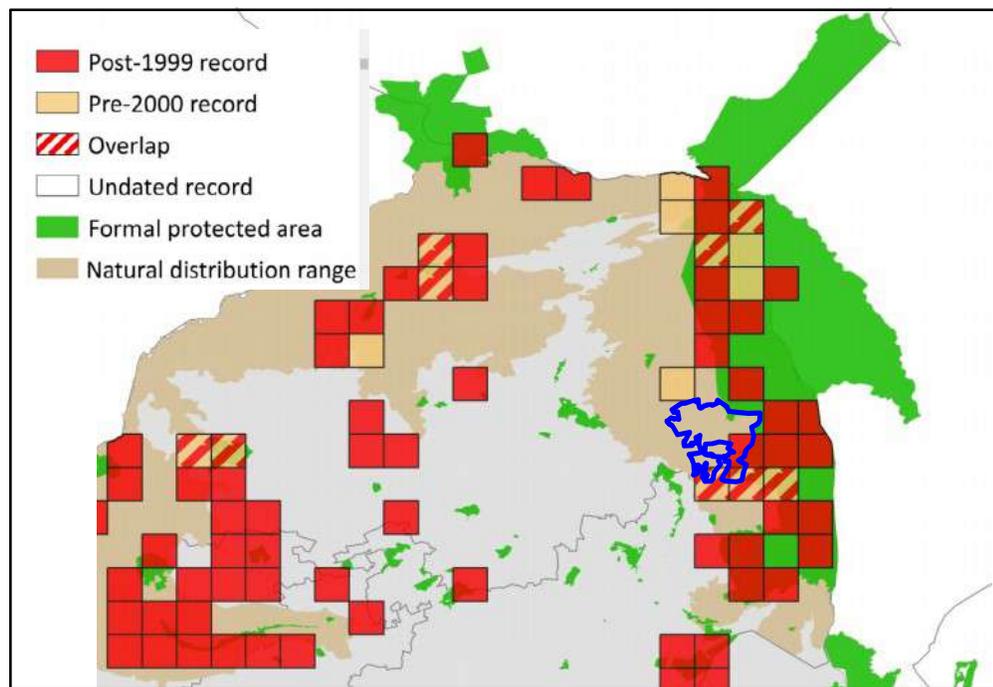


Figure 4 The historical distribution of Sable antelope in north-east South Africa (extracted from Parrini et al 2016; blue boundary shows the location of the Associated Private Nature Reserves (APNR).

Whilst the cost of re-establishing the habitat of the 1930s is neither financially nor ecologically feasible, using the example of Sable is a stark reminder of the influences and long-term impacts of management decisions. The management of water, therefore,

requires careful consideration. In fact, there is little chance that the land units comprising the ORR will ever recover as a suitable habitat for the now endangered Sable.

The following is taken from Section 10.3 in Peel *et. al.* (2009), Sections 2, 3, 4, 6 and 9 (BNR plan - Peel *in prep.*) and presented in Part 3 of this document:

- Water supply management;
- Monitoring of catchment/seep-line areas;
- Monitoring of rainfall; and
- Game

4.3.4 Wildlife Management and Fauna

The guiding principles for wildlife management on ORR are in line with those of the BNR and should be as follows (from Section 11 - Peel *et. al.* 2009), Section 5 and 9 (BNR plan - Peel *in prep.*) and presented in Part 3 of this document:

- The management of wildlife populations on ORR (within the BNR, APNR and greater KNP) will be to conserve, where possible, viable populations of those species that are indigenous to the Lowveld in such a way that visitors will be able to enjoy a high quality wildlife experience;
- Thresholds of Potential Concern (TPCs) should be established, at a general level, for all species and at a species-specific level, for those that can be cost-effectively monitored and those that are considered important in the BNR's and greater APNR's objectives;
- Sustainable utilization – a stated objective for BNR is that 'Best Practices' will be applied to manage the reserve within the context of the national and regional economic necessities. It is important to the region, that where animal populations can be utilized sustainably, without detracting from the experience of other users of the area, that this form of land use is practiced should the landowners choose to pursue this;
- Genetic diversity – populations, particularly species such as white rhino, should be managed so as to at least maintain or improve genetic diversity; and

- In all matters relating to game, the relevant veterinary legislation must be taken into account. In this regard, we should take note of the Animal Diseases Act 35 of 1984 and its amendments (Government Gazette 1986).

The following is taken from Section 11 in Peel *et. al.* (2009) and Section 5 and 9 (BNR plan - Peel *in prep.*) and presented in Part 3 of this document:

- Population monitoring (including game counts, population dynamics, condition assessment, diseases and parasites evaluation, behaviour); and
- Population control
 - control of indigenous species (live and dead removals);
 - control of problem species (feral dogs, other species);
 - Veterinary matters; and
 - Introductions or additions.

For completeness, Section 11 in Peel *et. al.* (2009) and Sections 5 and 9 (BNR plan - Peel *in prep.*) and presented in Part 3 of this document and includes:

- Guiding principles;
- Implementation;
- Setting the Thresholds of Potential Concern (TPC);
- Testing TPCs for herbivore populations within the BNR;
- Sustainable utilization;
- Wildlife monitoring;
- Reintroductions;
- Game removals;
- Alien species;
- Domestic animals; and
- Injured or sick animals.

4.3.5 Research and Monitoring

Presented in Part 3 of this document and Section 16 in Peel *et al.* (2009) and Sections 2, 4 and 5 (BNR plan - Peel *in prep.*).

4.3.6 Identified Projects

Projects that are suggested (Table 2) and those described here, are detailed in Part 5 of this document. The details are not repeated here where these are covered in the BNR and APNR plans.

4.3.7 Infrastructure Management and Development

For completeness, Section 12 in Peel *et al.* (2009) and Sections 2, 6 and 9 (BNR plan - Peel *in prep.*) also covers the following:

- Fences;
- Roads;
- Energy;
- Buildings;
- Communications; and
- Waste management.

4.3.8 Security Management

For completeness, Section 13 in Peel *et al.* (2009) and Sections 3, 6 and 9 (BNR plan - Peel *in prep.*) also covers the following:

- Current situation: appraisal and threat level;
- Access control;
- Field ranger strength and deployment;
- Field ranger capacity, training and equipment;
- Protection monitoring;
- Intelligence gathering;
- Tracker dog; and
- Standard operating procedures.

4.3.9 Reserve Management Staff

For completeness, Section 14 in Peel *et. al.* (2009) and Sections 1, 2, 3, 4, 5, 6, 8 and 9 (BNR plan - Peel *in prep.*) address the above aspect of management.

4.3.10 Community Outreach

For completeness, Section 14 in Peel *et. al.* (2009) and Sections 1 - 6 and 10 (BNR plan - Peel *in prep.*) address the above aspect of management.

4.3.11 Economic Aspects and Financial Planning

This important component is the responsibility of the Board, landowners and Warden (addressed in Sections 2, 3, 5 and 9 (BNR plan - Peel *in prep.*)).

5 PROJECT PLAN FOR ORR

5.1 Introduction

The focus of this section is to identify, prioritise and set in motion projects on ORR. The following projects are **proposed** (also from Part 3 of this document – Wardens to populate for discussion with consultants where necessary, who have identified potential topics below). These are further defined in reserve specific work plans (Appendix 1.1 & 1.2). This list will be added to as new projects are identified and priorities refined and projects are closed or abandoned.

5.2 Soils

- **Project 1** – Identify, map and treat sheet eroded areas and erosion
 - Sodich patches (e.g. sodich site identified);
 - Roads and tracks;

- Suspected old land that are not revegetating naturally;
- Restoration of a functional ecosystem on the old airstrip in the North and other suspected ‘old lands’;
- etc.

5.3 Vegetation

- **Project 2** - Continue with the integrated habitat management programme:
 - determine unacceptable thickening (i.e. compromise the achievement of stated conservation and/or reserve objectives) and plan bush thinning if appropriate; and
 - locate and remove invasive aliens.
 - use daily field patrols to locate infestations using CYBERTRACKER or similar low cost monitoring (see: <https://www.cybertracker.org/software/free-download>)
- **Project 3** - Determine the amount of firewood available from any habitat rehabilitation programme or high impact areas (e.g. road and rail reserve, powerlines, etc.).

5.4 Fauna

- **Project 4** - Record all animal species seen on pre-determined routes containing thinned and un-thinned vegetation.
 - Re-introductions – e.g. wildebeest

5.5 Water

- **Project 5** - Take necessary management actions to manage water points; and
- **Project 6** - Routine data collection – collect rainfall on a regular basis at various locations across ORR (at least monthly). The purpose here is to enhance management’s predictive ability as to the way the seasons unfold. This is particularly so to understand the patterns of grass growth, which remains the primary resource supporting both herbivore (prey) and predator species. It is a

critical adjunct to the vegetation monitoring. A relatively detailed data base could be developed by installing a number of inexpensive automatic rain gauges (<R 2000) across the ORR. Should cash flow dictate, these could be acquired over several years.

5.6 Projects (ongoing and potential)

Several of these proposed projects have elements that are already on going but are included for additional details and recording. In addition, those that are detailed make reference to “Obligation:”. As these plans are integrated set, the boards of reserves need to determine where the obligation rests. For example, security is managed at the level of the BNR and is funded from contributions from all reserves of a particular Region.

5.6.1 Waste

- General;
- Septic tanks; and
- Oils

5.6.2 Solar

To be populated once details of feasibility are determined.

5.6.3 Project Proposal Number 1: Rehabilitation of sodic sites

Purpose: To ensure vulnerable sodic areas are managed under Responsible Stewardship and do not erode.

Cross reference to this document: Action plan Part 3.1. Point 3; Part 4 section 4.6.1; Part 5 section 5.1.

Status: Proposed

Reference (including GPS position): Wardens to insert GPS location.

Comment: Responsible Stewardship requires the identification and sound management of sodic sites and in certain cases their attempted rehabilitation, as has been tried on neighbouring properties with reasonable success. Sodic site erosion is related to subsurface water flow and reduced soil strength above the junction of the permeable A horizon and the impermeable B or E horizon (Chappell 1992). Sodium plays a key role by causing de-flocculation of the clay fraction (i.e. by disrupting the electrostatic bonds between soil particles). The resulting disaggregated soil is vulnerable to displacement by moving water causing erosion. The erosion initially takes place under the surface and only becomes noticed once the underground pipes that form enlarge and collapse, forming a network of gullies (donga erosion). The situation is worsened by the attractiveness of the grazing in these base-saturated sodium-dominated soils, referred to as 'nutrient hot-spots'. Management practices such as the provision of artificial water points (often resulting in excessive grazing and poor soil moisture conditions in these sensitive areas) and poorly placed roads and tracks (that discharge excess water onto sodic areas) may result in a diminished grass cover, eventual loss of the top soil layer and an area which is susceptible to erosion and bush encroachment. Where soil structure is lacking and sodium levels high (as explained above) we get these extensive sodic patches. In these dispersing soils, treating them with Gypsum (CaSO_4) basically reverses the clay dispersion. Such treated soils will not crust, and will store larger quantities of water in the profile, due to improved structure. Gypsum therefore re-structures the clays and with proper management, results in water going into the re-structured soil and not running off and causing erosion, while at the same time creating favourable conditions for plant establishment. A small area can be used as a test site to illustrate to landowners how these eroded areas can be addressed. The initial relatively small scale site will reduce costs. As stated, these areas are popular among grazers and the small size of the area and its proximity to water may hinder rehabilitation.

BNR obligation: Board to determine.

Scale: Depends on the extent of sodic areas that are vulnerable.

Costing: IP/RG/Wardens to insert ORR cost – labour, mechanical, gypsum purchase and transport. Consultants as required for ecological assistance, monitoring, analysis, report back, etc.;

Responsible: ORR Board Member, Warden/s Priority, Consultants as a resource.

Timeline: Responsible ORR Board Members, Wardens to decide.

Method: Break the hard surface to a depth of around 10 cm by mechanically ripping the surface. Apply the gypsum at a rate of between 2 and 4 t ha⁻¹. Details in field to be discussed once a decision to go ahead has been made.

Monitoring (see Section 3.2): To demonstrate the improvement to members is it important that a simple vegetation survey, using the dry weight ranking method, where three dominant grass species, distance to and tuft size of each are recorded at every drop of a disk pasture meter (c. 50 drops). This generates information about the grass species contributing most to the grass biomass as well as an index of cover. Tree species composition and density can be measured but this would not be the focus of the exercise as soil surface cover is the objective.

5.6.4 Project Proposal Number 2: Maintain woody plant densities

Purpose: To maintain woody plant densities at levels which maximise grass production (by minimising woody/grass competition);

To reverse bush encroachment on areas which were previously considered open woodlands (refer 1944 and later aerial photographs) and on areas that will respond positively to bush control; to create preferred habitat for grazers.

Cross reference to this document: Action plan Part 3.1 point 4; Part 4 section 4.6.2.; Part 5 section 5.2. This may be considered a low priority on ORR which will be confirmed by analysis of historical air photography.

Status: To be determined.

Reference (including GPS position): Warden to insert GPS location.

Comment: The purpose of bush thinning in appropriately defined areas is aimed at determining whether linking the thinned areas at a width of around 100 m attracts low density shorter grass grazers such as wildebeest, while improving visibility for prey (the landscape of fear) in detecting predators. Landowners, it is hoped, will also benefit from driving through more open woodlands with productive grasslands and with better visibility for spotting animals. This approach is recommended, provided the following criteria are met:

- The area was previously open; and/or
- The area will respond positively to thinning in terms of grass establishment.

This is determined by an examination of historic aerial photography and examining the patterns in the landscape.

BNR obligation: To be determined by Wardens for ORR and BNR

Scale: Moderate to minor

Costing: Wardens to insert ORR costing – labour, mechanical, chemicals and transport. Consultants as required – for ecological assistance, monitoring, analysis, report back, etc.

Responsible ORR Board Members, Warden Priority:

Timeline: responsible ORR Board Member, Warden to decide

Method: See Part 6 section 6.2.2 of this document.

Monitoring: Expert assistance will be required to monitor the extent and effect of the habitat rehabilitation programme and review the success of coppice control work:

- Visit one site in each thinned block and sample a minimum of 30 treated plants per site. Calculate kill rate and for plants not killed determine whether it is due to coppice (missed part of the plant during treatment) or suckering (from beneath the soil – unavoidable).
- Visit one site in each thinned and adjacent un-thinned block and:
 - conduct a grass survey using dry weight ranking method where three dominant grass species, distance to and tuft size of each are recorded at every drop of the disk pasture meter (c. 50 drops). This generates information as to the grass species contributing most to the grass biomass as well as an index of cover;
- Conduct a tree survey recording tree species composition, density and structure (0-1 m, 1.1-2 m, 2.1-5 m and >5 m) in a belt alongside the 50 surveyed grass points (50 m x 2 m).

5.6.5 Project Proposal Number 3: Monitor Fauna

Purpose: Record all animal species as part of the broader annual census in the APNR to provide data for modelling animal performance, age and sex ratio and species suites.

Cross reference to this document: Action plan Part 3.1 points 4 and 6, Part 4 section 4.6.2, Part 5 section 5.3.

Status: Proposed

Reference: Warden to collate and analyse game sightings and locations from landowners (or grid position).

Comment: This exercise is aimed at determining whether linking of thinned areas at a width of around 100 m does in fact improve game sightings. It is a simple yet effective way of determining whether this objective is being met while involving interested landowners (citizen science).

BNR obligation: part of the annual census managed by ARC; Board to determine.

Scale: Moderate-large

Costing: Landowners fund the project; Warden/s to insert ORR cost; Consultants for ecological assistance, monitoring, analysis, report back, etc.;

Responsible: ORR Board Member, Warden Priority

Timeline: Ongoing immediate

Method: Record species and position (grid from map compiled by Warden/s and GPS), approximate number and distance into the veld at which animals are sighted. Data sheet compiled by Warden/s.

Monitoring: Warden/s, Consultants as needed – Landowners to hand data sheets to Warden for collation, capture, analysis and report back.

5.6.6 Project Proposal Number 4: Sustainable firewood harvesting

Purpose: Determine the amount of firewood available from the habitat rehabilitation, and 'sacrifice' areas such as the power line and rail reserve.

Cross reference to this document: Action plan Part 3.1 point 4; Part 4 section 4.6.2; Part 5 section 5.2;

Status: Proposed

Reference: Warden/s to insert GPS location.

Comment: This exercise is aimed at determining current levels of removal and whether some firewood from selected species (such as *Combretum imberbe* (Leadwood), *C. apiculatum* (Red Bushwillow), etc.) can be sustainably removed from the veld without deleteriously affecting the functioning of the system. The same areas are obviously not harvested on a regular basis. This can be a controversial issue for a number of reasons such as removing habitat for invertebrates and smaller vertebrates, etc. There is a school

of thought that some sustainable removable is possible where larger trees, that may take time to break down, may be used for other purposes, e.g. firewood. Several species such as *C. imberbe*, *Colophospermum mopane* (Mopani), the heart wood of *Senegalia nigrescens* (AKA *Acacia nigrescens*; Knob thorn), etc. do not breakdown for several decades, so the nutrients remain locked in the wood. In historical times, when fire was a regular component of the landscape the nutrients were released to the system. This mechanism is now largely absent in the ORR and greater BNR. Therefore, given the ban on collecting firewood in the KNP and general APNR, the Boards and landowners of ORR must decide whether this is an acceptable action or not. Having data on harvesting rates and sustainable harvesting will help counter any arguments to the contrary and support responsible Stewardship.

BNR obligation: None.

Scale: Small (at least to start and probably in the long term).

Costing: Warden/s to insert ORR cost but as it will form part of the bush thinning programme. The labour, removal and transport is largely covered. On the other hand, there is an income from the sale of the firewood; consultants for ecological assistance, monitoring, analysis and report back;

Responsible: ORR Board Member, Warden

Timeline: responsible ORR Board Member, Warden/s

Method: Within a number of demarcated areas of say 30 m x 30 m, all dead wood that can be picked up or branches broken off is collected and weighed. The exercise is repeated the following year to determine the amount of wood produced annually. As wood is not produced in regular amounts, the project should be ongoing.

Monitoring Warden/s and Consultants as required – Collation and analysis of data and report back.

5.6.7 Project Proposal Number 5: Manage water points

Purpose: Take necessary management actions to manage water points.

Cross reference to this document: Action plan Part 3 section 5, Part 4 section 4.6.3 and Part 5 sections 5.4;

Status: Proposed

Reference (including GPS position): Warden/s to insert GPS location.

Comment: The significantly altered availability of and access to permanent artificial water at ORR and indeed throughout the APNR is unlikely to change in the short term, even if some water points are closed (because they are so close together anyway) and given the water provision policies and practices within the APNR. Perceived advantage of providing permanent water is that we cater for water-dependent species thus ‘satisfying’ shareholder’s game viewing expectations. The disadvantages are that we are facilitating game (especially Elephant and Impala) to stay on the reserve during the seasonal dry periods and especially drought where Elephant, in particular, would normally move off. This obviously leads to overutilization of the vegetation and an increase in tree damage. Elephants and Impala switch quickly from grazing to browsing in dry periods and drought years when the grass is depleted. Because the provision of artificial water allows them to be ‘resident’, the impact on the grass layer is sustained and cumulative and this leads to reduced grass growth and a weakened grass layer. Elephants add to their destructive impact by uprooting trees, as the roots provide a valuable source of nutrients.

This is a clear case whereby the shareholders’ desires for year-round game viewing are in conflict with the need to manage a sustainable ecosystem. Therefore, within these constraints, management needs to look at what can be done to both maintain ecosystem integrity while still satisfying shareholder needs. The proposal is to:

- Reach agreement for a water supply management programme for animals;
- Assess the longer term effect of the artificial provision of water on the various habitats on ORR; and
- If necessary, close down over utilised water points – temporarily as a rehabilitation strategy or permanently e.g. near sodic sites (decision to be based on Landscape Functional Analysis or similar system); and
- Future management to be based on objective monitoring and research.

The Board and landowners must decide whether this is an acceptable action or not (there are both negative and positive consequences).

BNR obligation: None.

Scale: Small in the vicinity of water points.

Costing: Consultants – for ecological assistance, monitoring, analysis and report back;

Responsible: ORR Board Member, Warden.

Priority: Moderate-high

Timeline: responsible ORR Board Members, Warden to decide priorities

Method: 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. Conduct a vegetation survey (direction of the four cardinal points) at say 20 m, 40 m, 60 m and 80 m away from the water point. At each sampling site use the following method at 20 points, 1 m apart: Dry weight ranking method where three dominant grass species, distance to and tuft size of each are recorded at every drop of the disk pasture meter (≈ 20 drops). This generates information as to the grass species contributing most to the grass biomass as well as an index of cover. While the grass layer is of interest at these points it would be useful to conduct an elephant impact survey where trees say larger than 5 m are surveyed for damage using the Walker 7-point scale. Conduct a tree survey recording tree species composition, density and structure (0-1 m, 1.1-2 m, 2.1-5 m and >5 m) in a belt alongside the 20 surveyed grass points (20 m x 2 m).

Monitoring Warden/s and Consultants – Collation and analysis of data and report back.

5.6.8 Project Proposal Number 6: Collect rainfall on a regular basis

Purpose: To collect rainfall on a regular basis (at least monthly) to facilitate understanding the vegetation production and potential use of fire as well as threats from arson fires.

Cross reference to this document: Action plan Part 3 section 5, Part 4 section 4.6.3 and Part 5 section 5.4;

Status: Proposed.

Reference (including GPS position): Warden/s to insert GPS locations.

Comment: The importance of rainfall as a major driver in savanna ecosystem function makes this measurement essential. A number of gauges should be in place to determine the distribution of rainfall across ORR.

BNR obligation: None.

Scale: Spatially distributed across the entire area of ORR.

Costing: Wardens, Consultants – for ecological assistance, monitoring, analysis and report back;

Responsible: ORR Board Members, Warden.

Priority: High.

Timeline: Daily to weekly ideal but at least monthly.

Method: Standard collection and recording from distributed rain gauges.

Monitoring Wardens and Consultants – Collation and analysis of data and report back.

5.6.9 Project Proposal Number 7: Community engagement

Purpose: To formally address ORR's responsibility to provide input into the broader BNR social responsibility programme.

Cross reference to this document: Sections 1 - 6 and 10 (BNR plan - Peel *in prep.*) address the above aspect of management.

Status: Proposed.

Reference: Corporate Social Responsibility.

Comment: Despite legislated obligations, the need for engendering good neighbour relations is obvious and needs no detailed motivation. The ORR have been instrumental in setting up the Balule Outreach Trust (BOT), as founder and sole contributor. This instrument, as it gathers momentum, can be used for a sustainable Community Engagement Programme. Should the level of resources allow, an appropriately qualified Community Liaison Officer (CLO) can be appointed to the BNR team to serve all reserves for a co-ordinated Community Engagement Programme (a job description and Terms of Reference (TOR) can be provided). Ideally the candidate will be from the community adjoining the BNR and it is essential they have an excellent rapport with the community and excellent communication skills. Duties will include 'mapping' the community to determine opportunities for community-based entrepreneurs to pursue opportunities *inter alia*:

- provision of temporary labour gangs for special and fixed-term projects;
- recycling;
- waste management;
- composting;
- market gardening (including guidance to ORR staff gardens);
- beneficiated products from staff gardens;
- sustainable consumptive use of medicinal plants and thatching materials; etc.

The implementation of this proposal will assist ORR with several specific objectives related to management of staff, rehabilitation projects, reduction in waste, managing organic waste, plastic and the like.

BNR obligation: Coordination of the programme and human resource management of the CLO. Determine and collect contributions in consultation with Trustees of the BOT.

Scale: Spatially distributed across the entire area of BNR but emphasis on ORR. Depends on each region's contribution to the BOT.

Costing: To be determined once level of the post of CLO is decided.

Responsible ORR Boards Members, Warden Priority: Moderate to high.

Timeline: Ongoing but fixed term contract initially.

Monitoring: Boards and Wardens of BNR. Monthly progress reports from CLO.

6 GUIDELINES RELATING TO TECHNICAL ASPECTS OF SOME IDENTIFIED PROJECTS

This part provides technical guidelines for management relating in particular to:

- Soils – erosion and roads in particular;
- Vegetation – Fire management, bush thinning and alien vegetation;
- Water provision

6.1 Soils

6.1.1 Erosion Reclamation

The soils of the ORR are generally vulnerable and erodible, so careful attention needs to be paid to the management of surface water (see also Part 3 above). The extensive road network in both the North and the South, while not as intense as some adjoining properties, requires constant and well-planned management. The management of roads and ensuring the drainage and water management system is operating optimally is

essential. In particular, the number, placement, size and shape of berms and mitre drains are critical.

6.1.1.1 Erosion on Cleared Areas

Where necessary, soil moisture conservation can be achieved by using the felled tree crowns as contour brush packs above the donga head/s to minimise rainfall runoff into the drainage line (Figure 5). Important principles include:

- Brush packs must be laid out on the contour;
- A dumpy level should be used to peg out contour lines;
- Do not place brush packs closer than three times the vertical height of the donga head;
- Leave an opening of about 1 m between the brush packs on the same contour line;
- Stagger these openings between brush packs on adjacent contour lines (Figure 5); and
- If there is old fencing material or wire mesh available, use this to anchor the crowns as contour brush packs. Crosscut stems of felled woody plants can be sharpened as anchor pegs.

Eroding donga heads can be stabilised by building stone packs in the donga itself (Figure 6). Important principles include:

- Stone packs should not exceed 1.2 m in height (where possible gabion baskets should be employed);
- Each stone pack must be keyed in (at least 25 cm) on each side of the donga (see Figure 6);
- The spillway must be as wide as is practicable since the emphasis is on trapping silt and not creating a dam; and
- The entire upstream side of the stone pack should be lined with smaller rocks, stone and gravel as this acts as a filter and traps silt.

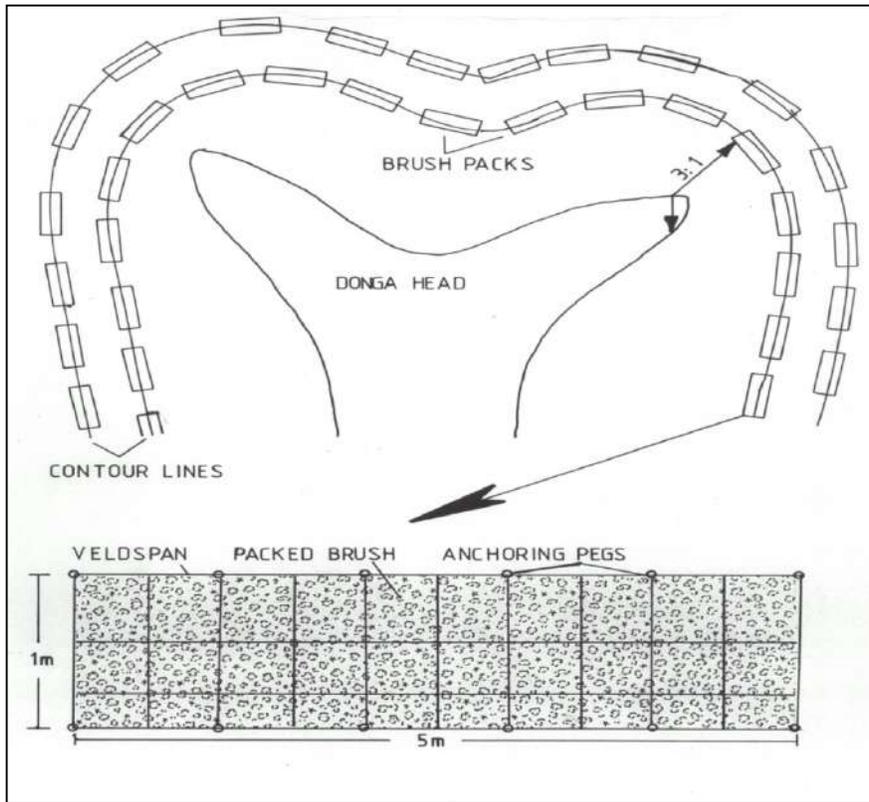


Figure 5 The layout and dimensions of contour brush packs.

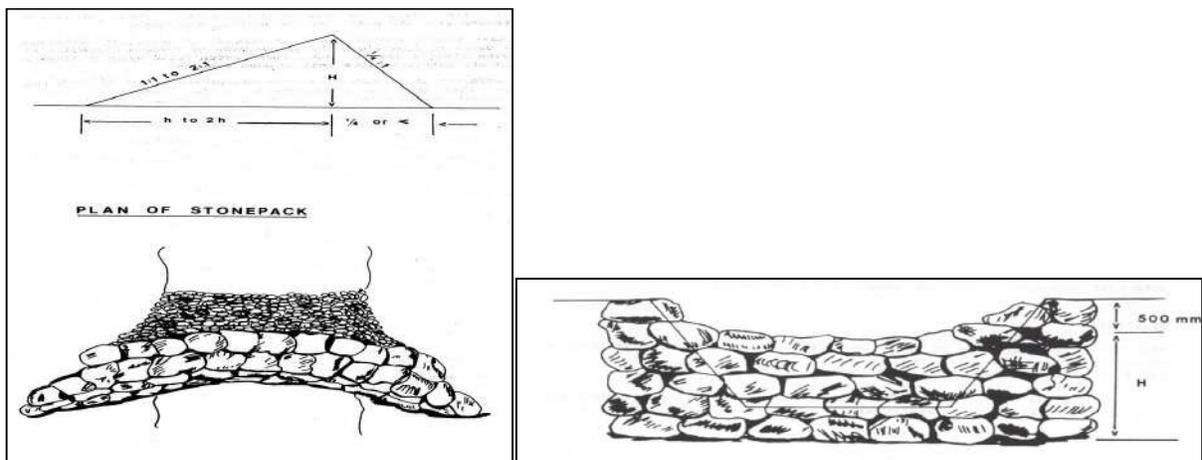


Figure 6 Details of a typical stone pack – Rocks should be elongated/flat/oval-shaped and hard durable and heavy – Pack the rocks so the long axis lies parallel to the upstream slope of the structure (1.5:1) – Ensure good bond in length and depth of structure with foundation and shoulders.

6.1.1.2 Erosion from Roads and Tracks

The objective is to minimise soil erosion and rainfall runoff from all roads and tracks on ORR by the correct drainage and placement of roads. Specific goals should be to:

- Reroute existing roads that are actively eroding;
- Reclaim and rehabilitate eroded sections of rerouted roads; and
- Where necessary, place new roads so that erosion is minimised.

6.1.1.3 Rerouting Existing Roads

Some soil types are more prone to soil erosion than others and **one of the basic principles of road construction is to avoid, if at all possible, soil types that are highly susceptible to erosion.** In the granitic areas of the Lowveld, soils that are most susceptible to erosion are the bottomland soils, particularly those that are saturated with sodium (sodic patch or '*brak kolle*'). The excess of sodium that moves down the slope from the uplands causes the clay particles to disperse instead of forming aggregates. This results in a hard impermeable sub-soil that is extremely susceptible to erosion and not conducive to grass growth. The recommendation is that **roads located on sodic areas be rerouted onto ridge crests or above the ecotone and that these tracks are adequately drained.** If it is not possible to reroute these tracks, then they should be hardened (using sandier all weather material) and built up above the surrounding area. **Another basic principle to minimise erosion is that roads should be sited on the ridge crests wherever possible as this disposes of a major problem in road maintenance, viz. drainage.** Where it is not possible to place a road on a crest, the next best alignment is on a gentle slope close to the true contour. Road traffic on wet (especially sensitive areas) can cause surface rutting which concentrates the flow of water on the road. Here cross-drainage measures are needed to interrupt this flow and divert it laterally before it concentrates and causes erosion. Cross-drainage can be done in a number of ways:

- Using mitre drains which are extensions of road cross-drains leading away from the road on the contour at an angle of about 30°- 40°;
- By crossbanks which are humps across the road; or
- By outsloping which is the sloping of the camber towards the downhill side of the road.

It is recommended that **roads should be cross-drained using a combination of mitre drains and crossbanks on steep, eroded sections. On flatter sections, roads should be drained using mitre drains only.** There are combinations as described above and relevant principles are outlined below (Figure 7):

- Place crossbanks and mitre drains where roads are rutted and there are signs of erosion wherever the slope of the road is above 2% (i.e. 2 m rise or fall over 100 m);
- On steep, eroded sections, crossbanks should extend on either side of the road, so that runoff water from the road is not diverted around them and back onto the road;
- If needed, bring soil in to build an adequate crossbank;
- Compact the crossbanks well, particularly where vehicle wheels will cross them, otherwise the crossbanks may be breached at these low points caused by compaction of the tyre tracks;
- The mitre drain should discharge the runoff water **along the contour** line and **never** down slope so that a donga does not form; and
- Regular inspection and maintenance of these structures is critical. The best time is late winter just before the spring rains.

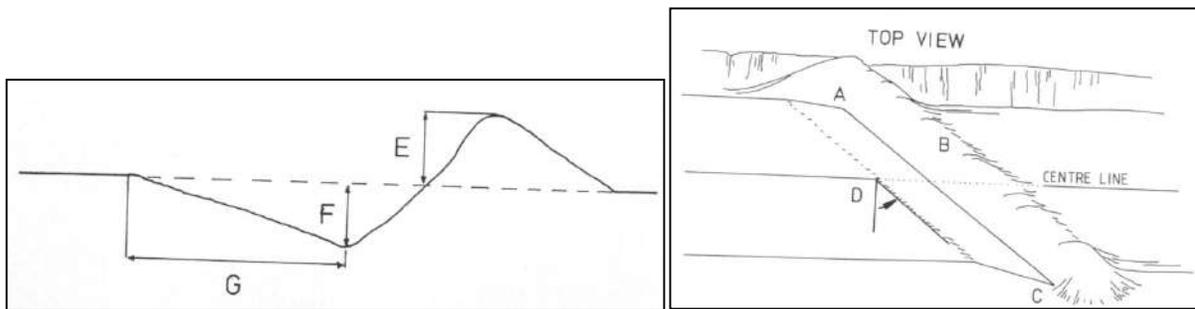


Figure 7 The layout and dimensions of crossbanks/mitre drain combinations. Average specifications given, adjust for situation as required. A=at tie in point with road verge cut 15-30 cm into the road bed; B=crossbank height should be 30-60 cm above the road bed; C=mitre drain outlet should be cut 20-40 cm into the road verge; D=angle mitre drain 30° to 40° downslope of the road centre line; E=crossbank height can be up to 60 cm; F=mitre drain depth can be up to 45 cm; and G=length of G can be 90-120 cm.

6.1.1.4 Reclaiming Eroded Roads

The Wardens need to evaluate each road to determine if certain roads on the reserve are presently acting as storm waterways and it may be more cost effective to re-site or close these and reclaim them rather than maintain them. Important principles to bear in mind when reclaiming eroded roads are:

- The entire road width and especially the compacted ground where the vehicle tracks run should be ripped with a grader or tractor drawn ripper, with at least a 300 mm tine penetration;
- Steep areas of roads should be drained with small crossbanks and mitre drains; and
- The entire road should be densely brush packed with the crowns of the cut brush facing down.

The size and number of crossbanks and their associated mitre drains is a function of slope angle (expressed as a percentage called road grade) and soil types. There are several formulae to calculate this in specific detail for each case but the expense of getting the relevant survey teams and experts is not warranted. Fortunately, several useful guides are available (Table 3)

Table 3 The recommended spacing for crossbanks and mitre drains depending on soil erodibility

| Road grade (%) [percent slope equals (rise/run) x 100] | Drain spacing (m) depending on erodibility | | |
|---|--|------|-----------|
| | Moderate | High | Very high |
| 1 - 5 | 750 | 500 | 300 |
| 6 - 10 | 600 | 300 | 150 |
| 11 - 15 | 300 | 150 | 100 |
| 16 - 20 | 150 | 100 | 75 |
| From: Forest road handbook. ICFR & FESA. 215 pages. | | | |

The soils across ORR, with limited exception, will be classified as ‘high’ and ‘very high’ erodibility. This can be determined by inspection using the following rule of thumb:

- 1) soils with surface pebbles and rocks are very high; and
- 2) those with finer surface soil and evidence of some clay are high.

There are no moderate or low erodibility soils based on the field inspection conducted in September 2019. All roads that impact sodic sites must be rerouted to ensure they do not cross a sodic site and all water is drained away from the sodic area.

6.1.1.5 Additional roads

The roads network across ORR provides access to all habitat types. With the exception of areas such as that bounded by 'Natures Valley Road' and 'Warthog Drive' in the South and 'Elephant Walk' and 'Sandbank Drive' in the North, as examples, the road coverage is relatively dense. This despite the fact the other reserves in the BNR have a much higher density of roads. The problem with too high a density of roads is cost of erosion control escalates and the need for additional borrow pits is obvious. None of these are desirable in terms of Responsible Stewardship.

More importantly, however, is a too dense road infrastructure leaves no areas as refugia for animals and in some cases also plants. Refugia are important to maintain ecosystem services and allow animals to exist relatively undisturbed. Having such refugia within the home range of species such as leopards is useful to ensure they remain resident in the area.

The addition of further roads in the ORR is therefore not recommended.

6.2 Vegetation

The monitoring and management of vegetation is the foundation of the enterprise on ORR and requires regular assessment (see Point 4 in Part 3 above).

6.2.1 Fire Management

Veld burning serves two useful purposes. Firstly, it removes old, unpalatable (moribund) grass unused from previous seasons which tends to smother the remaining grass if it is not removed (grass plants have basal meristems so require light to penetrate to the soil surface). Secondly, if the veld can be burnt regularly with an intense fire ($>4 \text{ t ha}^{-1}$ standing grass; $>25 \text{ }^\circ\text{C}$; and up to 20 km h^{-1} wind), it suppresses the establishment of young trees and helps in combating bush encroachment. Fire is a valuable tool in the management of natural vegetation, particularly in savanna areas such as ORR which

receives a relatively low rainfall when compared to other areas in the eastern Lowveld. Fire is a natural component of the system that has been excluded for too long.

As the ORR is relatively dry and the grass cover generally well under 4 t ha^{-1} standing crop, approaching 1.5 t ha^{-1} at best, regular intense fires are not probable. However, this does not eliminate the use of fire as a valuable management tool. Annual vegetation monitoring should include and assessment of standing crop using a Disc Pasture Meter. The assessment should be made at the beginning of winter and include identification of areas to be burnt. In periods of wet seasons burning excess grass in areas identified for bush control and those designated to be kept as open grassland may take place annually (see below and depending on the set objectives). In dry periods fire may be excluded or less frequent. A critical principle is to ensure large enough areas (>10 to 15 ha) should be burnt to minimise the potentially detrimental impacts of large numbers of animals concentrating on the recently burnt area. A number of 10 to 15 ha blocks should be burnt at the same time in a mosaic, dispersed across the ORR. Both planned and unplanned fires should be mapped and these records used to determine the timing and extent of controlled burns, when seasonal conditions allow. There needs to be a structured and active burning programme and fire recording system.

The veld-burning programme should aim at:

- Removing excess litter and old growth (which hampers new growth) to maintain a diverse, vigorous and productive grass sward; and
- Achieve a good top-kill rate on encroaching woody plants where this is the objective.

With increasing variability in rainfall, it is proposed that the veld be burned opportunistically when sufficient grass fuel ($>2 \text{ t ha}^{-1}$) has accumulated to allow an effective burn that will achieve the laid down objectives based on the following:

- If fuel load is less than 2 t ha^{-1} , then no burn should be attempted;
- If the fuel load lies between 2 t ha^{-1} and 4 t ha^{-1} , then a low intensity burn should be put in to maintain a vigorous and diverse grass sward;

- If the fuel load exceeds 4 t ha^{-1} , then a high intensity burn should be put in to combat bush encroachment (technical details on assessing the fuel load and fire intensity can be obtained from the authors).

6.2.2 Bush Thinning Programme

Bush thinning is the process by which the density of woody plants is modified. Because woody and grass plants compete for water in these semi-arid areas, bush thinning can increase the amount of grass produced in an area. Ecological bush thinning is aimed at reversing bush encroachment, increasing grass production, and creating preferred habitat for a diversity of game species in a way that creates an aesthetically pleasing landscape while ensuring a high quality game viewing experience.

A comparison of the 1944 and 1986 aerial photographs of the eastern Lowveld exhibit a pattern of increasing woody plant density over extensive areas. As stated previously, such increases in woody plant density has a negative impact on the major land-use in the area, viz, nature-based tourism. There is a critical need for thinning and coppice control, which is environmentally responsible, cost effective and which is appropriately monitored.

The use of a professional contractor and trained field staff is recommended as the most efficient approach to control bush, should this be needed. The use of species specific systemic chemicals is favoured as they allow for the selective control of target woody species. Access (Reg. No. L 4920) is the most commonly used chemical in the area. It must be remembered that bush control is seldom a once-off operation and follow-up treatment will be necessary. This can be managed by reserve staff under the direction of the wardens. If specialist contractors are used initially, the wardens need to use the opportunity to develop the knowledge needed to reduce the need for outsourcing.

As an example guideline for the application of Access, is a 2% mixture of Access mixed with Actipron and water with a dye added. The concentration depends on the density of the target species. The cost of re-treatment and follow-up is approximately a quarter of the initial treatment. Foliar application is sometimes used using a 0.75% mixture

formulated as described above. The initial and follow-up operations are done as cut stump treatments (as close to the surface of the soil as possible but maximum 10 cm above the ground).

The success of clearing operations is gauged by the length of time that the area remains open while maintaining a good herbaceous species composition, cover and production. Sites should be re-visited annually to determine the amount of coppice, suckering and natural recruitment of tree seedlings, in order to determine the type and timing of further treatment. It is emphasized that bush thinning is a regular management activity and not an event. Furthermore, no 'total clear' should be attempted, even in cases of monospecific stands of undesirable species, unless these are aliens and the area requires significant rehabilitation. The objective is to develop a functional savanna system where the ratio of grass to bush is self-sustaining.

When doing coppice control the following is important:

- It should be done systematically, in that one area must be completed (including the plan for the follow up treatments), before a new area is tackled
- Thinned areas should be re-treated as soon as game viewing is impaired by re-growth (this could be on a seasonal rotation basis);
- Fire (preferable) and herbicides are important tools in controlling coppice in the long-term; and
- Other management actions (e.g. strategic water provision and related animal densities) are important in keeping the thinned areas satisfactorily open.

6.2.3 Alien Vegetation Control

Certain alien plants colonise disturbed areas and then invade the indigenous vegetation. Such invasive alien plants replace or out-compete indigenous plants, causing considerable changes in the habitat. These changes are generally harmful to the animal and plant species associated with the natural habitat. The alien plant control programme should aim to:

- Eradicate invasive plants that are alien to the area (including introduced indigenous species); and
- Preventing further infestations.

Today there is an armoury of effective techniques to combat alien plants, from machines to the technology of biological control and a large array of sophisticated chemicals (Technical information on alien plant control can be obtained from the authors). Some guidelines to ensure that the alien plant control programme is run effectively follow:

- Mechanical removal should be employed for those species that can be controlled this way;
- Initial treatment of the target species should always be followed up with treatment of regrowth and seedlings;
- Species specific herbicides should be used in preference to broad spectrum chemicals;
- The training of labour in the effective application of herbicides and labour supervision;
- Personal Protective Equipment (PPE), as recommended by the manufacturer shall be **COMPULSORY** for all operators (the Wardens must instruct any contractor on this);
- Once mixed herbicides should be used as quickly as possible;
- Store herbicides in a cool place in the original containers and out of direct sunlight and destroy empty containers so they cannot be reused to store other liquids; and
- Knapsack sprayers should be washed out after use daily and no herbicide mixture should be left in the sprayer tanks for long periods.

6.3 Provision of Water

The living requirements of wild animals include food, cover and water. Some species are, however, more dependent on water than others. Water dependent species need drinking water at regular intervals and their densities decline markedly more than 5 km from water (e.g. Impala, Warthog and Bushbuck). Work done in the Kruger Park has shown that even Impala have an average daily cruising radius of 2.3 km from water (Young 1970). This

essentially means that any water closer than 2.3 km from another water point is in fact an oversupply for water dependent species. Zambatis (1982) recommended that water points should be spaced a minimum of 3 km and preferably 5 km apart. This is equivalent to one water point per 1 000 ha to 2 200 ha respectively. The situation in the APNR is one water point per c. 700 ha. For ORR it is 15 water points or one water point per c. 646 ha, against the recommended number being six (i.e. 1 per 1600 ha – the average as per Zambatis). This also ignores the permanent access to water along the Olifants River, so, based on these 'norms', ORR has over 250% of the recommend 'water holes'.

Given the sensitivity around providing water to enhance game viewing, it is recommended that existing artificial water points should be retained as controllable water points that can be opened or closed to encourage game movements and thus reduce the problem of soil erosion, trampling and heavy utilisation of veld near water points. The financial and ecological implications relating to infrastructure maintenance and water use and related ecological issues (as mentioned above) are of critical importance.

6.4 Ecological Monitoring

To reconcile the possible tension between game viewing objectives and sound veld management practices in the long-term, it is recommended that an adaptive management approach be adopted on ORR. Adaptive management is the term used to describe the system of making management decisions based on past successes and failure (manage-to-learn-learn-to-manage). Adaptive management depends on:

- Annual determining animal numbers by species;
- Measuring animal performance (and indirectly on visitor/landowner experience);
- Measuring change in vegetation; and
- Recording the environmental conditions in which the management system is applied.

All four are important and based on adaptive management, it is imperative that the following be done:

- Regular collection of environmental data, rainfall in particular (preferably on a daily basis);

- Make a note of animal mortalities and note species, sex, age class (adult, sub-adult, juvenile), physical condition (Figure 8), cause of death, date found and location;
- Make notes on the structure of animal populations (sex and age);
- Continue with the vegetation monitoring (as part of the Lowveld Protected Areas veld monitoring programme) and the bush thinned areas in order to:
 - Detect changes in the vegetation that conflict with veld management goals;
- Assess veld condition and trend on any thinned areas (and possibly in the vicinity of water points); and
- To monitor grass species composition and production, so that rational veld management decisions can be taken.

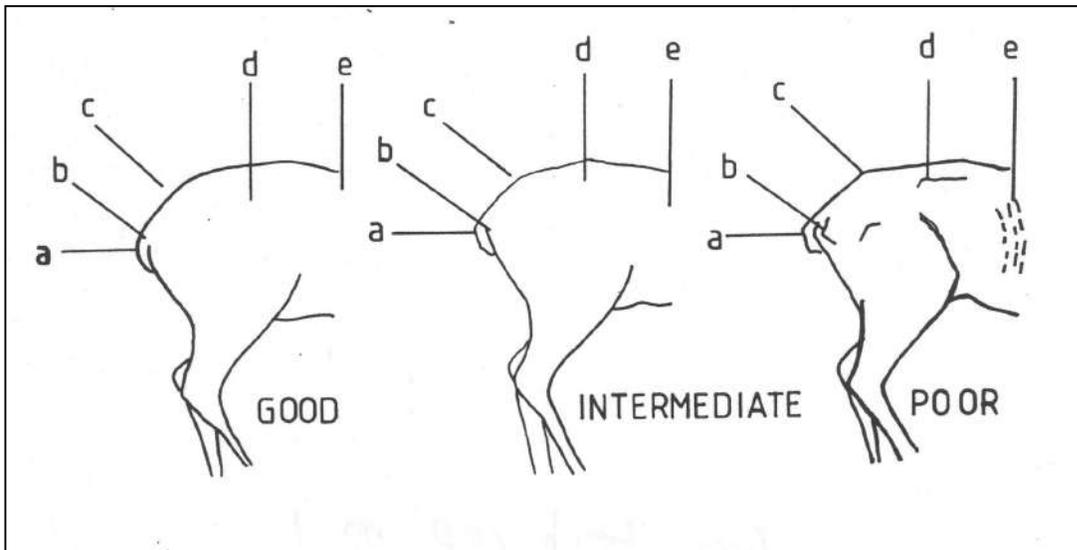


Figure 8 Illustration animal condition assessment using external features – a=tail; b=point of pelvic girdle; c=point A; d=lateral processes of backbone vertebrae; e=outline of ribs.

The scoring of physical condition is – POOR if point of pelvic girdle is visible, lateral processes of backbone vertebrae are visible and/or outlines of ribs are visible – GOOD if tail has no angles and there is no angle at point A - INTERMEDIATE if individuals are neither obviously in a poor or good condition.

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APPENDIX 1 – Specific plans for Olifants River Reserves

The plans for the two reserves are prepared as separate documents:

- 1. Protected Area Management Plan: Olifants River Game Reserve**
- 2. Protected Area Management Plan: Olifants North Game Reserve**