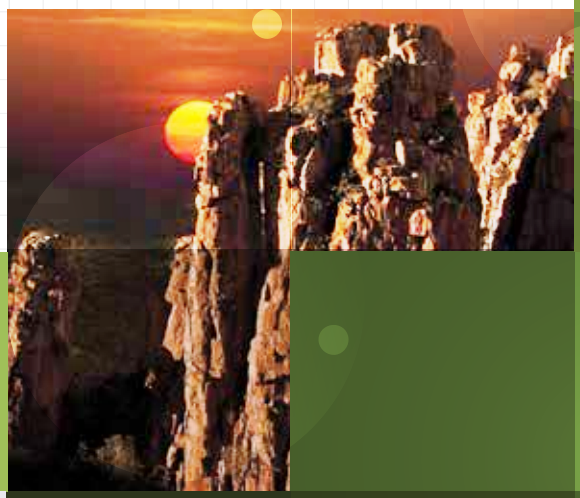
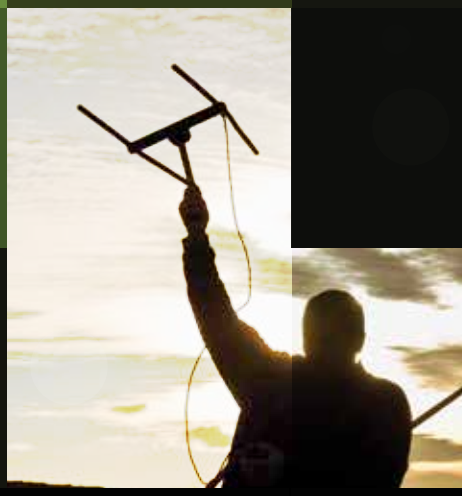
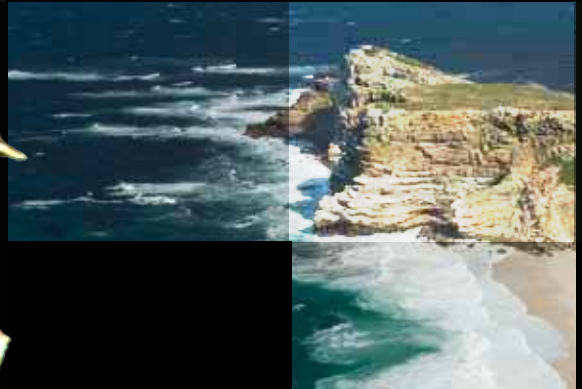
South African
NATIONAL PARKS

SANPARKS
RESEARCH REPORT
2013





SANPARKS 2013 RESEARCH REPORT:

Research and Monitoring: Interface with Legislation, Policy and Management.

FOREWORD

Over the past 50 years, rates of resource use and destruction of natural systems have reached alarming proportions, driving long-term biodiversity loss and eroding the ability of ecosystems to produce essential services. The world's 177,000 protected areas remain a conservation cornerstone, providing refuges for endangered species and preserving scenic beauty, but also safe-guarding ecosystem services and stimulating economic development. However, realising the societal value of these areas depends on their effective management. Protected areas are embedded in ever-changing socio-political and ecological contexts, and conservation challenges are highly dynamic and often without an obvious right or wrong answer. Increasingly, effective conservation management and policy need to be supported by rigorous evidence provided by science. SANParks relies on its in-house science function to generate relevant, timely and rigorous information, both through own research and cooperative, agreements with external institutions such as universities. As such, it is important for our scientists to demonstrate leadership and excellence in conservation science. This report serves both as an account to our stakeholders of some 2013 research highlights and as a mechanism for internal reflection and adaptive learning.

INTRODUCTION

Structure and function of Scientific Services, SANParks

The Conservation Services Division (headed by Managing Executive Dr Hector Magome) is tasked with providing SANParks with leadership in conservation through scientific, technical and policy support services. It comprises a number of units, of which Scientific Services (headed by Mr Danie Pienaar) conducts the bulk of SANParks' research in both the biophysical and social sciences. Other units under Conservation Services that contribute to research are Park Planning & Development, Veterinary Wildlife Services and Policy & Governance.

Scientific Services is divided into the following research nodes, each with its own diverse complement of researchers, technicians and support staff that seek to conduct research across a variety of disciplines relevant to management strategies, and actions and in compliance with national legislation and policy:

- Savanna & Arid Research Unit (headed by Dr Stefanie Freitag, with three main offices in Skukuza, Phalaborwa and Kimberley, and a number of satellite offices across the parks);
- Cape Research Centre (headed by Dr Wendy Annecke, with one office in Tokai); and
- Garden Route (headed by Dr Rod Randall, with three offices: Rondevlei, Knysna and Saasveld).

Rigorous research provides managers and decision-makers with an essential evidence base for conservation management and policy. Such scientific evidence helps to identify and mobilise resources needed to combat threatening processes and/or ensure that protected area values are preserved. Furthermore, having breadth of scientific expertise in-house: (1) improves the organisation's ability to absorb, transform and utilise external scientific information, (2) serves as a catalyst for collaborative research with external organisations, and (3) enables SANParks to be proactive in identifying knowledge gaps.

Historically the research emphasis has been on the biophysical sciences. In recent years, the social sciences domain has increasingly gained prominence. This broadening of scope is reflected in the appointment in 2013 of social scientist, Dr Wendy Annecke, to manager of the Cape Research Centre. Moving forward Scientific Services aims to foster stronger links between biophysical and social science research.

About this report

Peter Novellie

In 2012 SANParks produced the first of what will be a series of annual stand-alone research reports, thus starting on a learning journey, highlighting and reflecting on a diverse range of research activities. This, the 2013 report, continues the learning journey. Like its predecessor, this report does not intend to be comprehensive and all-encompassing, but uses an exemplar approach to research and monitoring. It differs, however, in that the contributions were chosen to highlight relevance to conservation management, legislation and policy.

This recognises that SANParks is not primarily a research organisation, rather its research is focused on the mandate of managing a system of parks which represents the indigenous fauna, flora, landscapes and associated cultural heritage of the country. This mandate gives SANParks accountability for conservation of important

3-Second Brief:

This Research Report aims to highlight the essential role played by research and monitoring in demonstrating SANParks' performance in achieving outcomes set in legislation and national policy. SANParks is accountable for managing complex socio-ecological systems, and in such systems the pathway to achieving desired outcomes is seldom predictable and straightforward. Research and monitoring are vital to guide the way to successful achievement of desired outcomes.

public assets. As for all organs of state, there is a need to measure performance in achieving objectives. SANParks' mandate is framed in national legislation and policy, and answers to South Africa's commitments as a signatory to the Convention on Biodiversity (CBD) and other international conventions. Hence the criteria against which SANParks is held accountable follow from this body of legislation and policy.

Accountability for performance represents a particular challenge for SANParks. The public assets for which it is accountable are socio-ecological systems, characterised by complexity and inherent unpredictability. In such systems relationships between management interventions and desired conservation outcomes are not always clear and foreseeable. It is recognised virtually worldwide that adaptive management constitutes the best, if not the only, approach to the task of managing complex natural systems.

To manage complex systems it is necessary to formulate conceptual models regarding the way the system functions, and to anticipate likely responses of the system to management interventions. Management interventions are applied as experiments. Outcomes of research and monitoring provide the essential 'feedback' that allows re-evaluation and adaptation of management interventions and the models upon which they are based. Research and monitoring are therefore central to SANParks in demonstrating performance in managing public assets.

It is often not appreciated that complex systems are never fully knowable. Hence the challenge of testing performance in managing natural systems through research and monitoring is widely underestimated. In this report we hope to provide a reflection of the nature of this challenge by highlighting the relationships between research and monitoring on the one hand, and legislation and policy directives on the other. The report should therefore be of interest not only to scientists, but also to conservation managers and policy-makers.

3-Second Brief:

The strongly collaborative basis for SANParks' research and monitoring derives from a set of conservation values adopted by SANParks. SANParks science-management forums promote interactive collaboration with park and tourism managers. SANParks policy facilitates and encourages wide collaboration with local and international researchers.

Setting out values and principles guiding research and monitoring in SANParks

Harry Biggs

SANParks has a broad mandate requiring appropriate support from its scientists, and has a history of taking research and monitoring seriously in relation to management needs. Over the last two decades goal-oriented approaches to conservation management have led to value-based 'desired future states' being set for the various parks and surrounds, as well as for particular themes, such as research. In this article we outline the foundational values and principles on which all research and monitoring in SANParks are based.

A good starting point is the set of conservation values adopted by the organisation. These are:

- Respect for complexity (the richness and diversity of the socio-ecological systems which include national parks, and all the interdependencies and interactions) which in turn enables biophysical, aesthetic, cultural, spiritual and educational benefits. This 'complexity framing' has important systemic implications for research and monitoring.
- Striving to maintain natural processes in ecosystems as well as the authenticity and worth of cultural heritage components. This provides important focus for research and management.
- Managing with modesty, since the systems under our stewardship are complex and can only ever, even as knowledge increases, be partly understood. Furthermore there are many drivers beyond our direct control, as our values influence, and are influenced by, the values of our many stakeholders.
- Striving to maintain a healthy flow of ecosystem and socio-cultural goods and services. These are defined by collaboratively determined desired states.
- When necessary, intervention in systems should be responsible and based on the

principles of sustainability and of using only the level of interference needed to achieve the mandate, preserving all options for future generations yet, importantly, recognising that systems change over time.
- Finally, there is a recognition that conversion of some natural (e.g. road clearing) and cultural capital has to take place to sustain the mandate, but should not happen in a way that erodes the core values above.

All the above values (complemented by well-known regular corporate aspirational values such as accountability and transparency) therefore set the broad framework within which research and monitoring take place in SANParks. More detailed guidance as to exactly which research themes or monitoring approaches are needed for which particular parks or situations, is heavily dependent on park management objectives that are co-developed with stakeholders and technical experts. Also important in guiding research are technical and policy documents such as the Biodiversity Monitoring Programmes.

The particular way in which research and monitoring are implemented is an extremely important additional determinant of success. In addition to being guided broadly by all the above values, SANParks practices very wide collaboration with local and international researchers, supported by an open and friendly system of project registration and of co-learning. SANParks often convenes useful or important forums, for example, the Annual Savanna Science Network meeting in Kruger NP. SANParks has popularised the term 'science-management links' and practices, wherever possible, a highly interactive collaboration between external scientists, SANParks scientists and park and tourism managers. In this, adaptive management serves as a central joint learning and response tool.

Related:
Read about SANParks' Biodiversity Monitoring System on page 8

Related:
Read about internally- and externally-driven research projects on page 13, and about the Savanna Science Network Meeting on page 62

Strategic processes, legislation and policies that shape and are shaped by research and monitoring objectives

Strategic Adaptive Planning as applied in the context of the development of park management plans

Stefanie Freitag-Ronaldson

Conceptually and legislatively there has been a shift from centralised command and control towards participatory natural resource management and protected area governance systems in South Africa. An example is the National Environmental Management: Protected Areas Act (NEMPAA), which makes it obligatory for park management plans to be developed in consultation with stakeholders. This does not, however, remove responsibility from SANParks as designated management authority. Reconciling the need for participatory governance and enabling ongoing adaptation, the Adaptive Planning Process is an essential early component of Strategic Adaptive Management (SAM). A special issue on Strategic Adaptive Management was published in SANParks' in-house journal *Koedoe* in 2011, Volume 53 (2). It is an easy and effective tool for enabling real stakeholder participation in producing an effective shared rationale or overall big picture 'desired state' for a national park. It requires expression of the various stakeholders' value systems and then builds on the shared values to consider all possible system drivers (social, technological, economic, environmental and political). The process enables stakeholders to consider opportunities to strengthen the vital attributes of the park and their determinants and to counteract the threats and constraints to these. These opportunities are formulated as the high level objectives of the park management plan. In this way the desired state of the park, its vision and mission, and high level objectives are co-constructed with stakeholders. This strategic-level guidance obtained through stakeholder consultation is then unpacked into further detail and articulated as sub-objectives, either in-house or with relevant experts.

10-Second Brief:

The Strategic Adaptive Planning Process was developed by SANParks to build consensus on and ensure stakeholder buy-in to the strategic direction taken in managing national parks. This process ensures that the desired state (vision/ mission and high-level objectives hierarchy) set in park management plans are co-constructed with stakeholders, thus enabling SANParks to meet an important requirement of the National Environmental Management: Protected Areas Act.

Related:
Read about *Koedoe* on page 18

Related:
Read about the complexity of socio-ecological systems on page 4

Related:
Read about the Heterogeneity Paradigm on page 25

At the same time, ecosystems are known to be complex and dynamic. The best management response for such systems necessitates ongoing testing and learning to deal with ongoing change. This does not simply mean that if something doesn't work, then just try something else. SANParks uses strategic (or 'forward-looking') adaptive management to set clear and explicit ecosystem and other objectives. These are designed to allow system variability rather than attempting to hold it in one particular state. We believe that allowing variability over space and time supports biodiversity in its widest definition and provides the best platform to absorb natural or unnatural disturbances (e.g. droughts, effects of global environmental change, economic crises). In this way spatial and temporal heterogeneity promotes desirable system resilience (Rogers 2003).

To allow for system variability the desired state comes with the definition of end-points or desired trajectories of change, often described as 'thresholds of potential concern' or TPCs (Biggs & Rogers 2003). These assist SANParks in articulating the nature and extent of the desired variability to support the objectives, and provide warning lights as we approach the undesirable variability and/or states. SANParks uses these thresholds as key links between research, monitoring and management. Research is often geared at better identifying or understanding both the thresholds and the mechanisms by which they manifest; monitoring aims to measure changes in relation to hypothesised system drivers and thresholds; and management uses thresholds as a cue to consider action.

For more than a decade SANParks has been using the Adaptive Planning Process with stakeholders. This often requires managing differing individual and/or group values, prejudices and sensitivities. Nevertheless, the process provides all participants with a space to express their own and understand other's views. This ensures mutual understanding and commitment to both the process and the end product, namely the park management plan.

Stakeholders, including representatives from various NGOs and government departments, local landowners and residents, and contractual partners participate in the Tankwa Karoo NP and the Marakele NP park management plan revision processes.

References

Rogers, K.H. (2003). Adopting a heterogeneity paradigm: Implications for biodiversity management in protected areas. In: du Toit, J.T., Rogers, K.H. & Biggs, H.C. (Eds) The Kruger experience: Ecology and management of savanna heterogeneity. Island Press, New York. Pp. 41-58.

Biggs, H.C. & Rogers, K.H. (2003). An adaptive system to link science, monitoring and management in practice. In: du Toit, J.T., Rogers, K.H. & Biggs, H.C. (Eds) The Kruger experience: Ecology and management of savanna heterogeneity. Island Press, New York. Pp. 59-80.

Making the links to enable feedbacks: Strategic Adaptive Management, the Desired State of the Parks system and the Biodiversity Monitoring System

Stefanie Freitag-Ronaldson

Decision-making amidst uncertainty and multiple belief and value systems is challenging. Dealing with such complexity requires multi-scale approaches to adaptive evaluation. This article describes three relative prioritisation and evaluation processes, and their interactions and feedbacks. This system is important in determining objectives and targets, and shapes and guides SANParks' research and monitoring efforts to enable directed and effective resource allocation.

The Desired State of Parks

While all park management plans address main themes such as biodiversity, tourism, awareness, neighbour benefits, not all parks can 'mean everything to everybody'. It became apparent that desired states set in individual park plans lacked overall strategic and policy guidance, which was inevitable given that each park plan was developed in isolation to meet the requirements of NEMPAA. In 2011 SANParks embarked on a process to encourage meaningful differentiation of parks based on their relative strengths, potential and contribution to the overall SANParks strategy. SANParks recognised that to achieve its broader organisational mandate, a desired state for the national park system as a whole is required. The development of a 'Desired State of Parks' entailed three steps, namely:

- identifying key components of the Desired State of Parks that enable SANParks to fulfil its mandate (including overall biodiversity value, scenery and landscape, cultural heritage value, range of tourism products, revenue generation, socio-economic contribution, bioregional context, education and awareness, bank of rare or threatened organisms, consolidation and expansion potential, sustainable living practices);
- assessing the actual and potential future contribution of each national park to these different components of the desired state; and
- developing a risk profile for each park with respect to attainment of the desired state.

The Desired State of Parks has relative prioritisation implications for individual park management plans and will be reflected in the objectives and targets of park management plans as they are revised.

3-Second Brief:

Multi-scale adaptive evaluation processes are required to deal with the inherent uncertainty associated with complex systems. Three key interrelated processes in SANParks are: the Desired State of Parks, Strategic Adaptive Management, and the Biodiversity Monitoring System. These three approaches are influential in shaping SANParks' research and monitoring focus.

Strategic Adaptive Management

Strategic Adaptive Management can be regarded as comprising two parts: adaptive planning and adaptive implementation. The former is described in the previous article. Adaptive implementation gives effect to SANParks' desire to 'learn by doing'. In this phase, managers and researchers jointly scope options to achieve set objectives. This includes anticipating outcomes, assessing their acceptability and then selecting the best combination of management intervention options. Systems diagrams have been increasingly used to scope such management options by making explicit the anticipated linkages between drivers and their systemic influence and associated outcomes. Together with risk-benefit analyses, implementation decisions are then made on best available knowledge. This approach provides a collective 'mind map' of current understanding of system function and enables predictions to be made for management options and outcome evaluation. Research and monitoring serve to test predictions and to provide the feedback necessary to reassess current understanding of the system.

Related:

See an example of a systems diagram on page 49

Biodiversity Monitoring System

The Biodiversity Monitoring System (BMS) comprises a suite of ten Biodiversity Monitoring Programmes (McGeoch *et al.* 2011) and was developed to standardise certain monitoring components across parks for ease of comparison and thus enhanced learning, while at the same time enabling organisation-level reporting. The system is designed to provide baseline data, methods and procedures as well as status and trend information upon which management action decisions can be made. Baseline monitoring includes background variables (e.g. rainfall, temperatures, etc.) and baseline biodiversity inventories and assessments. In addition, ongoing surveillance monitoring for the slow changing variables and/or indicators, often at broader scales, assist in keeping an overall 'finger on the pulse'. Monitoring for decision-making and management feedbacks in the ecological systems integrity programme (also known as the biodiversity mechanisms programme) is aimed at shorter- to medium-term detection of unacceptable directional change across a variety of scales and in response to key concerns.
The 10 programmes deal with:

- biodiversity mechanisms;
- freshwater and estuarine systems;
- habitat degradation and rehabilitation;
- species of special concern;
- alien and invasive species;
- resource use;
- disease;
- climate and climate change;
- habitat representation and persistence; and
- organisational reporting.

Specific park-level biodiversity monitoring programmes for implementation are then developed in support of park management plans.

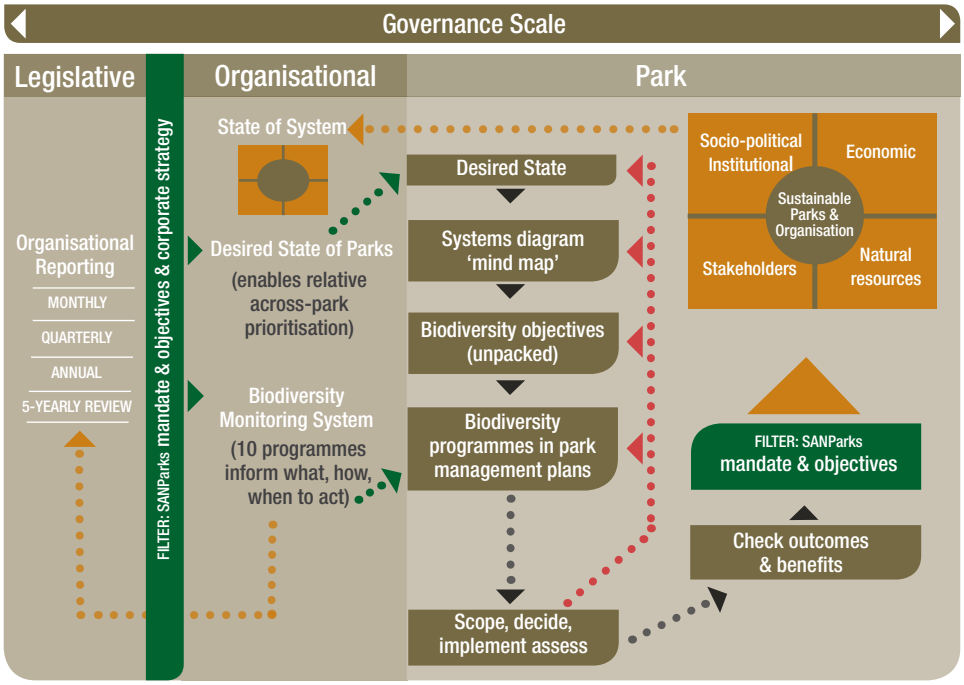


Figure 1: Relationships between Strategic Adaptive Management, Biodiversity Monitoring System and the Desired State of Parks.

Figure 1 depicts the linkages between the three processes outlined above, showing the prioritisation influence on park level planning by the Desired State of Parks and the Biodiversity Monitoring System (green arrows), cascading Strategic Adaptive Management

processes from desired state setting with stakeholders, to management plan implementation and outcome evaluation (black arrows), within-park adaptive feedbacks and reflection (red arrows), and strategic organisational level reflection from park to organisational mandate and legislative levels (orange arrows).

Such multi-scale adaptive evaluation is intended to enable completion of the links and feedback loops. Nevertheless, a key challenge lies in streamlining and consolidating feedback loops and prioritisation efforts across parks, regions and science nodes, providing sufficient comparability while enabling local flair and adaptation. We are currently striving for 'progressive realisation' and ongoing adaptation of monitoring implementation while finalising the organisational biodiversity reporting system. Thereafter, we must be moving beyond the biodiversity components to include the all-important people and tourism objectives as a next step.

International Conventions, National Legislation and National Biodiversity Performance Indicators: Implications for monitoring and research

Peter Novellie

South Africa has signed numerous international conventions on the protection of the environment and biodiversity, thereby accepting the commitments they entail. Many of these commitments have been incorporated in national legislation, and influence both regulations issued in terms of legislation, and national policy. The legislation also makes provision for Norms and Standards to guide the development and implementation of measures to protect the environment and biodiversity. These have certain direct or indirect implications for SANParks research policy, and for the conduct of research and monitoring in parks. The relationship is two-way. The legislation and regulations influence the type of research and monitoring that needs to be conducted, and research and monitoring should guide the revision of legislation to optimise its effectiveness. This article indicates how the different contributions to this Research Report link with national legislation, international conventions and national performance indicators.

10-Second Brief:

Natural systems are complex. The outcomes of any attempts to influence them to achieve selected objectives are not fully predictable. This holds whether the attempts constitute management programmes, legislation, regulations or policies. Research and monitoring are therefore needed to verify effectiveness in attaining objectives, even in the case of legislated measures. The conservation of natural systems requires good science-policy interfacing.

Reference

McGeoch, M.A., Dopolo, M., Novellie, P., Hendriks, H., Freitag, S., Ferreira, S., Grant, R., Kruger, J., Bezuidenhout, H., Randall,R.M., Vermeulen, W., Kraaij, T., Russell, I.A., Knight, M.H., Holness, S. & Oosthuizen, A. (2011). A strategic framework for biodiversity monitoring in South African National Parks. *Koedoe* 53(2): Art. #991. DOI:10.4102/koedoe.v53i2.991.

INTERNATIONAL CONVENTIONS, COMMISSIONS AND TREATIES

relating to Biodiversity Conservation and Protected Areas, to which South Africa is a signatory

NATIONAL ACTS, REGULATIONS, NORMS & STANDARDS AND POLICIES

with which Protected Areas have an obligation to comply

SANParks Research and Monitoring

SANPARKS POLICIES

A policy is a statement of corporate principles to guide decision-making and operations of the organisation

SANPARKS STRATEGIES

A strategy is a broad non-specific statement of an approach to accomplishing desired goals and objectives

SANPARKS PROCEDURES

Procedures explain how to implement policy and strategy and take the form of frameworks, guidelines, protocols or standard operating procedures

Frameworks	Guidelines	Protocols	Standard Operating Procedures
Conceptual structures used to address complex issues, outline courses of action and present a preferred or reliable approach	Documents standardising or streamlining actions and approaches to improve effectiveness and quality of operations throughout the organisation	Mandatory procedures for standardising actions and approaches or codes of correct conduct	Management processes that describe chronological steps to follow and decisions to make in carrying out tasks or functions

Related:

Read about advances in monitoring techniques on pages 24 and 37

The National Environmental Management: Protected Areas Act (NEMPAA) (Act 57 of 2003) http://sanparks.org.za/docs/general/ProtectAreasAct.pdf

This Act requires that the management authority of a protected area conduct monitoring to ensure that income-generating activities do not negatively affect the survival of any species in, or significantly disrupt the integrity of, the ecological systems of the national park. The BMS of SANParks (McGeoch *et al.* 2011) is designed to give effect to this requirement in NEMPAA. This requires the development of appropriate monitoring techniques, as well as the collaborative design and implementation of monitoring projects.

Regulations in Terms of NEMPAA for the Proper Administration of Special Nature Reserves, National Parks and World Heritage Sites https://www.environment.gov.za/sites/default/files/gazetted_notices/nempa_naturereserves_administrationg28181gon1061.pdf
Section 7 of these Regulations requires annual reporting to the Minister on the use of all biological resources in parks during the preceding financial year.

Section 38 of the National Environmental Management: Biodiversity Act (NEMBA) (Act 10 of 2004) https://www.environment.gov.za/sites/default/files/legislations/nema_amendment_act10.pdf
Section 38 of NEMBA requires the Minister to adopt a National Biodiversity Framework (NBF) and to monitor implementation of this Framework. The NBF identifies priority areas for the establishment of protected areas to conserve representative examples of South Africa's biodiversity (the National Protected Area Expansion Strategy or NPAES). This means monitoring and reporting on progress in expanding and consolidating national parks, as well as representation of threatened biomes and vegetation types in parks.

Related:
Read about resource use on pages 45 and 46 and about the diversity of vegetation types and threat status of plant species on page 55

Section 9 of NEMBA
Section 9 allows the Minister to issue Norms and Standards for the achievement of any of the objectives of NEMBA. National norms and standards have been promulgated to guide the development of Biodiversity Management Plans for Species (BMP-S). Of particular importance to SANParks are the Norms and Standards for the Management of Elephants in South Africa. Adherence to Norms and Standards is mandatory.

Related:
Read about the development of BMPs for bontebok and Cape mountain zebra on page 31

Sections 43 and 45 of NEMBA
Section 43 makes provision for Biodiversity Management Plans (BMPs), either for an ecosystem or for an indigenous species. Section 45 provides for monitoring and reporting against the BMP by the responsible authority. In 2013 SANParks collaborated with other conservation authorities and stakeholder in the development of BMPs for bontebok and Cape mountain zebra

The Convention on Biological Diversity (CBD) http://www.cbd.int/convention/
The CBD has three main goals: to promote the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of benefits from genetic resources. Articles in this Research Report are relevant to two components of the CBD:

- the Global Strategy for Plant Conservation (GSPC); and
- Article 8f which calls on parties to rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies.

Related:
Read about the complexities of ecological rehabilitation on page 35 and about climate change monitoring on page 29

The GSPC **http://www.cbd.int/gspc/** addresses the challenges posed by threats to plant diversity, and has the following five objectives:

- plant diversity is well understood, documented and recognised;
- plant diversity is urgently and effectively conserved;
- plant diversity is used in a sustainable and equitable manner;
- education and awareness about plant diversity, its role in sustainable livelihoods and importance to all life on Earth, is promoted; and
- the capacities and public engagement necessary to implement the Strategy have been developed.

United Nations Framework Convention on Climate Change http://unfccc.int/resource/docs/convkp/conveng.pdf
Parties to this international treaty undertake to cooperatively consider what they can do to limit average global temperature increases and the resulting climate change, and to cope with and adapt to whatever impacts are inevitable. The Convention requires monitoring and reporting on climate change and its impacts on biodiversity. National parks are potentially important reference sites in monitoring climate change impacts.

Related:
Read about the state of SANParks' wetlands on page 53

Ramsar Convention http://www.ramsar.org/cda/en/ramsar-home/main/ramsar/1_4000_0__

The Ramsar Convention, officially known as the Convention on Wetlands, provides a framework for the conservation and wise use of wetlands. Contracting parties to Ramsar are obliged not only to promote the conservation of the wetlands on the List of Wetlands of International Importance but also, as far as possible, all wetlands in their territory. Thus SANParks needs to implement relevant Ramsar policies and regulations for all wetlands across national parks. Ramsar also urges that conservation areas be established to protect wetlands, and that adequate provisions be made for their management.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) http://www.cites.org/eng/disc/what.php

CITES is an international agreement between governments that aims to ensure international trade in specimens of wild animals and plants does not threaten their survival. Information on the endangered status of species in trade, and the factors that affect their status, are critical for decisions on trade regulation through CITES. SANParks is required to provide relevant information to the Department of Environmental Affairs (DEA). Of current concern is the illegal international trade in rhino horn and the poaching threat to South Africa's rhinos.

Related:
Read about SANParks' integrated rhino research approach on page 22

Performance Indicators in Biodiversity Conservation

Measuring performance is important for all organs of state responsible for managing public assets, which is a particular challenge when those assets are complex natural systems. The Department of Performance Monitoring and Evaluation in the Presidency was established to monitor performance in achieving government priorities. Each Minister has signed performance and delivery agreements with the President **http://www.thepresidency-dpme.gov.za/keyfocusareas/outcomesSite/Pages/default.aspx.**

SANParks' research and monitoring has relevance for many of the indicators of Outcome 10, the delivery agreement for the environment. Again, the relationship is two-way. Research and monitoring results are used to show performance according to the indicators. They should also be used to assess the relevance and usefulness of the indicators. Monitoring and research during 2013 contributed to the Outcome 10 indicators. However, in a number of cases we note that the national indicators are inappropriate and could be improved upon when it comes to reflecting the situation in the parks.

OVERVIEW of RESEARCH

Registered research projects

SANParks' policy of registering research projects

Peter Novellie

As a long-standing tradition, SANParks has encouraged research in national parks. This is in accord with section 20(2) of NEMPAA which states that parks should provide scientific opportunities which are environmentally compatible. SANParks' approach to the registration of research projects meets this provision of the Act.

In terms of this approach, prospective external researchers are invited to submit research proposals outlining research questions, methods, anticipated study period, as well as requirements for support from SANParks. Support may include accommodation in research facilities in parks, if available, or the protection by game guards if field work needs to be conducted in parks with dangerous animals. A reasonable fee is charged for these services.

Each research proposal is evaluated by the relevant research node in terms of its logistics, and possible risks to the environment or to the quality of visitor experiences in national parks. If the proposal involves handling of animals it is referred to the SANParks Animal Use and Care Committee, which is responsible for ensuring that the highest ethical standards are maintained in the treatment of animals. The research committee also rates each proposal in accordance with its relevance to SANParks' knowledge needs and management objectives. High priority proposals may merit particular support from SANParks. However, no project is rejected solely on the basis of its relevance to SANParks' priorities. Projects may be rejected if they are incompatible with the environment, visitor experiences or with ethical treatment of animals, if they are deemed unfeasible, or if SANParks does not have capacity to meet the requirements of the project. In general few proposals from external researchers are rejected.

Related:

Read about research outputs by external collaborators on page 19

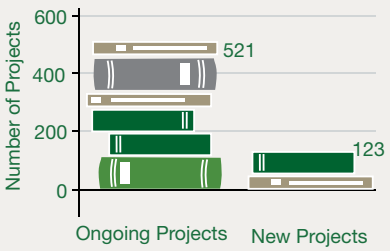
If accepted, researchers enter into an agreement with SANParks, and undertake to provide reports on the outcomes of the project as well as copies of data and publications. In this way SANParks ensures that national parks are available for a wide range of scientific research, and that research results are available to potentially inform the management of parks.

Report on the scope of the research projects

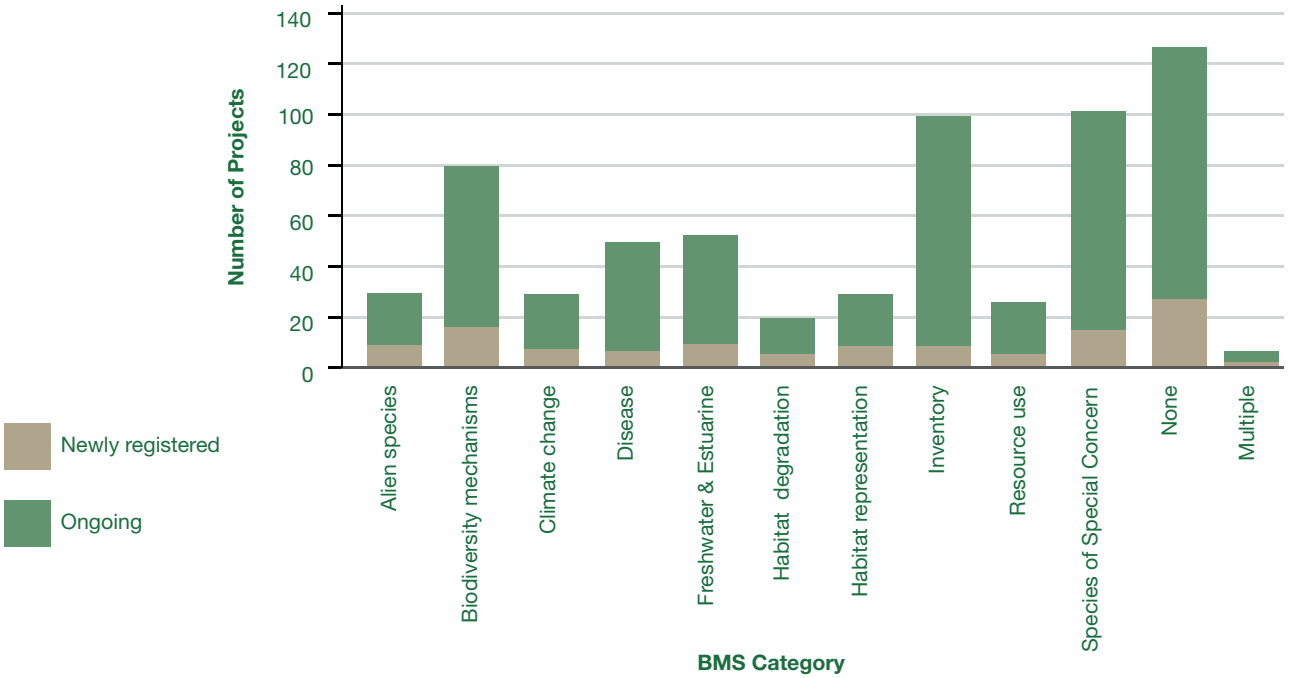
Nicola van Wilgen, Jessica Hayes, Deborah Winterton & Rheinhardt Scholtz

During 2013 there were 644 registered research projects active across SANParks, 123 of which were registered during the year, while the rest were ongoing from previous years (Fig. 2). Eleven per cent of the projects were initiated and driven by SANParks scientists, while the remainder were led by external researchers, with 22% overall initiated by research institutions outside of South Africa. Sixty seven per cent of research is therefore led by researchers from South African universities, government institutions like South African National Biodiversity Institute (SANBI) and South African Environmental Observation Network (SAEON) and national NGOs (Fig. 3). The majority of projects are active in Kruger NP (213), which is the biggest national park and houses SANParks' oldest research node, and Table Mountain NP (185), which is in close proximity to three national universities and a technical university (Fig. 3).

In 2013:



644 registered research projects were active



Related:
Read about the BMS on page 8

Figure 2: The number of active research projects in SANParks during 2013 grouped according to their most relevant contribution to SANParks Biodiversity Monitoring System programmes.

Traditionally SANParks has used a number of different classification systems to classify projects (e.g. by ecosystem or by the importance of the project to SANParks). For the purposes of this report, projects were classified using the nine major programmes of the SANParks BMS. Although this categorisation broadly relates each project to a BMS programme, the projects are not necessarily (in fact for the most part not) monitoring projects *per se*. In addition to the nine categories in the BMS, an 'inventory' category was added for projects that do not relate directly to one of the programmes, but provide important baseline data on particular taxa or systems.

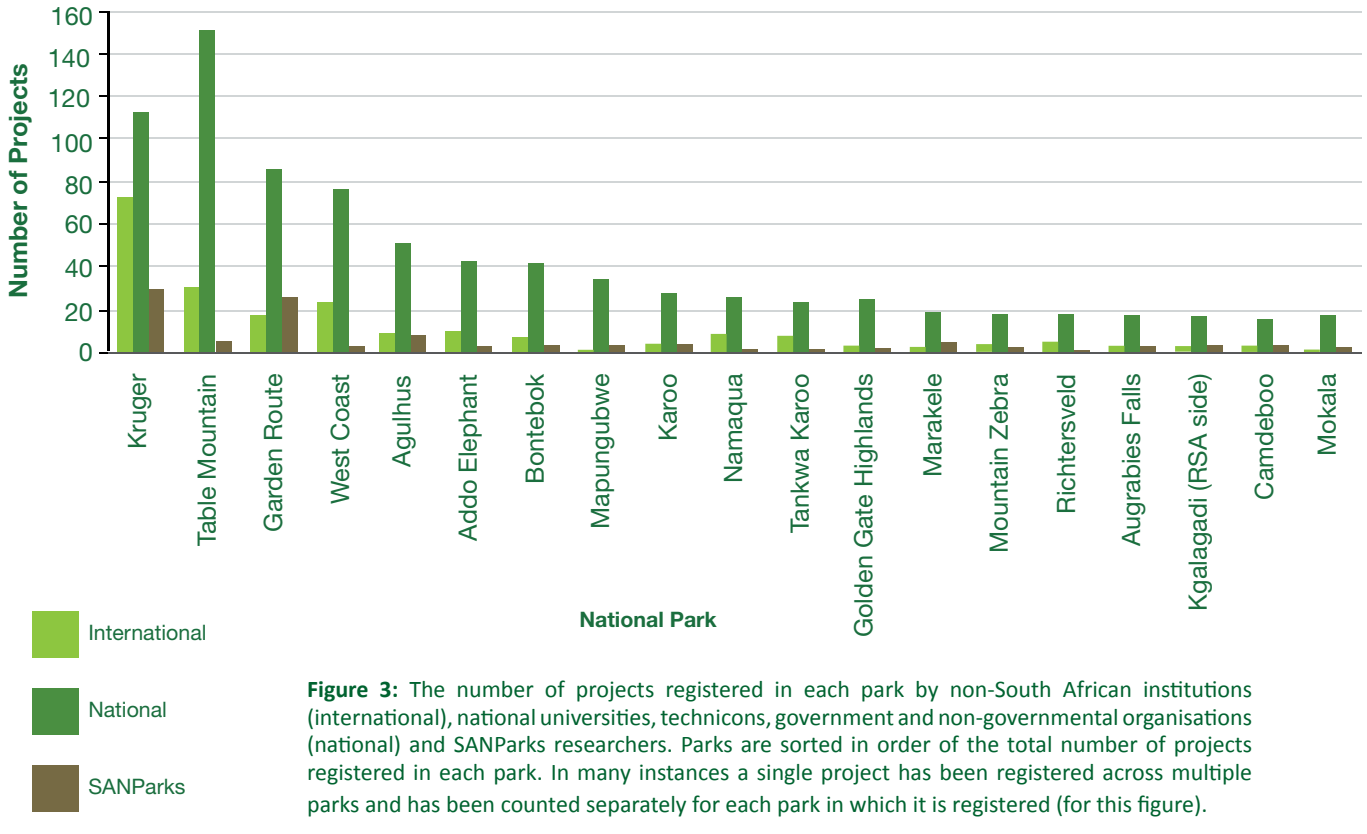


Figure 3: The number of projects registered in each park by non-South African institutions (international), national universities, technicons, government and non-governmental organisations (national) and SANParks researchers. Parks are sorted in order of the total number of projects registered in each park. In many instances a single project has been registered across multiple parks and has been counted separately for each park in which it is registered (for this figure).

Focal research areas for the 644 projects are similar for SANParks-led and externally-led research projects (Fig. 4), with research on species of special concern and biodiversity mechanisms (fire, herbivory, pollination and interactions between these and other programmes) being the most prominent. Inventory projects collecting a variety of types of baseline data were also common, particularly for externally-driven research and the majority were classified upon registration as essential or important (Fig. 4a). In its current format, however, the BMS does not include social research or tourism monitoring (approximately 37 projects that were not related to the other categories) nor the direct monitoring of long-term geological processes or pollution. For this reason many registered projects were deemed not to be associated with SANParks' monitoring system categories ('none' in Figs. 2 & 4). Other projects in the 'none' category include those focusing on individual species or taxa that are not threatened or of special concern, as well as physiological and certain evolutionary studies.

Upon registration, SANParks-led research was nearly always classified as Essential or Important towards achieving SANParks' objectives (Fig. 4b), as were most of the externally-led projects. Assessment of the relevance of the research to monitoring priorities, however, requires a park-level focus as these priorities are set individually per park. Because the BMS is a fairly new system, in several instances park-level priorities for data collection are still being assessed. For some parks, a need to initiate additional projects in areas that are currently 'under-researched' has already been identified. As the BMS is implemented more widely, it is expected that future research projects will align more closely with park-level priorities and that SANParks will actively encourage external research in important areas where in-house capacity is constrained.

Related:

Read more about SANParks' policy on registering research projects on page 13

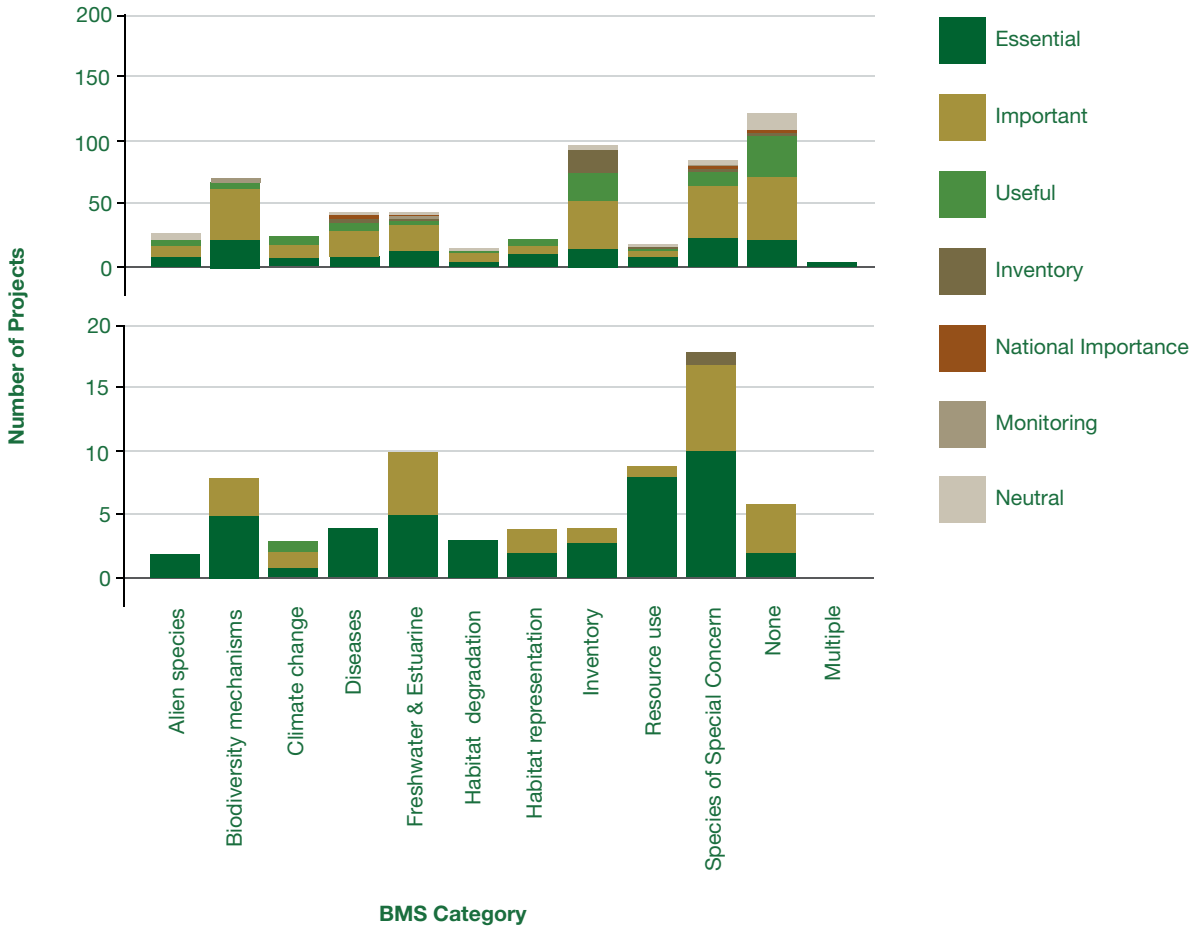


Figure 4: The importance of projects, as classified at the time of their registration, being led by (a) external and (b) SANParks researchers, conducted in each category.

In 2013:

54 Articles were published in peer-reviewed journals

43 Staff Members Contributed as authors

11 as Principle author on **17 Articles**

92% of the articles were published in *Thomson Reuters* **Accredited** and **83%** in **International journals**

Publications and Conferences

Papers in peer-reviewed journals

Izak Smit, Luanita van der Walt, Llewellyn Foxcroft & Inês Ferreira

During 2013 SANParks research staff authored or co-authored 54 peer-reviewed journal articles (see Appendix A for full reference list). This represents an increase of approximately 19% on the number published in 2012. Forty-three staff members contributed as authors (up from 37 in 2012), with a total of 82 SANParks authorships across the papers. Eleven SANParks staff members were principle authors on 17 (~31%) of the publications. Most staff members authored/co-authored a single paper (28), 13 authored/co-authored two to four papers, while two staff members published five or more papers in 2013.

The 54 publications were spread across 38 journals, 35 (92%) of which are accredited by Thomson Reuters (formerly ISI), and 83% (45) of which are international. The former cover a range of impact factors (as defined and determined by Thomson Reuters) (Fig. 5). According to the 2012 impact factors (2013 impact factors will only appear in the second half of 2014), four (7%) of the papers appeared in journals with impact factors greater than five, namely *Ecology, Ecography* (2 papers) and *Remote Sensing of Environment.*

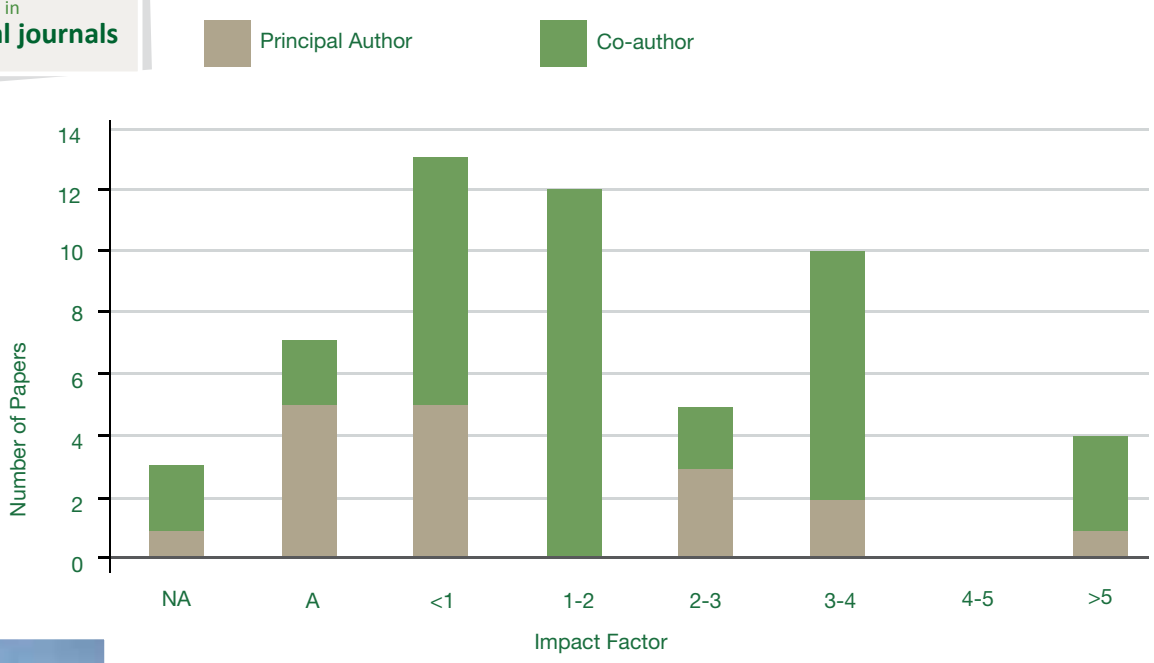


Figure 5: Number of peer reviewed papers published by SANParks research staff during 2013 according to impact factor of journals (NA = not accredited; A = accredited, awaiting 1st impact factor). Impact factors were obtained from journal and/or publisher websites, and **www.bioxbio.com.**

The most frequently used journal for research dissemination was the in-house journal *Koedoe* (6 papers) – see *Koedoe* insert. Nine journals have more than a single paper published with SANParks-affiliated authorship, with the remaining 29 journals having a single paper (Table 1).

Table 1: Journals in which SANParks research staff published in 2013 as principle author or co-author (ordered by number of papers, followed by impact factor) (A = accredited by Thomson Reuters, awaiting first impact factor; NA = not accredited by Thomson Reuters) (full reference list in Appendix A). Impact factors were obtained from journal and/or publisher websites, and **www.bioxbio.com.**

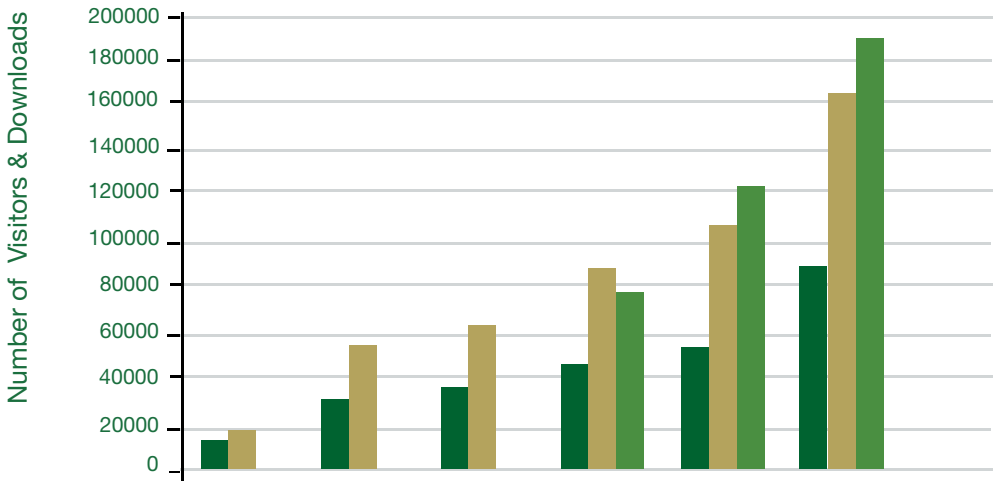
Journal	Total # papers	# papers (principle author)	# papers (co-author)	Impact factor
Koedoe	6	5	1	A
Biological Conservation	3	0	3	3.794
PLoS ONE	3	2	1	3.73
Journal of Zoo and Wildlife Medicine	3	0	3	0.427
Ecography	2	1	1	5.124
International Journal of Wildland Fire	2	2	0	2.322
Austral Ecology	2	0	2	1.738
Veterinary and Comparative Orthopaedic and Traumatology	2	0	2	1.013
South African Journal of Wildlife Research	2	0	2	0.294
Ecology	1	0	1	5.175
Remote Sensing of Environment	1	0	1	5.103
Forensic Science International. Genetics	1	0	1	3.861
Environmental Research Letters	1	0	1	3.582
Annals of Botany	1	0	1	3.449
Journal of Environmental Management	1	0	1	3.057
Ecology and Society	1	0	1	2.831
Basic and Applied Ecology	1	0	1	2.696
Applied Vegetation Science	1	1	0	2.263
IEEE Geoscience and Remote Sensing Letters	1	0	1	1.823
Journal of Insect Conservation	1	0	1	1.801
Oryx	1	0	1	1.624
International Journal of Geographical Information Science	1	0	1	1.613
Journal of Fish Diseases	1	0	1	1.591
South African Journal of Botany	1	0	1	1.409
Journal of Plant Ecology	1	0	1	1.355
Journal of Helminthology	1	0	1	1.157
African Journal of Marine Science	1	0	1	0.932
Water SA	1	1	0	0.876
African Zoology	1	1	0	0.746
African Journal of Ecology	1	0	1	0.631
Ostrich	1	0	1	0.468
African Journal of Aquatic Science	1	1	0	0.446
Pachyderm	1	1	0	0.289
Journal of the South African Veterinary Association	1	1	0	0.27
Journal of Coastal Conservation	1	0	1	A
Ecosphere	1	0	1	NA
Herpetology Notes	1	0	1	NA
International Journal of Biodiversity	1	1	0	NA
TOTAL	54	17	37	

Overview of *Koedoe*

Koedoe, the official, peer-reviewed journal of SANParks, promotes biodiversity conservation science and protected area management in Africa, by publishing research that will enhance the body of knowledge required to support effective conservation and sustainable management of our natural resources. This knowledge is generated within the context of complex ecological and social systems in which protected area networks are imbedded. As a result, *Koedoe* highlights fundamental practices that contribute to the conservation of natural resources, which are increasingly faced with pressures from a growing human population and the effects of global environmental change. The journal also publishes scientific advancements in field studies, in-depth reviews of complex topics, as well as evidence-based policy and management approaches to assist with context-specific management challenges. The journal was accepted into Thomson Reuters Science Citation Index in 2011 and will receive its first impact factor mid-2014.

There has been a substantial increase in visitors to the *Koedoe* website, **(http://www.koedoe.co.za/index.php/koedoe),** and in the number of papers that have been downloaded from the site since the journal moved to AOSIS, the online publishing platform, in 2008 (Fig. 6). In 2013, over 163,600 visits were made to the website, of which approximately 87,800 were first time visitors to the website (unique visitors). These visitors originated from 176 countries. All volumes of *Koedoe,* dating back to Volume 1 in 1954, are electronically available on the website. To date, papers have been downloaded a total of 1,166,200 times. More than 186,700 papers were downloaded during 2013. The special issue on Strategic Adaptive Management in SANParks (2011, Vol. 53:2) has been downloaded over 54,000 times.

Related:
Read about Strategic Adaptive Management on page 7



	2008	2009	2010	2011	2012	2013
Unique Visitors	12602	30628	35383	45236	52882	87836
Total Visitors	19919	54008	62814	87004	105654	163617
Downloads				76987	122819	186764

Figure 6: Numbers of visitors and articles downloaded between 2008 and 2013 (data from AOSIS server); unique visitors refer to first-time visitors; total visitors include repeat visits.

In 2013, 48 manuscripts were submitted to the journal and 22 papers published (Table 2). Of the 242 manuscripts (all categories) submitted since 2008, 113 have been published, giving an overall rejection rate of 46.6%. The number of submissions was inflated in 2010 because of the special issue published in 2011, which featured invited contributions (Table 2). Notwithstanding 2010 there is an indication of an upward trend in submissions, with the highest received in 2013.

Table 2: Status of manuscripts (all categories) submitted to *Koedoe* between 2008 and 2013

Type	2008	2009	2010	2011	2012	2013
Total submissions	39	37	51	25	42	48
Average articles in Review per month			16	13	12	20
Decision recorded: Accept submission			13	30	16	28
Decision recorded: Rejected without review	12	15	18	15	13	35
Decision recorded: Decline submission	9	8	17	10	9	23
Decision recorded: Resubmit for review	1	13	9	4	3	14
Decision recorded: Revisions required	5	13	27	26	21	31
Articles published online	20	12	10	32[#]	17	22

[#] Includes special issue on Strategic Adaptive Management Vol. 53:2.

External peer-reviewed research emanating from/related to national parks

SANParks leverages enormous intellectual capital and research funding through registered projects by external collaborators. During 2013, 144 papers relating to 17 of the 19 national parks were published in peer-reviewed journals (Table 3) (full reference list in Appendix B). Kruger NP (64 papers) and Garden Route NP (16 papers) were the parks that featured the most in the peer-reviewed literature during 2013, but encouragingly, many papers also appeared that considered more than one national park (20 papers). Approximately 30% of the 144 papers published in 2013 that related to national parks had SANParks authorship or co-authorship (compare 27% in 2012), suggesting that SANParks staff are well integrated into the science community that conducts research in the parks. This illustrates that SANParks researchers are key collaborators with a range of experts, and this should translate into effective internalisation of knowledge generated through research on the SANParks estate.

Table 3: Articles related to specific South African national parks appearing in peer-reviewed journals during 2013 full reference list in Appendix B). Note: the numbers below exclude eleven papers published by SANParks research staff that do not relate to specific parks, for example, conceptual papers, studies conducted outside national parks or papers relating to scales larger than national parks.

National Park	# papers	# papers with SANParks authors
Addo Elephant	6	3
Agulhas	2	1
Augrabies Falls	1	0
Bontebok	1	0
Camdeboo	1	1
Garden Route	16	8
Golden Gate Highlands	1	0
Karoo	0	0
Kgalagadi (RSA side)	4	0
Kruger	64	22
Mapungubwe	3	0
Marakele	0	0
Mokala	1	1
Mountain Zebra	2	1
Namaqua	1	0
Richtersveld	5	0
Table Mountain	5	1
Tankwa Karoo	1	1
West Coast	4	1
Multiple Parks	20	3
Transfrontier (including SANParks)	6	0
TOTAL	**144**	**43**

Books and Book Chapters

SANParks staff were involved in two books that were published in 2013. Llewellyn Foxcroft edited a book on alien invasive species that was published by *Springer* and also contributed as author and co-author on a number of chapters in this book – see Appendix C. Furthermore, *Bloomsbury* published a book on African mammals, to which Armin Seydack contributed a chapter relating to the bushpig (Appendix C).

Technical and Scientific Reports

SANParks research staff contributed to eight external reports in 2013 (Appendix D). Lists of internal reports can be requested from the various research node offices.

Conference Presentations (national and international)

SANParks research staff presented 18 papers at national and 25 papers (and one poster) at international conferences during 2013, representing SANParks at a total of 23 different conferences and forums (note, only reflecting principle authorships) (Appendix E). Fourteen of the conferences were hosted in South Africa, while nine were hosted abroad. Three staff members were invited to give keynote presentations at five national conferences. Two staff members also received awards for 'Best Platform Presentation' (at *48th Symposium of the Grassland Society of Southern Africa and SAEON Graduate Student Network Indibano 2013),* as well as 'Best Student Presentation' *(International Meeting of Fire Effects on Soil Properties).*

SANParks research staff contributed both to biome-specific conferences (e.g. *Fynbos Forum, Thicket Forum, Savanna Science Network Meeting)* as well as discipline-specific conferences (e.g. *Grassland Society of Southern Africa; INSAKA, Invasive Alien Plants).* SANParks was well represented on the programmes of the *Savanna Science Network Meeting* (6 presentations), *Fynbos Forum* (6 presentations), *INSAKA* (5 presentations) and *South African Wildlife Management Association Symposium* (3 papers). SANParks organized and hosted the *11th Savanna Science Network Meeting* in Skukuza, Kruger NP and staff were also involved in the organising committee of the *South African Wildlife Management Association Symposium* (which was also held in Skukuza), as well as of the *Fynbos Forum.*

Related:

Read about the Savanna Science Network Meeting on page 62

RESEARCH HIGHLIGHTS

Safe-guarding South Africa's rhinos – Integrated research by SANParks

Sam Ferreira, Markus Hofmeyr & Mike Knight

3-Second Brief:

A suite of integrated research projects allows SANParks to make key contributions to the national response aimed at curbing poaching and securing rhino populations. Importantly, research outputs allow authorities to gauge how successfully rhinos are being protected, in addition to providing supportive information to international forums, for example, CITES.

Poaching is an increasing threat to rhinos. Until relatively recently, the world's largest rhino population, resident in Kruger NP, had been increasing in size. During the last five years the number of rhinos lost (via poaching, removals and natural deaths) has matched the number born. Rhino numbers will decline if poaching continues at its current escalation rate. Even in some areas where there is little poaching rhino numbers are decreasing. This is due to the population density and ecological limits

SANParks has realised that more rangers on the ground and that the use of exciting new technology are not enough to secure rhinos. It therefore uses integrated approaches to combat poaching and manage rhino populations at several levels (Fig. 7). Research plays an important role and is split into two key focus areas. The first aims to give guidance on how to **manage the threat of poaching** to rhinos. Projects support rangers and assess techno-tools used in zones where anti-poaching units provide intense protection. Predictive spatial studies of poacher and rhino behaviour allow anti-poaching teams to be more effective. Forensic research aims to assist lawyers with court cases involving detained poachers. Risk-benefit studies are used to evaluate alternative conservation options. Modelling helps to predict how rhino populations may change if managers put these options into action, some of which include reducing the demand for rhino horn as well as legal methods for providing horn.

Managing rhinos is the second key focus area of research. SANParks evaluates how rhinos respond to water and fire regimes, as well as to the removal of individual rhinos. SANParks has proactively removed animals (selling many to the private sector) over the last decade to expand the species range and generate important revenue for other conservation projects such as the expansion of the SANParks estate. At present, SANParks captures rhinos in areas that have high densities. In addition, relocating some of those rhinos that live in areas of high poaching risk may save them from poachers. Annual monitoring of age and sex structures is thus a key rhino research focus. As one of its strategies, SANParks introduces rhinos into larger private farms where they are protected and can breed naturally and sexes are skewed towards females to increase rate of breeding. Rhinos will also in the future be introduced into sanctuaries that are small, easy to protect and have good rhino habitat, to maximise breeding. This helps to improve the conservation status of rhino by offsetting rhinos lost to poachers. It also helps to provide benefits to owners. Projects thus focus on the development as well as evaluation of robust husbandry methods.

White rhinos in Kruger NP seen here grazing on short grass.

White rhino calf in Kruger NP.

Catching rhinos poses some challenges. In remote areas specialised equipment and skills are required, adding to the overall capture costs. As a result, the capture process is adaptive and learning is fast. Luckily, disease risks from rhino are low. Although SANParks has not recorded any disease-related deaths in their national, regional and international translocations, ongoing research aims to constantly evaluate the risk of diseases.

Several international agreements, such as CITES and a local moratorium, provide for and regulate actions. These include rhino protection, demand reduction and horn/animal provision. Such actions aim to reduce the threat to rhinos. Through ecological management, strategic removals and the creation of rhino sanctuaries and conservancies, SANParks seeks to increase rhino numbers as a buffer to poaching and to provide increased economic opportunities. Criminal networks trade illegally in rhino horn, negatively affecting nearly all of the methods that managers use to save rhinos. For this reason SANParks seeks ways to disrupt organised crime, making use of analytical methods such as social network analyses to create actionable information. Anti-poaching units use it to execute several levels of legal responses. Organised crime, however, exploits poor communities that have few other economic choices. These criminals recruit people living adjacent to protected areas to become poachers. SANParks thus also seeks to assess and facilitate other economic options in these poor areas. Some of these will focus on benefits from live rhinos to draw such real and potential poachers away from illegal activities.

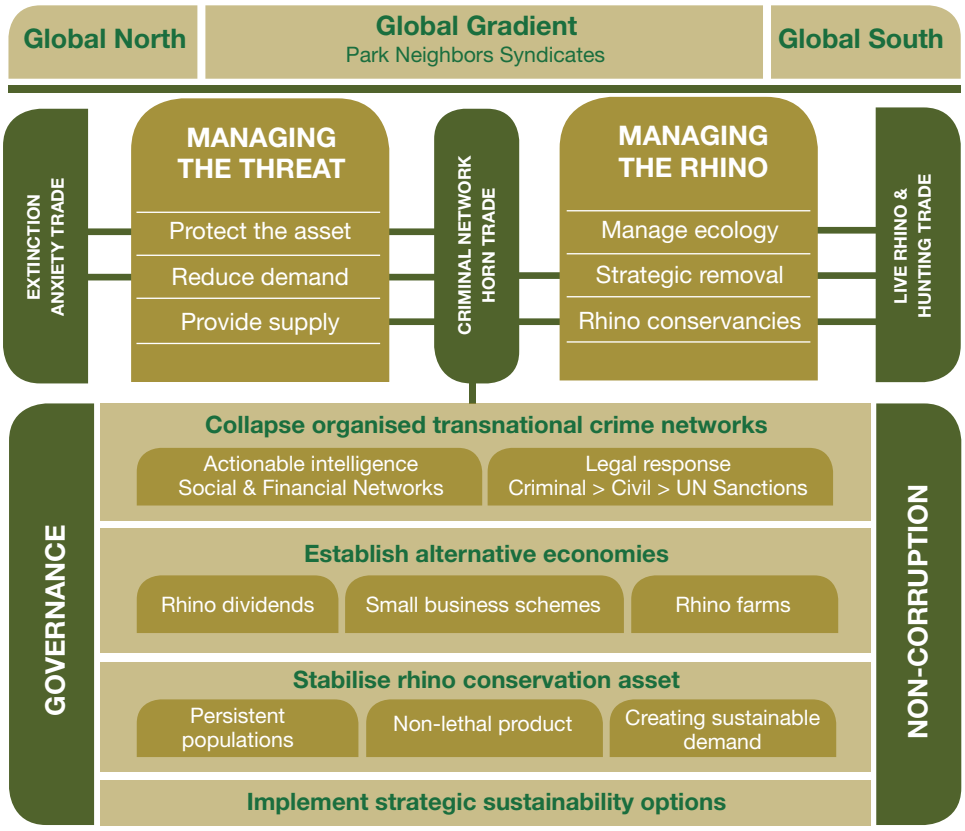


Figure 7: Integrated approaches that SANParks uses to safe-guard rhinos.

Captured white rhino being loaded into a crate for transport to a holding facility for later relocation to private game farms.

Monitoring from above – The use of satellite imagery for monitoring in SANParks

Izak Smit, Chenay Simms & Angela Gaylard

3-Second Brief:

Keeping up with advances in technology, SANParks is increasingly using data from satellite and aerial sensors to map and monitor the dynamic processes taking place in national parks. These remote sensing techniques are supplementing traditional data collection methods by providing monitoring data at spatial and temporal scales previously not possible.

Managing more than four million hectares, SANParks needs to constantly explore new and innovative ways of supplementing current monitoring efforts. Remote sensing (sensors installed on satellites or aircraft) is an alternative monitoring method increasingly used by SANParks. During 2013 SANParks explored the use of satellite imagery for monitoring vegetation greenness and cover in Mountain Zebra, Karoo and Camdeboo NPs. Making use of the Enhanced Vegetation Index (EVI) derived from the MODIS satellite sensor and provided by the CSIR-Meraka Institute, it is possible to monitor how vegetation greenness and cover change over space and time (Fig. 8).

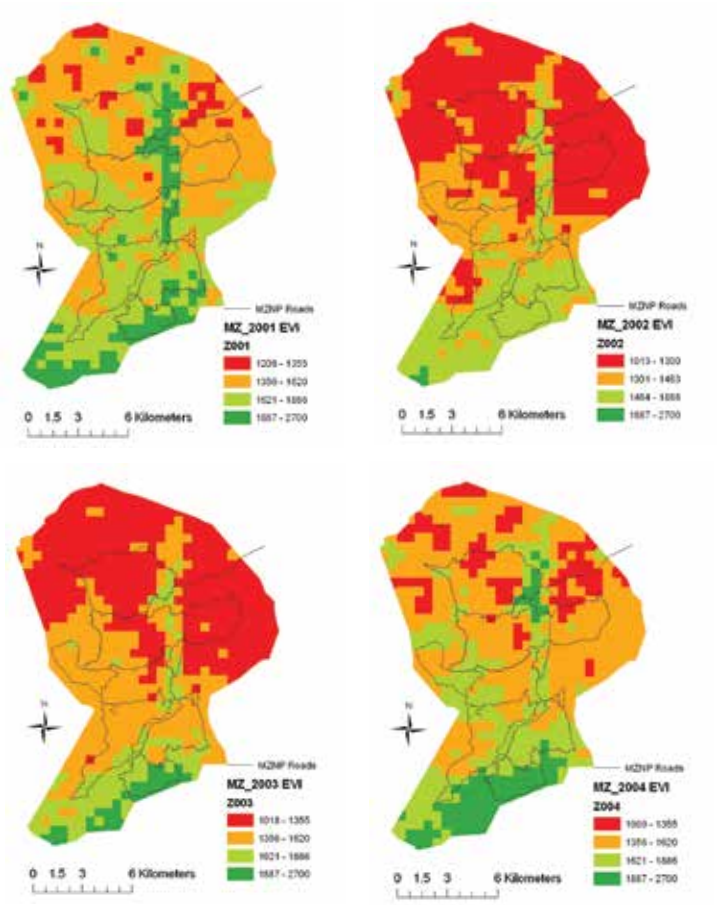


Figure 8: Average annual Enhanced Vegetation Index (EVI) of Mountain Zebra NP for four successive years (2001-2004). The higher rainfall mountainous grasslands in the south of the park are clearly distinguishable from the drier karoid northern parts, with elevated EVI also visible along the south-north running Wilgerboom River. Note how EVI changes over time, illustrating how dynamic and responsive these systems are.

When rescaling the EVI time-series for a park according to the long-term average values, it is possible to determine when a park's vegetation greenness and cover is above or below the long-term average for a specific time of year (Fig. 9). SANParks is currently also exploring the use of EVI data as a way to quantify and monitor spatial variability ('heterogeneity'). By averaging each 500m x 500m pixel in a park over the 46 images available for each pixel per year, a histogram can be generated of the yearly average EVI values in the park. The 'pointedness' (kurtosis) and 'spread' (range) of EVI values in a park for a specific year therefore provides an indication of the EVI heterogeneity – the more 'pointed' the histogram and the narrower the spread of EVI values, the less heterogeneous (Fig. 10).

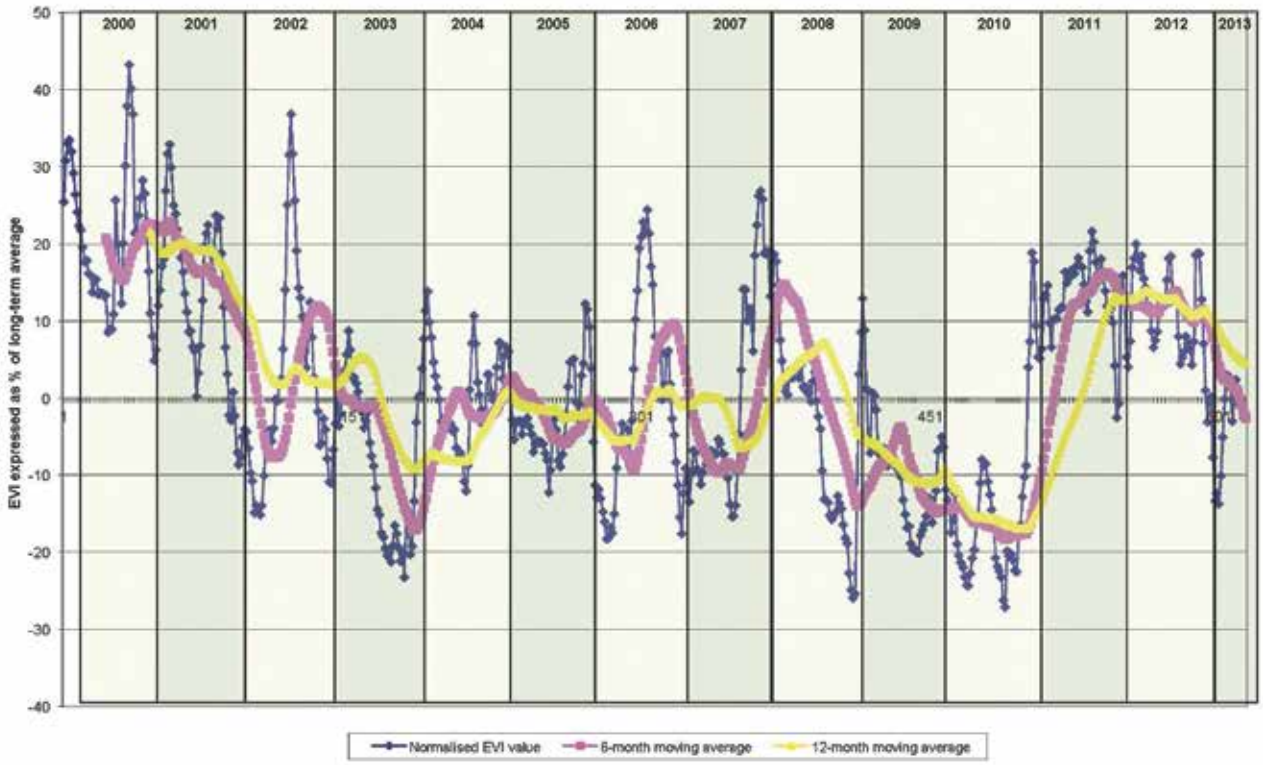


Figure 9: EVI time series (expressed as percentage of long-term average EVI) for Camdeboo NP. During December 2010, the park-wide EVI was about 20% lower than the long-term December average EVI, suggesting that the park's vegetation, and thus herbivores, may have been experiencing more stress/pressure then than during comparable periods in other years. Conversely, significantly above-average conditions were observed during 2000-2001.

The Heterogeneity Paradigm

Spatial and temporal heterogeneity are recognised as being critical to support biodiversity. From this perspective the task of managing for biodiversity is seen as identifying and maintaining the essential natural processes that drive heterogeneity, an approach that has been called the heterogeneity paradigm (Fuhlendorf & Engle 2001; Rogers 2003). Localised impacts such as climatic events, fires, or alterations in grazing pressure interact with spatial heterogeneity caused by topographic, geological, soil and microclimatic variation to create a mosaic of patches in the landscape. Patchiness promotes diverse habitat conditions suitable for a range of species. Spatial and temporal heterogeneity also promote ecosystem resilience, allowing the system to absorb and accommodate disturbance without undergoing major changes in structure and functioning. Hence the importance of maintaining ecological processes that produce patchiness. In particular, management measures that homogenise impacts, for example, unnaturally regular veld burning schedules, should be avoided.

References

Fuhlendorf, S.D. & Engle, D.M. (2001). Restoring heterogeneity on rangelands: Ecosystem management based on evolutionary grazing patterns. *BioScience* 51: 625-632.

Rogers, K.H. (2003). Adopting a heterogeneity paradigm: Implications for biodiversity management in protected areas. In: du Toit, J.T., Rogers, K.H. & Biggs, H.C. (Eds) The Kruger experience: Ecology and management of savanna heterogeneity. Island Press, New York. Pp. 41-58.

Related:

Read about the importance of system variability on page 6 and about monitoring heterogeneity on pages 35 and 55

Although remote sensing is already actively used in SANParks, it is anticipated that it will become increasingly useful for large-scale 'finger-on-the-pulse' vegetation dynamics monitoring and also for informing herbivore off-takes from small, fenced-in parks. However, it is not intended to replace field monitoring methods but to act as a complementary approach, providing monitoring results at spatial and temporal scales not possible using traditional field methods. Of particular value is the potential of remote sensing to monitor heterogeneity as the latter is of significance in managing for biodiversity.

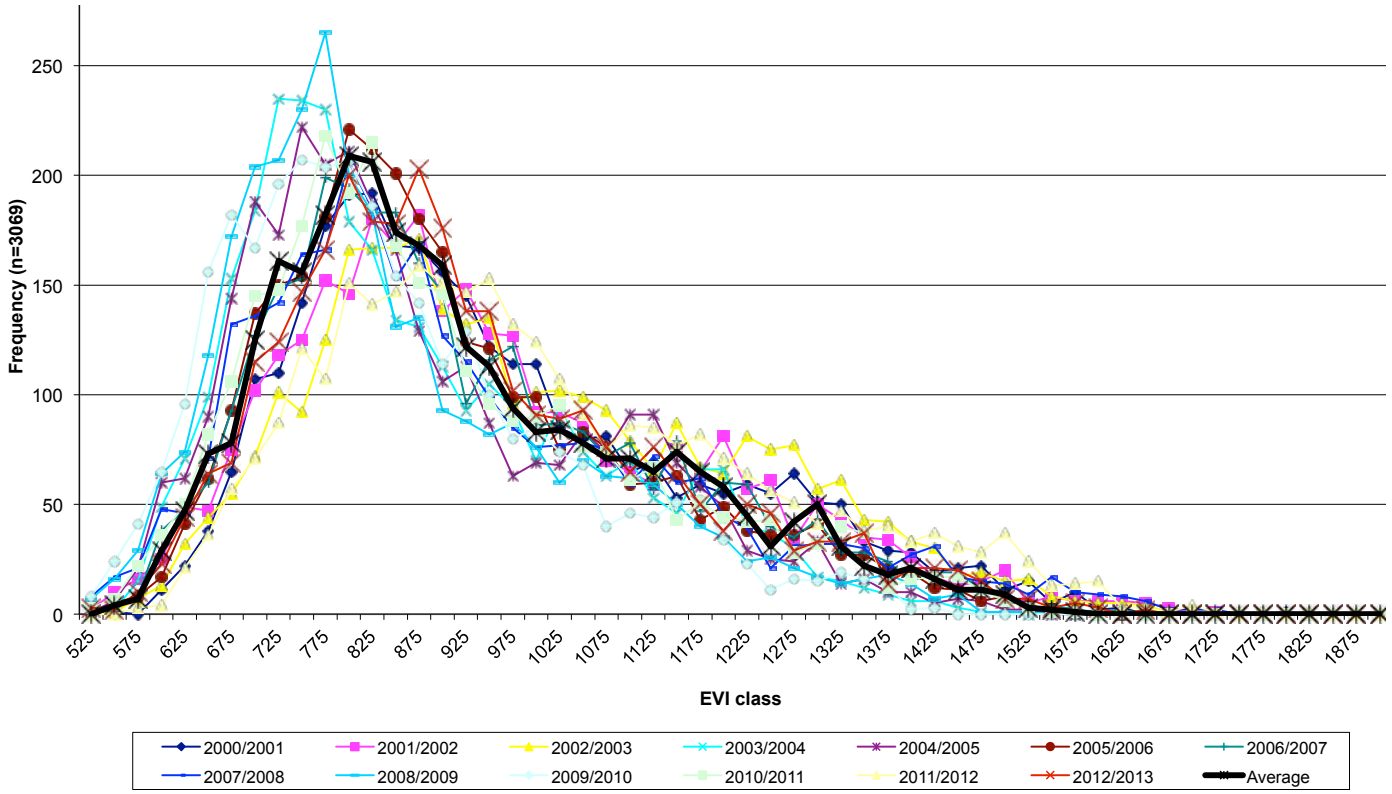


Figure 10: Average annual EVI histograms for Karoo NP for the past 13 years. A marked change or directional change in the shape or location of a yearly histogram will flag change in vegetation cover and greenness. Although it is probably healthy to have some variability between years as observed here, currently there does not seem to be any concern warranted due to major or directional change in EVI for the period under consideration.

Monitoring of elephant impacts in Kruger National Park

Rina Grant

The decline in large trees (trees taller than 5m) in Kruger NP has been a topic of discussion for the past decade. Large tree populations continued to decline despite managing the elephant population by means of culling between 1967 and 1994 (Eckhardt, van Wilgen & Biggs 2000; Scholes & Kruger 2011). This calls into question the role of elephants in the decline. Large tree populations in riverine areas may be particularly vulnerable to elephant impact, as these habitats are highly favoured by elephants in the dry season. In 2009 a monitoring programme was initiated to establish the extent to which mortality of tall trees in riverine areas could be related to elephant density. On the basis of long-term (20 years) dry-season elephant census data average density was calculated per 1km x 1km cell across Kruger NP. Using this information, riverine habitats along all major rivers were grouped into two categories: high density (about 3.5 elephants/ha), and low density (about 0.3 elephants/ha).

Elephant dung pile counts were conducted during one dry season in 2013, to test if this would be a useful proxy for elephant density. Counts conducted along four 750m transects in both density areas along the Sabie River showed a higher frequency of dung piles in the high density area compared to in the low density area.

For the purpose of assessing tree mortality, transects were laid out in the high and low density areas in 2009. All trees taller than 5m rooted within the transects were permanently marked. The per cent mortality of these trees that could be attributed to elephant, was determined in 2013, four years after they had been marked.

Surprisingly, along the Sabie River tree mortality was higher in the area of long-term low elephant density (Table 4).

Table 4: Tree mortality (all species over 5m tall) along the Sabie River over four years compared between high and low density elephant habitats.

Zone	Number of marked trees > 5m tall	Per cent tree mortality assessed to be due to elephants over 4 years
High elephant density	728	3.7%
Low elephant density	635	14%

The most common explanations for tree mortality caused by elephants were: (1) trees being pushed over, (2) main stems broken or (3) more than 50% of bark removed. In large Knobthorns *(Acacia nigrescens),* the most common species encountered, the mortality rate over 4 years was 7% in the low elephant density area compared to 1.4% in the high density area.

The occurrence of more damage in areas with lower historical elephant densities and lower current dung counts could possibly suggest that elephant impact happens at small scales and may be caused by individuals rather than herds. In future it will be necessary to investigate whether such individuals can be kept away or discouraged from utilising the areas of concern identified in the Kruger National Park Elephant Management Plan (SANParks 2011). New approaches to keep elephants out of certain areas need to be investigated, and this may require revision of the National Norms and Standards for the Management of Elephants to make provision for such approaches.

10-Second Brief:

Elephant-induced mortality of trees taller than 5m was higher in riverine habitats that carried low elephant densities than in those that carried high elephant densities. This shows that maintaining low elephant densities will not necessarily avert damage to trees. Other factors are involved, for example, tree-damaging habits of individual elephants. New approaches to keeping elephants out of particular areas need to be investigated.

Elephants impact trees in different ways with some causing mortality by severe debarking or breaking of the main stem. When just feeding on leaves or branches, damage is seldom as severe as to cause mortality.

References

Eckhardt, H.C., van Wilgen, B.W. & Biggs, H.C. (2000). Trends in woody vegetation cover in the Kruger National Park, South Africa, between 1940 and 1998. *African Journal of Ecology* 38: 108-115.

Scholes, R.J. & Kruger, J.M. (2011). A framework for deriving and triggering thresholds for management intervention in uncertain, varying and time-lagged systems. *Koedoe* 53(2): 185-192.

South African National Parks. (2011). Elephant Management Plan, Kruger National Park, SANParks.

Climate monitoring in SANParks

Nicola van Wilgen, Judith Botha, Stephen Holness & Peggy Madonsela

10-Second Brief:

Existing data indicate that climate changes will impact significantly on protected areas. Understanding and monitoring these changes and their consequences, and being able to anticipate further impacts are essential. This requires continuous and improved climate change data collection and management, and will enable climate change response strategies to be formulated, and appropriate management plans implemented.

Outcome 10, the Ministers' Delivery Agreement, seeks to identify climate change impacts and provide adaptation frameworks integrated into national sector plans. A representative, extensive and well-managed protected area network, which includes SANParks, forms the backbone of the government Ecosystem-based Adaptation strategy. The strategy uses natural systems and processes (as opposed to structures such as dams) to buffer the impact of climate change on communities. SANParks' work on climate change therefore makes an important contribution through increasing our knowledge of climate change, and assessing the impacts of these changes in national parks. Ongoing monitoring of climate and climate change in parks will help to anticipate future change and identify suitable climate change mitigation measures and, importantly, direct appropriate management. This may in turn contribute to informing the Outcome 10 indicators at national level.

Climate change occurs slowly over long periods. It is therefore particularly important to maintain continuous long-term climate records. Certain climatic variables, especially rainfall, show wide natural variations that need to be quantified and understood before changes in these natural cycles can be interpreted. A recent analysis of available data showed that temperatures in most parks have increased between 1 and 1.5°C over the past 50 years. This has also had significant implications for the number of very hot days, with Kalahari Gemsbok NP, for example, now experiencing 36 more days above 35°C than it did 50 years ago (Fig. 11). Changes in rainfall have been more variable and difficult to interpret, although our 2013 analyses show that rainfall in the north-eastern lowveld, especially at Skukuza, appears to be becoming more variable, with greater extremes. There also appears to be a drying trend in the southern coastal parks. Data of sufficient length to draw meaningful conclusions were, however, not available for all parks, meaning that for several parks trends remain unclear.

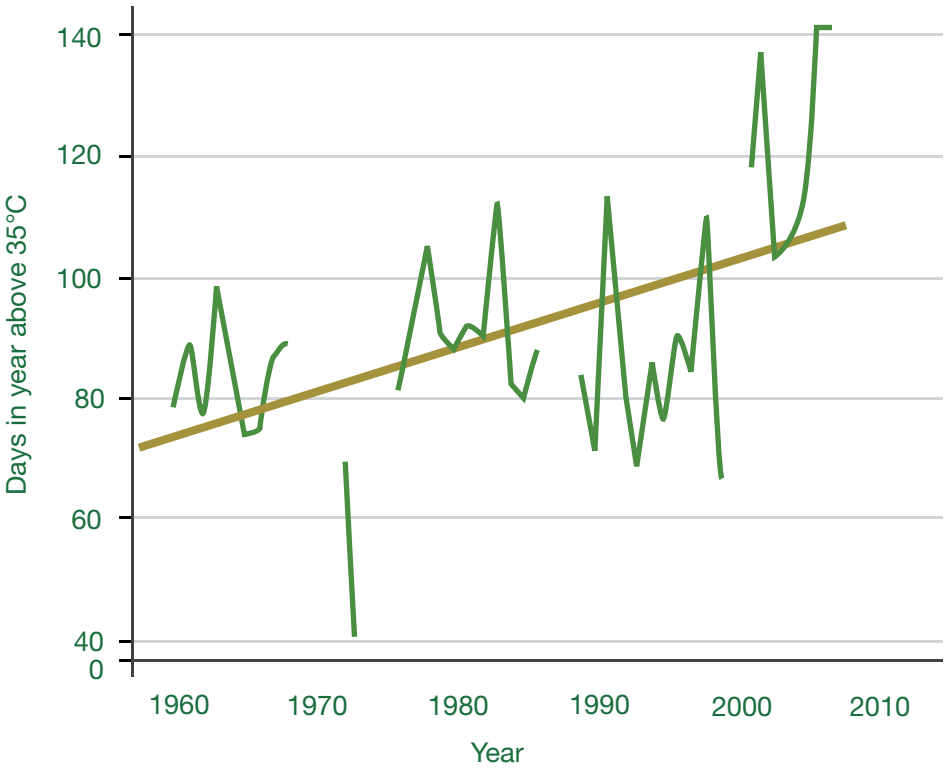


Figure 11: The number of days in each year where the maximum recorded temperature at Twee Rivieren, Kalahari Gemsbok NP, was above 35°C. This graph shows an increase from an average of around 80 such days in the 1960s to 116 such days in the late 2000s, i.e. 36 more very hot days per year than were experienced 50 years ago.

As part of an initiative to improve archiving of SANParks' climate data, a project was initiated in 2013 to establish a comprehensive database of weather stations and available data. The database includes all weather stations as well as the type and frequency of data collected at each weather station. Historic data to the end of 2009 were also archived. The next phase will archive data from 2010 to date, as well as ensure that archivists regularly receive data from all stations. In many instances this will require collaboration with external partners. It is hoped that the project will promote internal awareness of the importance of climate data collection as well as strengthen and build lasting relationships with other key role-players in the field of climate change and data management.

Due to historical excavations of guano, availability of penguin nesting sites that provide refuge from predation and excessive heat has been dramatically reduced, contributing to the decline of several species of burrow-nesting seabirds including penguins. Heat stress is exacerbated by increasing temperatures. The provisioning of artificial nesting structures is being investigated as a useful conservation intervention that offers alternative shelter from the weather, as well as protection from predators.

Biodiversity Management Plans for Cape Mountain Zebra and Bontebok

Carly Cowell

The National Environmental Management: Biodiversity Act enables any person, organisation or organ of state to compile a BMP for ecosystems, indigenous species and migratory species, and to submit it for consideration by the Minister responsible for the environment. Norms and Standards have been gazetted to guide the way that Biodiversity Management Plans for Species (BMP-S) should be developed and implemented. The purpose of BMP-S is to ensure the long term survival in nature of species which are listed under the Threatened or Protected Species Regulations. The BMP-S is thus a legislative tool that can be used to ensure protection of species, and features in Outcome 10, the Ministers' Delivery Agreement.

A BMP-S has particular value when responsibility for the conservation of a species is shared between different conservation authorities. Thus SANParks and CapeNature jointly identified the need for BMP-S for bontebok and Cape mountain zebra. The two organisations face common challenges in protecting these species, and both have a wealth of monitoring and research results that could be effectively shared. The development of plans for the two species proceeded simultaneously as both have similar requirements. All experts and representatives of stakeholder groups and individuals were identified (Dana *et al.* 2012) and invited to a two-day workshop in November 2013, co-hosted by SANParks, CapeNature and DEA. A background document was compiled based on monitoring and research information on each species. Results were presented and discussed at the workshop, and participants jointly identified and prioritised the key threats to each species over the next 5 years. To mitigate or prevent these threats a set of objectives was formulated to state explicit outcomes. Clear actions were identified to achieve the outcomes. As these plans deal with the implementation of conservation actions for long-term survival of a species, the objectives, outcomes and actions must be realistic and achievable. They also need to make provision for adaptive management supported by monitoring to check that intended outcomes are achieved.

10-Second Brief:

Biodiversity Management Plans for Species are a legislative tool to increase protection of species. To ensure success each plan should be developed in collaboration with partners who can contribute to its implementation. Research and monitoring data of SANParks and CapeNature were used to derive, in collaboration with stakeholders, appropriate objectives and actions for national plans for bontebok and Cape mountain zebra. This collaborative effort improved the 2013 Outcome 10 performance indicator for the protection of species at national level.

The Cape mountain zebra, also a grazer, favours grassy habitats in the Nama Karoo, Grassland and Fynbos Biomes. It differs from the plains zebra in various ways, being slightly stockier and having stripes that do not extend around its stomach.

Bontebok are short-grass specialist feeders which are restricted to the Renosterveld vegetation type in the Fynbos Biome, but are also adaptable to grazing on old cultivated fields.

Two similar objectives were highlighted for bontebok and Cape mountain zebra. Firstly, owing to the low genetic diversity of each species (low founding population numbers) new practical applications of techniques for the conservation of genetic integrity must be developed. Secondly, monitoring actions must be improved and increased both inside and outside of protected areas. The development of these plans revealed a need to change the format of BMP-S to be more user friendly. SANParks and CapeNature are working closely with DEA and SANBI to create a new template. The plans are currently in the draft phase, following re-formatting of the template, and will be distributed for comment in the second quarter of 2014.

Reference

Dana, G.V., Kapuscinski, A.R. & Donaldson, J.S. (2012). Integrating diverse scientific and practitioner knowledge in ecological risk analysis: A case study of biodiversity risk assessment in South Africa. *Journal of Environmental Management* 98: 134-146.

Human-wildlife conflict: Environmental justice and building community support for conservation

Alexis Symonds & Louise Swemmer

Wildlife escaping from Kruger NP sometimes impacts negatively on the wellbeing of people living on the border of the park, by destroying infrastructure and/or agricultural crops, injuring or killing livestock and posing a danger to people. While SANParks continues to collaborate with provincial conservation authorities to control or limit the risks associated with escaped wildlife, the extent of the fence, damage to the fence by elephants, the uneven and remote terrain and the many rivers and streams entering the park, pose a challenge to fencing these areas securely, and break-outs remain inevitable. For many years the resultant human-wildlife conflict has been a major stumbling block in building and maintaining cordial and mutually beneficial relationships with affected neighbours.

SANParks, faced with the on-going demands for compensation, took a decision to address human-wildlife conflict on the Kruger NP boundary, despite the lack of guiding legislation. Kruger NP staff embarked on a process of gathering information on human-wildlife conflict from community-based sources, from SANParks rangers and colleagues and from the neighbouring conservation agencies. The research evaluated current and past trends in frequency and location of Damage Causing Animal (DCA) incidents. It explored the implications of various compensation models based on global case studies and predicted potential future implications of various options, based on historical data collected in neighbouring communities.

3-Second Brief:

SANParks undertakes to compensate livestock owners from communities neighbouring the Kruger NP for damage to livestock caused by listed predator species, where evidence exists that the Damage Causing Animal originates directly from the park.

The outcomes from the research supported a recent agreement entered into between Kruger NP and the Limpopo Department of Economic Development, Environment & Tourism for the cooperative management of DCAs. It also facilitated the development of The Kruger National Park Protocol for Compensation of Livestock Deaths Resulting from Human-Wildlife Conflict.

After consideration by the SANParks Executive Committee and the Kruger NP Management Committee, SANParks expressed its willingness to pay compensation for livestock losses on the border of Kruger NP. This decision gives credence to the SANParks vision of *connecting to society* and the notion of *environmental justice* which seeks to ensure that communities are not unfairly disadvantaged by bearing the costs associated with living adjacent to national parks.

While it is acknowledged that human-wildlife issues are complex and highly emotive and that on-going collaborative efforts to streamline the compensation process will be required, SANParks has taken a significant step in addressing community concerns in an attempt to grow societal support for conservation efforts in Kruger NP.

Fencing rivers and streams securely poses an on-going challenge.

A ranger tracks a hyena through the Kruger NP fence.

Top Right:
Kraals often provide inadequate protection while cow bells call predators to dinner.

Right:
Elephants destroy even the most sturdy fences to get to their favourite snack on the other side of the fence.

Successful compensation claims are paid out by SANParks on an *ex gratia* basis. This means that claims are assessed case by case and that payments are made from a sense of moral obligation with no legal liability to pay. Compensation is considered for all claims resulting from damage to livestock (cattle, horses, donkeys, mules, goats, sheep, and pigs) attributed to lion, spotted hyena, cheetah and wild dog under certain conditions and where irrefutable evidence exists that the DCA originated directly from Kruger NP. SANParks does not pay compensation for damage to livestock suffered in respect of activities relating to crocodiles, leopards, jackal, and caracal or for any other predators or species that range freely in areas adjacent to Kruger NP.

Complexities of ecological rehabilitation in SANParks

Mahlomola Daemane & Johan Baard

South Africa, as a signatory to the CBD, is committed to rehabilitating and restoring degraded ecosystems. At national level, progress towards rehabilitation is monitored through Outcome 10. The Expanded Public Works Programme (EPWP), funded by DEA, conducts rehabilitation while providing valuable temporary work for the unemployed. Biodiversity Social Projects (BSP) is the SANParks unit responsible for implementing EPWP. This work has rehabilitated many areas in parks that were used for agriculture or forestry before they received national park status.

Related:

Read more about the EPWP on page 50

During 2013 many parks controlled soil erosion through the Working for Wildlife Programme, one such BSP programme. Control measures for soil erosion included brush packing, gully re-sloping, and ponding in capped soils to capture sediments and encourage vegetation reestablishment. In Marakele and Kruger NPs degradation through bush encroachment is being controlled by bush thinning. This is followed by vegetation monitoring to gauge success. In Addo Elephant NP, areas that have been stripped of vegetation by human activities are rehabilitated by planting spekboom *(Portulacaria afra),* one of the dominant indigenous plants of the park. Garden Route NP faces a particular challenge of rehabilitating 25,000 ha of former plantation land. Fortunately many of the indigenous plant species survived in the plantations, and current evidence suggests that these systems have reasonable potential for rehabilitation to occur naturally. Depending on topography and composition of natural species, some areas will be rehabilitated to fynbos, others to indigenous forest. To aid natural rehabilitation the fynbos areas need to be burnt appropriately. In contrast fire needs to be kept out of areas destined for indigenous forest, and invader plants need to be controlled. In addition, unnecessary roads and river crossings, quarries and borrowpits need to be rehabilitated.

3-Second Brief:

SANParks attempts not only to meet national targets for rehabilitation of degraded land, but also to understand the extent to which lost ecosystem processes can be restored, and to unravel the myriad complexities of ecological rehabilitation. This requires research and monitoring of the often poorly predictable outcomes of rehabilitation efforts.

One of the targets of Outcome 10 is to increase the area rehabilitated per year from 800,000 ha to 3.2 million ha by 2014. Monitoring progress on the basis of numbers of hectares rehabilitated suggests that the process is straightforward. In truth rehabilitation is complex. Firstly, one needs to define what constitutes ecological rehabilitation and to distinguish that from ecological restoration. The latter involves restoring an ecosystem back to its original state. This is not always possible, however, and one must thus adjust expectations and set goals accordingly. The process of achieving realistic goals is called rehabilitation. Rehabilitation aims to re-establish ecosystem processes that have been lost, for example, the restoration of vegetation cover provides food for herbivores, thus restoring the essential ecosystem process of herbivory.

Secondly, outcomes of rehabilitation attempts do not necessarily follow expectations. Degradation may have a variety of causes, for example extreme climatic events, overgrazing, invasion by alien species or various forms of human activities. These causes may interact in complex ways to produce changes that are irreversible. Changes are therefore not necessarily gradual and predictable. Instead, the system may change abruptly between different stable states.

Landscape Function Analysis Monitoring in Camdeboo NP in areas affected by soil degradation. The method measures landscape stability, infiltration and nutrient cycling.

Monitoring of simplistic indicators, such as the numbers of hectares rehabilitated, does not give a true picture of the complexity of rehabilitation. To succeed we need to understand the complex interrelationships between rehabilitation efforts on the one hand and the way the ecosystem reacts to these efforts on the other. This requires carefully designed research and monitoring projects.

Soil ponding intervention measure used in rehabilitation of areas affected by soil capping. Sediments are captured and vegetation re-established.

The spekboom plant is used for rehabilitation of degraded spekboom vegetation communities in Addo and Camdeboo NPs.

Fynbos recovering after two years of exotic plantation having been felled.

Fine-tuning the monitoring of marine fish in Marine Protected Areas

Nick Hanekom, Kyle Smith & Rod Randall

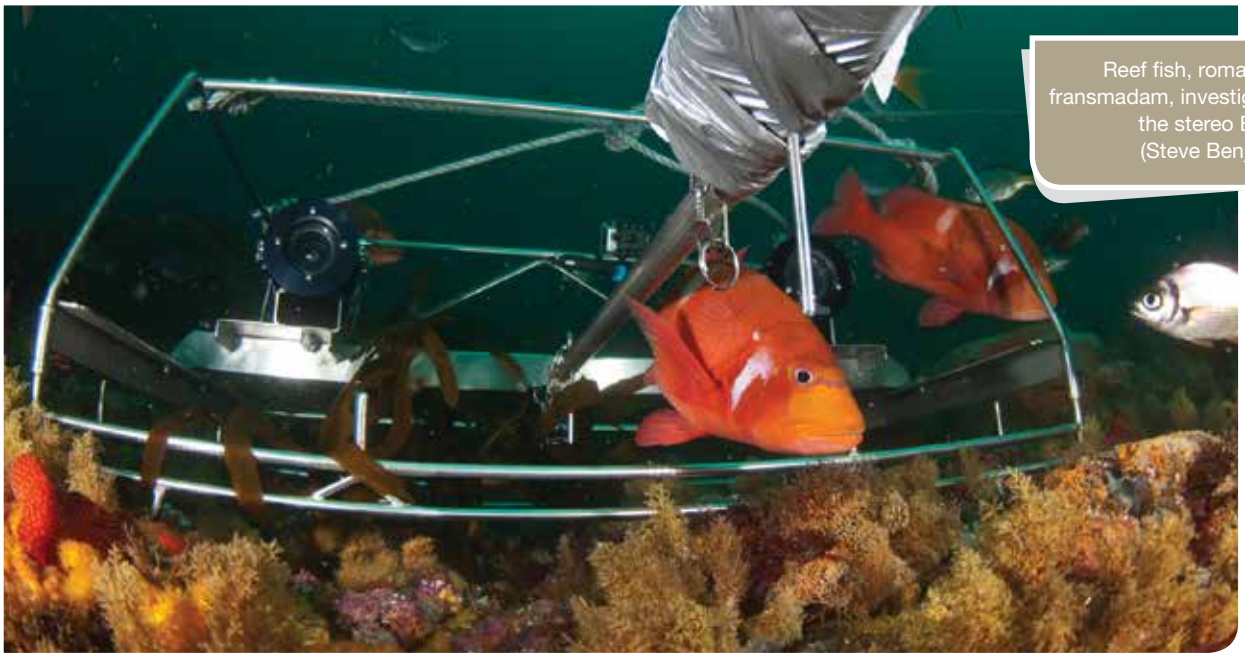
A network of 21 Marine Protected Areas (MPAs), augmented by fishery regulations and controls on pollution, shipping and mining, form the core of South Africa's marine conservation strategy. Four of the eight MPAs managed by SANParks have 'no-take zones' and contribute substantially to the 9% of the South African coastline along which extractive resource use is prohibited.

Extractive resource use is a major threat to marine diversity, especially to marine fish stocks, and NEMPAA stipulates the need for park authorities to monitor key components of their protected areas. A variety of traditional monitoring techniques exist for marine reef fish. However, the logistical challenges associated with these techniques often hamper their use in sustained monitoring programmes. Consequently, the Elwandle Node of SAEON conducted a series of studies to determine the most appropriate methods for monitoring reef fish populations in Tsitsikamma MPA. Their initial research concentrated on underwater visual census (UVC) and controlled angling. The former method gave more consistent estimates of relative fish densities, but a lower sampling efficiency than controlled angling. Therefore, it was recommended that the two methods be used in conjunction.

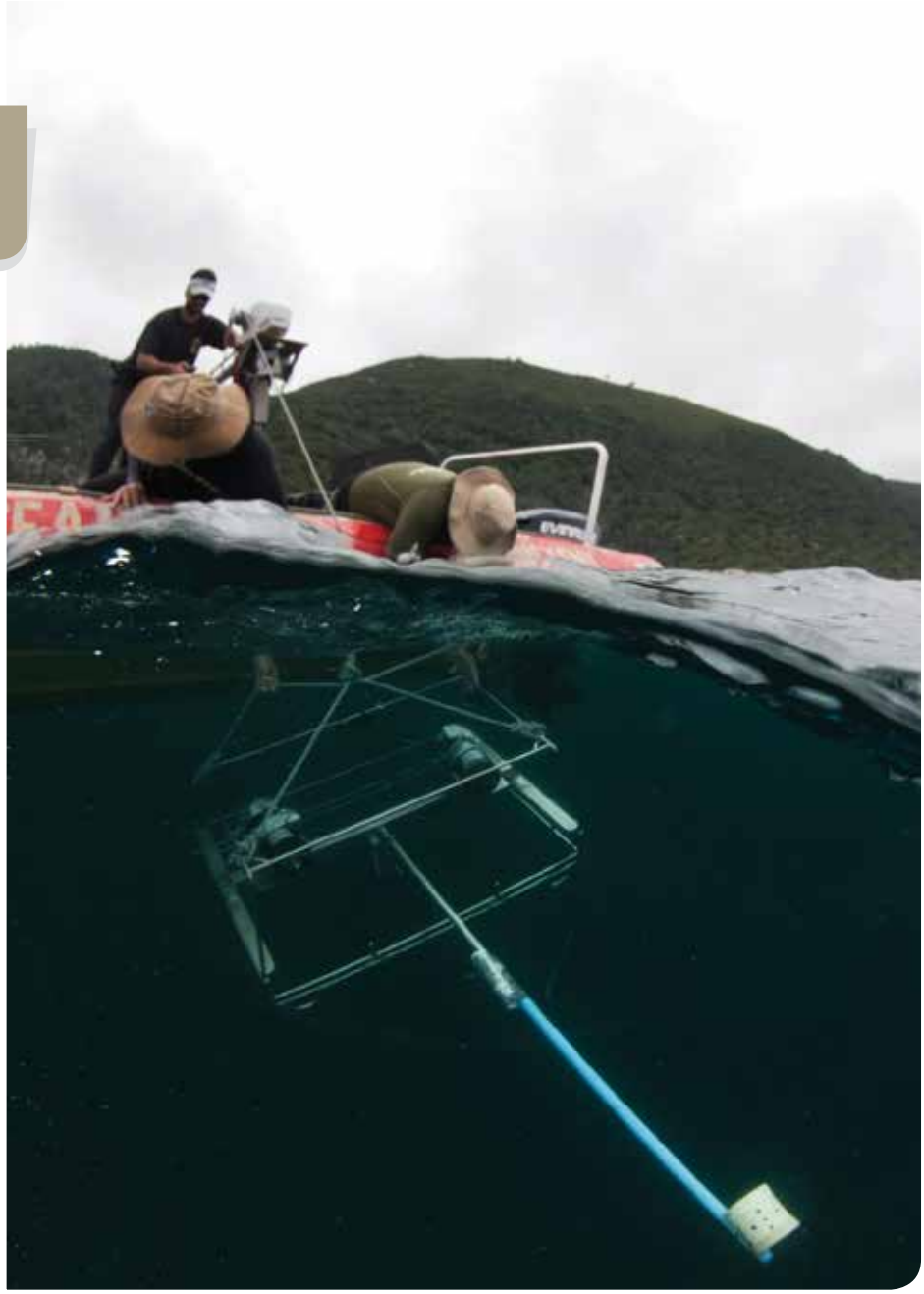
3-Second Brief:

Technical advances in remote underwater video equipment hold great promise for monitoring reef fish populations in Marine Protected Areas.

However, applying such methods is challenging. In underwater surveys divers are limited by water depths and time restrictions, as well as by stringent safety and labour regulations, while in controlled angling studies catches may be influenced by fishing skills and post-release mortalities. Therefore, more recently developed monitoring methods were investigated. The first of these was the remote underwater video (RUV), which causes minimal environmental disturbance. However, the variability between samples is often substantial and the relatively large number of replicates required to obtain data with a high statistical power using this method makes it less appealing for long-term monitoring programmes. Baited remote underwater video (BRUV), which uses bait to attract fish from the immediate surroundings to the camera site, proved to be more successful at surveying a broader range of species. These two methods recorded more species than the underwater visual census studies and in combination they offer an effective monitoring suite that outcompete the more traditional methods in terms of minimising environmental disturbance, effective use of manpower and repeatability.



Reef fish, roman and fransmadam, investigating the stereo BRUV. (Steve Benjamin)



Researchers deploying a stereo BRUV off the Tsitsikamma coast. (Steve Benjamin)

In 2013 Australian and SAEON researchers, assisted by a SANParks scientist, tested a stereo-BRUV in Tsitsikamma MPA for the first time. The stereo system allows for the size of fish photographed to be calculated and population structures to be assessed. Such size structure data are important in monitoring, because in an open access area, changed population size structure, with decreased average fish size, is often one of the first signs of over-fishing. The video footage also provides long-term records that may be re-evaluated by other researchers, or used in educational programmes. Depending on the results collected, the monitoring programme in Tsitsikamma MPA may be rationalised by changing from traditional controlled angling to stereo-BRUV. This 'change-over' will not influence the comparability of the data already collected, which is evaluated in relation to sea temperature and ocean current data recorded in the MPA. Such monitoring methods based on rigorous science are essential to promote both fishery and conservation benefits of MPA's while also influencing national policy.

Pyjama catshark having a close look at the stereo BRUV. (Steve Benjamin)

Reef fish, strepie and fransmadam, attracted to the bait container of a stereo BRUV. (Steve Benjamin)

SANParks' Marine Protected Areas

The importance and value of MPAs in our national parks are not widely appreciated. There are MPAs in four national parks: Addo Elephant, Garden Route, Table Mountain and West Coast NPs. Table 5 describes the relevant restrictions on resource use that apply in each MPA and outlines their value and importance.

There are eight MPAs managed by SANParks: Sixteen Mile Beach, Malgas, Jutten and Marcus Islands, Langebaan, Table Mountain National Park, Tsitsikamma and Bird Island. Collectively they cover an area of approximately 1635km^2 of which about 27% is no-take.

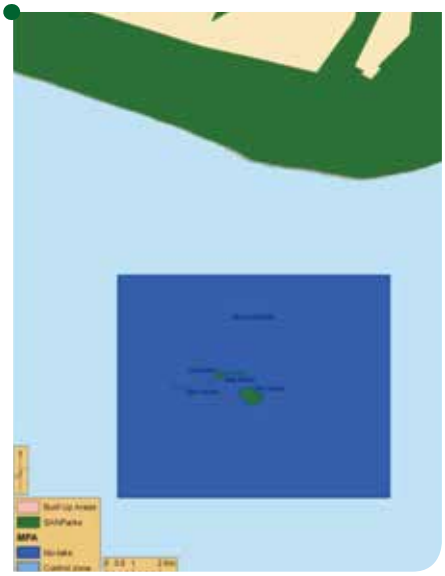
Table 5: The restrictions, importance and value of each of the eight Marine Protected Areas managed by SANParks (Nick Hanekom).

National Park	MPA(s)	Zonation / Restrictions	Importance and value
Addo Elephant	Bird Island	No-take	As its name implies Bird Island hosts important seabird colonies including 3 Red Data Book species (African penguin, Cape gannet, roseate tern). The MPA protects subtidal reef habitat and populations of many endemic invertebrates, seaweeds and fish, including large stocks of threatened abalone. In addition, the seal breeding colony on Black Rocks provides an important food source for great white sharks.
Garden Route	Tsitsikamma	No-take	Oldest and one of the largest no-take MPAs in Africa. Situated in the middle of the warm temperate bioregion, its location is central in the distributional range of many endemic fish species whose populations are considered to be over-exploited. The MPA protects important reef habitats and provides an important nursery and breeding area for commercially and recreationally exploited fish and invertebrate species.
Table Mountain	Table Mountain National Park	Large control zone within which there are six 'no-take' areas: St. James, Boulders, Castle Rock, Paulsberg, Cape of Good Hope and Karbonkelberg.	Located in a transition zone between the South-western Cape Bioregion and the Agulhas Bioregion, this MPA protects a rich diversity of marine species including several commercially exploited species. Culturally significant features such as fish traps and old ship wrecks are also found within the MPA.
West Coast	Langebaan	Zoned into three areas: Zone A: Recreational fishing and permitted net fishing is allowed Zone B: Only permitted net fishing is allowed Zone C: Exclusion zone, no boating or fishing can take place	Protects the only true marine lagoon system in South Africa. The extensive salt marshes and sand and mud flats support a diverse invertebrate fauna, including South Africa's most critically endangered marine mollusc *(Siphonaria compressa,* right, Knysna Basin Project*),* and provides productive summer feeding grounds for large numbers (> 15 000) migrant water birds.
West Coast	Malgas, Jutten and Marcus Islands	Control zone: No shore fishing allowed but boat-based fishing is permitted.	These offshore islands are important breeding sites for six Red Data Book seabird species. The surrounding MPAs limit human activity on the intertidal shores and provide protection for the rich marine invertebrate and algal communities associated with such islands.
West Coast	Sixteen Mile Beach	Control zone: No shore fishing is allowed but boat-based fishing and recreational catching of rock lobster is permitted.	Conserves a representative area of the exposed sandy beaches in the South-western Cape Bioregion.

Garden Route NP: Tsitsikamma MPA

West Coast NP: Langebaan, Malgas, Jutten, Marcus Islands and Sixteen Mile Beach MPAs

Table Mountain NP: MPA



Addo Elephant NP: Bird Island MPA

Maps: SANParks-managed Marine Protected Areas (Peter Bradshaw).

Marine research and monitoring in the Cape parks – An overview

Mbulelo Dopolo, Nomfundo Nkabi, Nonhlanhla Nyalungu & Ndiviwe Baliwe

10-Second Brief:

In compliance with national legislation SANParks is monitoring the fishing activities and quantities of fish and invertebrates harvested in SANParks-managed Marine Protected Areas. The focus is on shore- and boat-based fishing, gillnetting and prawn harvesting. Key target fish species are southern mullet (harders) and snoek.

Sustainable resource use is a particular focus of marine research in Table Mountain and West Coast NPs. The CBD commits SANParks to promoting sustainable extractive use of selected natural resources. This commitment is legislated in NEMPAA, which requires annual reporting to the Minister of Environmental Affairs on extractive resource use. The principle of sustainable use is reflected in the SANParks mission statement and Resource Use Policy.

Monitoring of shore- and boat-based fishing: Cape cluster parks

In SANParks, monitoring of marine resource use, carried out with the help of local people, includes the following objectives:

- assessing the spatial and temporal trends in catches and catch composition;
- assessing total catch and/or catch per unit effort (CPUE) of target organisms;
- assessing the level of compliance with fishing regulations (e.g. size limit and permit); and
- collecting economic data and investigating social impacts with regard to allowed activities.

To date, there is no MPA adjacent to Agulhas NP but one is envisaged in the future; information being gathered now will contribute to defining the boundaries and evaluating the impacts thereafter. Preliminary results indicate that the catch composition adjacent to Agulhas NP is diverse (~20 species), dominated by kabeljou *(Argyrosomus japonicus),* sand shark *(Carcharias taurus)* and galjoen *(Dichistius capensis;* all galjoen were caught within season) compared to West Coast NP (Langebaan Lagoon MPA) where four species were recorded and dominated by white stumpnose *(Rhabdosargus globiceps).* Most of the recorded species were within size limit except for white steenbras *(Lithognathus lithognathus)* in Agulhas NP. In Table Mountain NP MPA the catch composition was also diverse with more than 20 species recorded. Commonly caught linefish species included yellowtail *(Seriola lalandii),* snoek *(Thyrsitesatun),* roman *(Chrysoblephus laticeps),* galjoen and hottentot *(Pachymetopon blochii),* and most of these were within minimum size limit. This is an encouraging statistic as it suggests compliance with fishing regulations. However, the decline in CPUE from 2.96 (2005) to 1.27 (2008) fish per 10 angler days is a cause for concern, as this possibly suggests a decline in the abundance and/or availability of fish.

Related:

Read about SANParks-managed MPAs on page 39

Snoek make up more than 95% of the catches in Table Mountain MPA. (Kerry Sink)

In addition to the obligatory reporting to DEA, the information is shared with the Department of Agriculture, Forestry and Fisheries (DAFF) and appropriate platforms (e.g. South African Linefish Symposium).

Table Mountain NP MPA covers 1 000km^2 of the seas along the Cape Peninsula. Monitoring of boat fishing during 2013 indicates that catches were dominated (> 90%) by snoek, followed by the yellowtail. The most intense boat fishing appears to coincide with summer months and/or possibly the availability of snoek, the main target species.

Layout of gillnets in Langebaan Lagoon, in West Coast NP, one of eight MPAs in the SANParks estate.

Species of waders in Langebaan Lagoon. (Peter Ryan)

Reconciling conservation and fisheries objectives in Langebaan Lagoon Marine Protected Area, West Coast National Park

Langebaan Lagoon is a wetland of international importance, listed in terms of the Ramsar Convention. Originally proclaimed as a haven for migrant waders it supports approximately 10% of the coastal wading bird population in South Africa. Subsequently, in the late 1990s, it emerged as an important conservation area for the threatened white stumpnose, elf *(Pomatomus saltatrix)* and smoothound shark *(Mustelus mustelus).* The lagoon also has a rich diversity of marine invertebrates and seaweeds, and is one of only two known habitats for *Siphonaria compressa,* South Africa's most critically endangered marine mollusc.

Related:

Read about the Ramsar Convention on page 53

Siphonaria compressa is a small, air-breathing sea snail commonly referred to as a false or pulmonate limpet. (Knysna Basin project, above)

This rich biodiversity needs to be reconciled with the gillnet fishery, traditionally practiced by the local people. The main target species is southern mullet *(Liza richardsonii),* called 'harders' in the Western Cape. The harders are sold fresh, frozen or dried for human consumption and as bait. SANParks is studying temporal and spatial dynamics of this fishery in terms of effort, catches, bycatch and its economic performance. Spatial dynamics are important because the marine protected area is divided into zones to regulate resource use: fishing is more strictly regulated in Zone B than in Zone A. Paradoxically, monitoring since July 2010 until June 2013 revealed that over 70% of the harders are caught in Zone B, whereas less than 25% come from Zone A. This is because Zone B is characterised by the shallow sandy areas favoured by the harders, whereas Zone A is mostly deep waters and channels. This underlines the need for careful monitoring of the catch. Fortunately the bycatch (inadvertent catch of non-target species) is less than 1% of the total catch, and its overlap with harders has been found to be negligible using a geostatistical analysis technique (local index of collocation).

Dried and salted harders (southern mullet), constitute a delicacy known locally as 'bokkoms', which is sold throughout the country at Shoprite/Checkers chain stores. In general, bokkoms is processed from smaller harders (< 25cm).

Invertebrate surveys (prawn biomass estimation, harvesting rate and invertebrate species assemblages) in West Coast National Park

Sandprawns *Callichirus kraussi* and *C. rotundicaudata,* and mudprawns *Upogebia africana* and *U. capensis* are intensely harvested by anglers, especially during summer and spring holidays. It is important to determine the sustainability of this harvesting activity. During 2013 SANParks initiated monitoring and research to assess the biomass and distribution of these prawns, and the extent to which they are harvested. Harvested areas are compared with reference sites where there is no harvesting. To date, data indicate that the biomass and abundance is highest on heavily impacted areas, i.e. Sand Baai (mud prawns only) and Klein Oestewaal (sandprawns only) compared to moderately impacted Maart se Plaat or not impacted Kliphoek (or Klein Mooimak) and Kraal Baai. These observations are counterintuitive, and this could be attributed to a range of probable drivers, for example, sediment type or productivity in terms of detritus that prawns feed on or circulation of currents and or water temperature. In terms of species assemblages, Kraal Baai (area not impacted) and Maart se Plaat (area moderately impacted by harvesters) have higher number of species compared to Sand Baai, Klein Oestewaal and Kliphoek. The other invertebrate species were dominated by diverse polychaetes (have multiple chaetae, 'hairs', per segment).

The need to establish and adjust harvest quotas, and the challenges in doing so (Mbulelo Dopolo)

A progressive decline in CPUE may suggest that fish stocks are dwindling, indicating that it is time to close the fishery or adjust the effort or catch limits (i.e. daily catch or total allowable catch). However, many marine fish have vast, variable and undefined spatial ranges making it difficult to generate conclusive inferences about the stock status on the basis of trends in CPUE. For example, spawning areas or migration routes may contain large aggregations. If fisheries concentrate on these high density areas CPUE values may remain high even if stocks are actually declining. On the other hand if the fish should disperse from the fishing areas/survey sites CPUE values could decline despite the species remaining abundant. Consequently there is a high risk that over-exploitation may go undetected.

The situation is exacerbated by lack of capacity, especially appropriately qualified stock assessment scientists, and regular monitoring. Where funding and resources are available to conduct the requisite surveys to establish or adjust harvest quotas, these are almost entirely directed towards large-scale industrial fisheries (e.g. sardines, hake, squid, and lobster). Species of low commercial value are therefore particularly vulnerable. Development of human capital in marine science, as well as systematic, long-term monitoring of marine resource use, are urgent priorities if overuse of marine resources is to be prevented. Despite these challenges, there are set and pre-agreed assumptions made regarding each fishery in order to develop plausible management regimes, especially for large-scale industrial fisheries.

10-Second Brief:

Legislation governing protected area management encourages extractive resource use, provided it is sustainable. Sustainability can seldom be guaranteed in advance, hence needs to be verified through ongoing research, monitoring and adaptive management. The Annual Report to the Minister on resource use is an important accountability tool that is dependent on the quality of SANParks' research and monitoring.

Related:

Read about the complexity of setting marine harvesting quotas on page 45

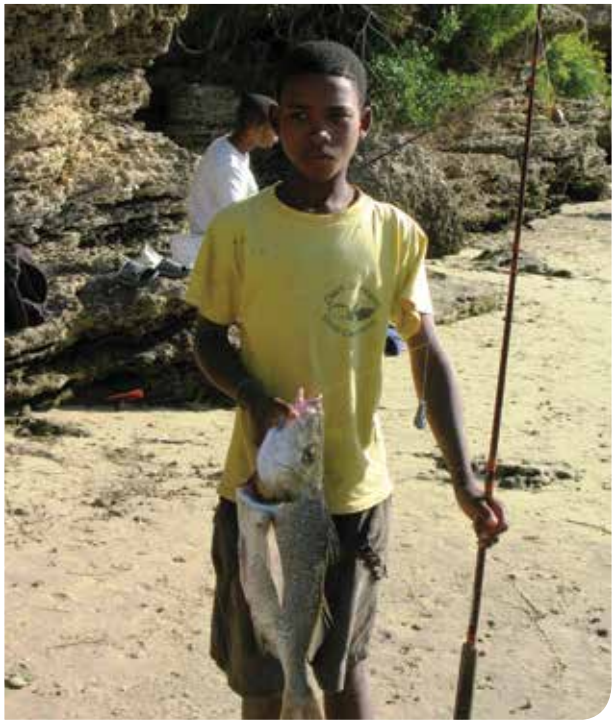
Annual Report to the Minister of Environmental Affairs on resource use

Alexis Symonds

SANParks submits a report to the Minister of Environment Affairs in compliance with Section 7 of NEMBA – Regulations for the Proper Administration of Special Nature Reserves, National Parks and World Heritage Sites, each year in June. The report requires protected area agencies to list the number of licenses, permits and agreements granted or entered into in respect of the use of biological resources; a description of the biological resource used; the quantities harvested; the income generated and the conservation status of the biological resources being exploited (DEA 2005). Information and data from SANParks reports are included in national and international reports and presented in various forums.

During the previous financial year, SANParks documented the permitted use of indigenous biological resources in terrestrial and aquatic ecosystems in 13 of its parks. In approximately 41% of projects, resources harvested served either to generate an income for SANParks, for example, from the sale of excess wildlife for the purpose of ecological management, or to support management functions. Approximately 40% of projects were of a subsistence nature including the personal, cultural, medicinal or symbolic use of resources, while17% of projects generated an income which accrued to individuals in local communities.

The implementation of sustainable resource use projects, both from a biological and socio-economic perspective is often complex and relies on research, monitoring and adaptive management to ensure that projects are sustainable. This implies that the rate of extraction does not lead to the long-term decline in the resource or the disruption of the ecological integrity of the ecosystem in which the resource occurs (SANParks 2010). Where there is a lack of baseline data to determine harvest limits, the precautionary principle is applied. SANParks utilises research and monitoring to ensure that resource use is biologically feasible, economically viable and socially justifiable.



Left:
A young local fisherman with a good sized spotted grunter caught on Swartvlei estuary in Garden Route NP.

Right:
Recreational and subsistence fishermen enjoying a sunny afternoon at a popular fishing spot on the banks of the Swartvlei estuary in Garden Route NP.

Reference

South African National Parks. (2010). SANParks Resource Use Policy. SANParks.

Community thatch grass harvesting project in Kruger NP. During 2012/2013 over 32,000 bundles were harvested by members of the Mduli Tribal Authority.

Harvesting of *Helichrysum* spp. in Golden Gate Highlands NP. These and several other plant species are known as imphepho (Zulu) and are used as a ritual incense with the purpose of invoking the ancestors.

Prescribed herbal mixes made from a variety of Table Mountain NP species including *Tulbaghia, Artemesia, Agathosma, Aloe* spp. Such mixes are prepared by Rasta herbalists resident in Cape Town commonly known as 'Bossie Doctors'. Customer ailments are noted on the bag, and these pre-prepared mixes are commonly available at local informal markets. (Leif Petersen)

A mix of wild harvested materials destined to be mixed together for treating various ailments – retailed by Bossie Doctors. (Leif Petersen)

Arum lillies *(Zantedeschia aethiopica)* harvested from throughout Cape Town and parts of Table Mountain NP make up an important seasonal informal economy business activity. (Leif Petersen)

Illegal resource use

The Annual Report to the Minister on resource use does not require management authorities of protected areas to report on illegal or unauthorised resource use. Permits to harvest resources (e.g. thatching grass, mopane worms, fish and bait organisms) are required in all national parks. However, there is widespread use of these and other resources without the necessary permits. This situation impacts negatively on sustainability, has the potential to drive losses in biodiversity and also to undermine organised resource use programmes.

Adaptive planning and monitoring at park level: Collaborative learning opportunities

Angela Gaylard & Mmoto Masubelele

Related:

Read about SAM on page 7 and about the adaptive planning process on page 5

3-Second Brief:

The collaborative development of park-level monitoring programmes through Strategic Adaptive Management in Camdeboo NP ensured compliance with legislation and provided unique opportunities for internal learning and capacity building.

Monitoring is a critical component of SAM since it provides the feedback required to determine the success of management interventions. By evaluating whether the predicted consequences of management interventions materialise, monitoring provides the adaptive link between implementation and learning. In this article we outline lessons learned in applying the collaborative SAM approach to the development of monitoring programmes in the Camdeboo NP management plan.

The process started with adaptive planning, which takes place in the context of developing the park management plan. Stakeholders jointly derived a vision and high level objectives for the park, in compliance with NEMPAA which requires consultation with stakeholders in developing a park management plan.

The high level objectives were then unpacked into a nested objectives hierarchy that takes into account the different factors that determine, or alternatively threaten, the park's biodiversity. A group of SANParks scientists and managers at Camdeboo NP jointly compiled a series of systems diagrams to describe their understanding of the underlying processes for each of these components of biodiversity (Fig. 12).

These diagrams facilitated the identification of key agents of change in the system. This approach ensured that the park monitoring plan comprised the minimum set of programmes that could be traced back through the objectives hierarchy to the stakeholder-derived high level objectives and vision. This allowed for a defensible costing of the monitoring programmes in compliance with NEMPAA which requires programmes of implementation with costing. The priority monitoring programmes identified for Camdeboo NP were rehabilitation of soil functioning and impacts of herbivores on the vegetation.

Figure 12 (a)

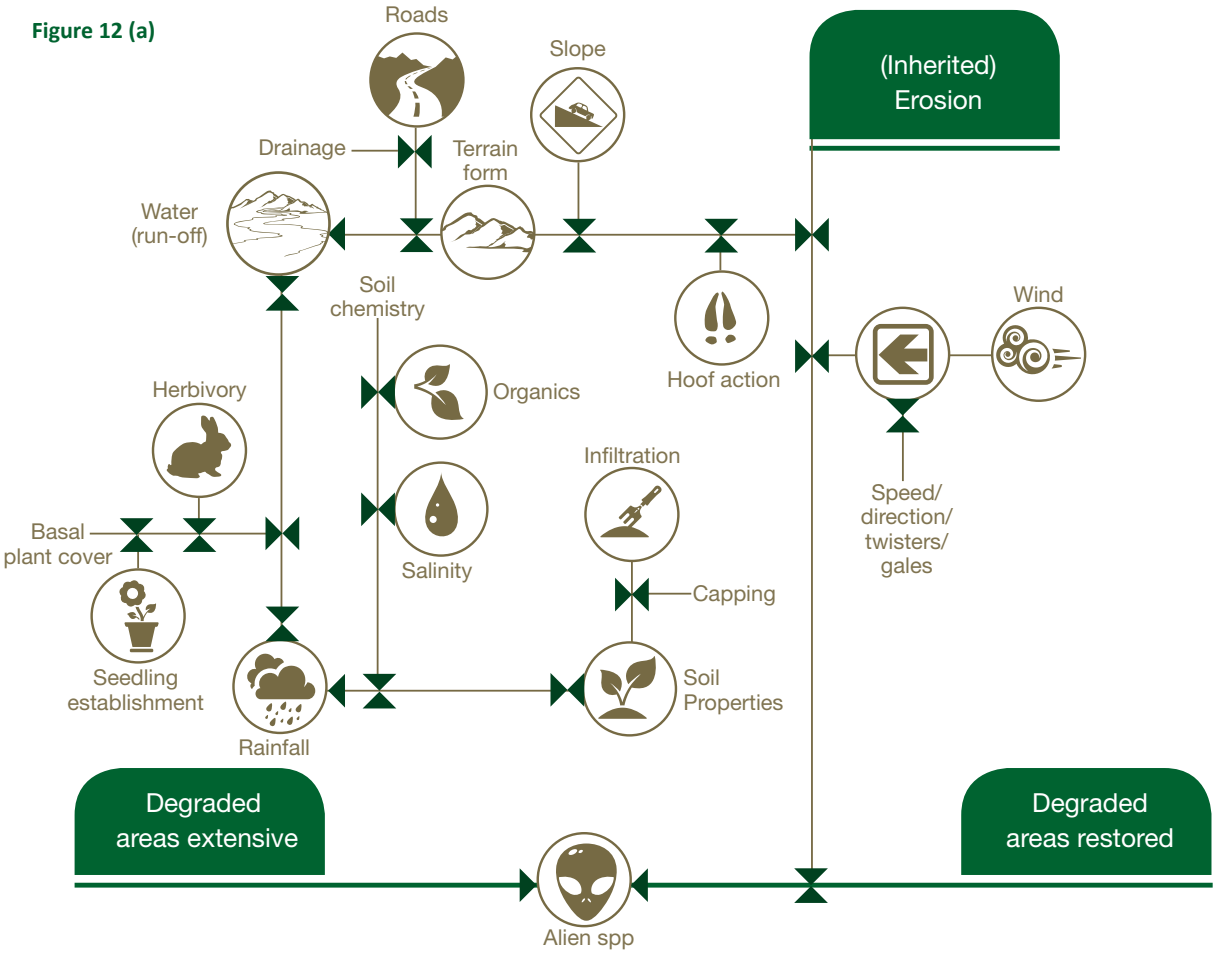


Figure 12 (b)

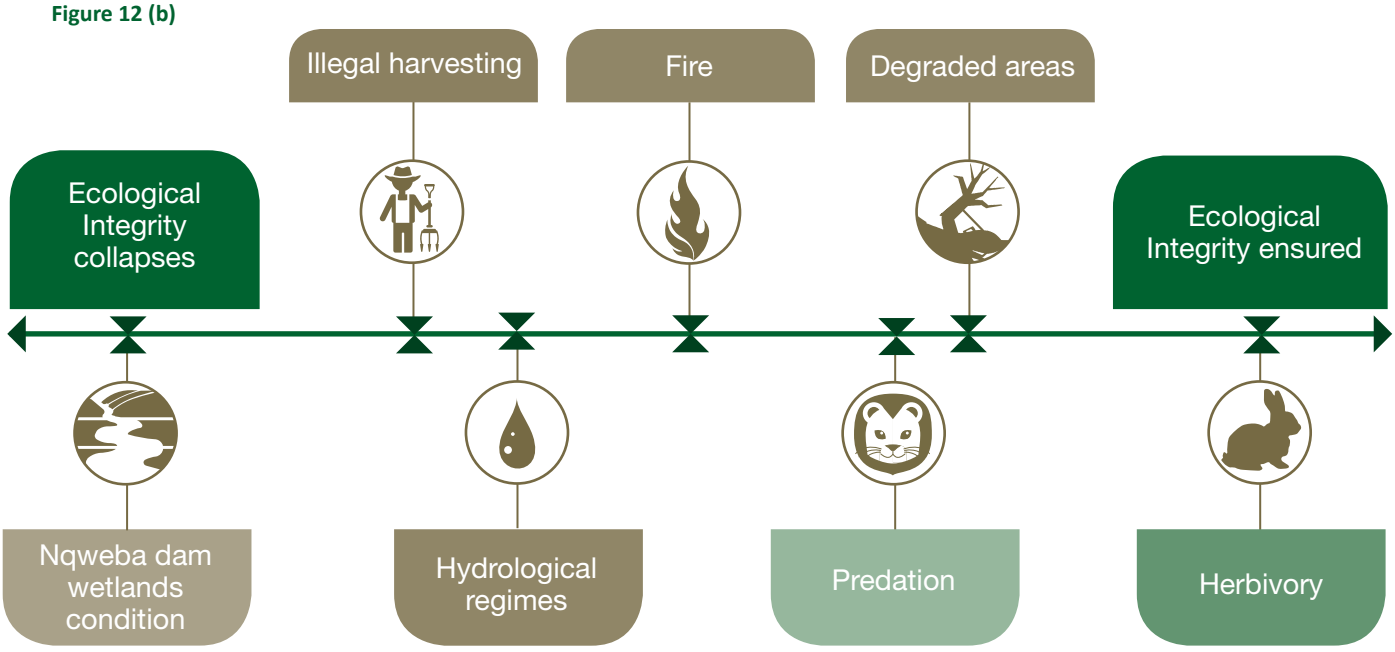


Figure 12: Systems diagrams, as shown here, are jointly developed by SANParks scientists and managers, and reflect a combined understanding of the processes driving specific management concerns. For example, in Camdeboo NP landscape degradation (a) represents a key threat. In combination with other major threats, (b) such as illegal harvesting, and ecological processes, such as herbivory, the park's ecological integrity can either collapse or be restored. Arrows represent the complex interactions, either one-way or two-way, between the multitude of variables. Management interventions aim to influence the driving processes to ensure that ecological integrity is restored.

Related:

Read about the complexities of ecological rehabilitation on page 35

The adaptive planning process is particularly valuable in promoting internal learning. Firstly it facilitates dialogue between SANParks scientists and managers through the joint development of systems diagrams. In Camdeboo NP science-management engagement benefited from the long experience of the park manager and his staff. Secondly, the process offered unique learning opportunities for Environmental Monitors (EMs), as part of the EPWP. This programme aims to train EMs in accordance with the Outcome 10 objective of developing human capital in biodiversity conservation.

Landscape Function Analyses being performed in Camdeboo NP to assess whether rehabilitation measures were successful in restoring soil functioning.

In Camdeboo NP the need to evaluate whether rehabilitation measures were successful in restoring soil functioning at erosion sites provided a valuable opportunity to develop the capacity of EMs. Scientific Services partnered with BSP to employ and train the EMs. Specifically, EMs performed Landscape Functional Analyses to assess whether rehabilitation had restored soil functioning. When compared with the results from sites along a continuum of degraded to pristine soil condition, the monitoring showed which sites required further intervention, thereby assisting the BSP unit with prioritisation and planning for subsequent years.

Experience in Camdeboo NP during 2013 showed that budgetary shortfalls remain a challenge, both to SANParks' capacity to comply with monitoring requirements of NEMPAA, as well as to the important aim of developing capacity of EMs. Even though salaries are provided by EPWP, shortages of transport and operational budgets severely compromised the productivity and learning opportunities available to the EMs, some of whom have gone on to find permanent work as biodiversity practitioners elsewhere. Innovative methods of acquiring funding for essential monitoring and capacity building will have to be explored.

Environmental Monitors are shown here collecting herbarium specimens, used to identify plant species being mapped in Agulhas NP.

River systems of Kruger National Park

Eddie Riddell & Robin Petersen

Kruger NP, straddling the middle reaches of two international drainage basins, the Incomati and the Limpopo, is located at a 'hydrological crossroad'. Research in the park during 2013 highlighted the receiving effects of upstream problems on its river systems.

University of Johannesburg revealed through micro bio-telemetry (radio-tracking) that in the heavily utilised Crocodile River water quantity and quality degradation from non-point sources upstream can have serious impacts on the behaviour and health of yellowfish *(Labeobarbus marequensis).* This is because yellowfish have relatively small home ranges and show a preference for less turbulent low flows. They also show markedly higher levels of heavy metal contamination of their tissues compared to yellowfish in more pristine rivers of Kruger NP, such as the Sabie River which is minimally impacted by mining and agricultural activities. North-West University provided evidence of the effects of bio-accumulating toxins (heavy metals and pesticides) on the viability of tigerfish *(Hydrocynus vittatus)* in the park's northern rivers. The study showed that tigerfish is an important indicator species for water quantity owing to its specific flow and habitat requirements.

Renewed interest in the effects of extreme climatic events on Kruger NP river systems followed Cyclone Dando of January 2012. River hydraulic research through AECOM, a global consulting company, and University of Salford, United Kingdom, revealed the significance of Dando in causing the Olifants River to have one of the largest documented floods for any South African river over the last 11,000 years. The study identified the crucial role of routine cyclones originating from the Mozambiquan Channel in maintaining and redistributing the supply of relatively young sediments (~500 years). This allows for variation in river morphology, and vegetation diversity, providing a variety of suitable aquatic habitats in Kruger NP.

SANParks river bio-technician, Mr Jacques Venter, and SAEON river bio-technician, Mr Thabo Mohlala, conducting fish surveys using electro-shocking in the Luvuvhu River.

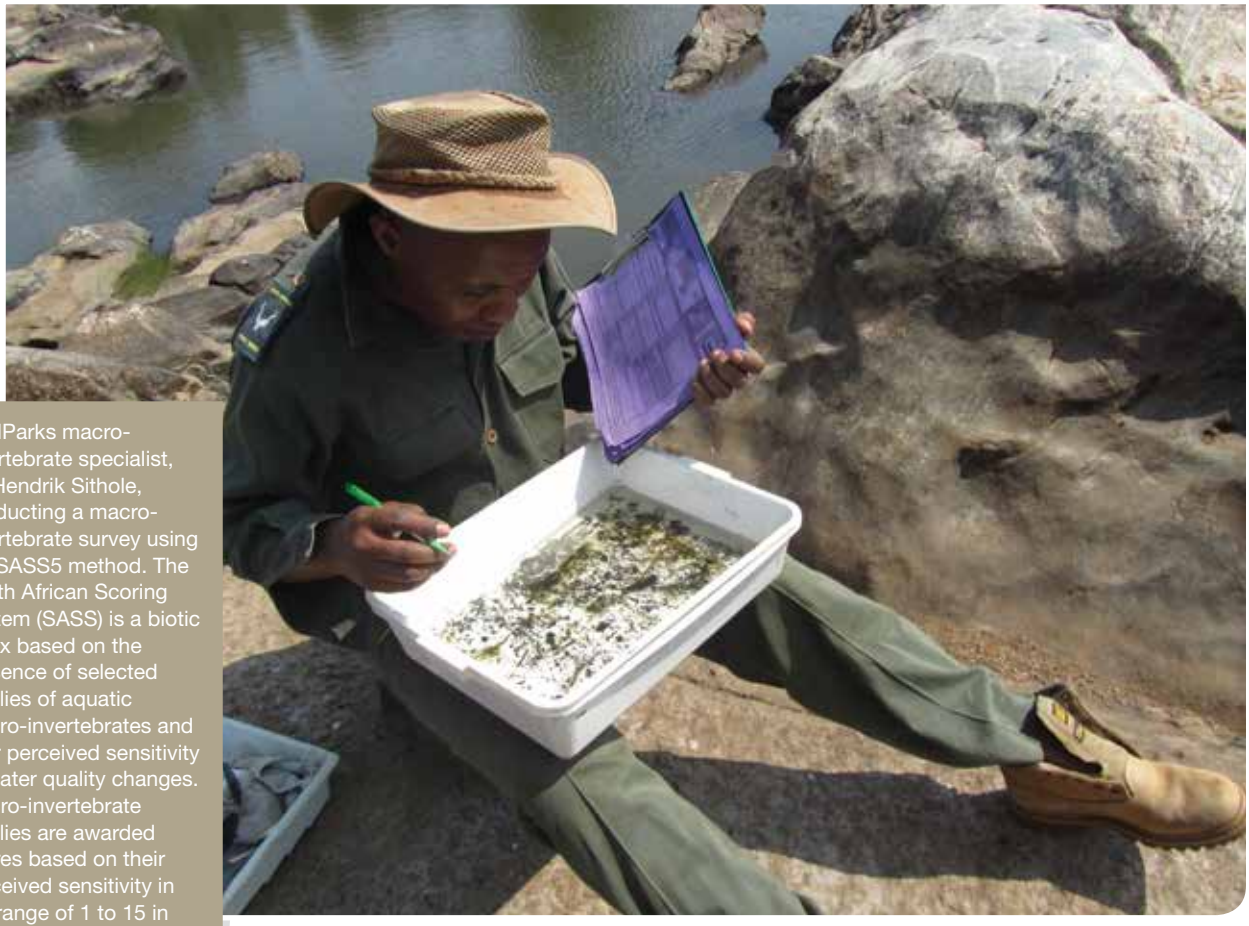
10-Second Brief:

On-going research has shown promise that modern adaptive river management practices can be integrated with biological 'gauge' species to monitor impacts and to minimise the long-term effects of river flow modifications in terms of flow and water quality. This is important given Kruger NP's location in our international river basins. It serves a vital role in watching for and limiting the effects of upstream externalities, provisioning ecosystem goods and services for ourselves and our downstream neighbours.

Related:

Read about strategic adaptive processes in SANParks on page 5

Instituting an adaptive approach to river management has shown promise through research during 2013 with the pilot implementation of a rapid-response decision-making process between SANParks, the Inkomati Catchment Management Agency and partners on the Crocodile River. The aim is to link ecological responses of river systems to controlled releases from upstream dams and other actions through an early warning system. Early results attest to buy-in from all stakeholders sharing this river system and to the success of the process. This comes at an important time given that in-stream monitoring in Kruger NP is conducted within the framework of the national River Health Programme which is an important indicator of water resource protection in Outcome 10, the Ministers' Delivery Agreement. This intensified bio-monitoring programme is designed to assess the biological and habitat integrity of rivers. It enables scientifically sound reporting on the ecological state of rivers, and assists in identifying areas of unacceptable ecological deterioration. It also indicates the effectiveness of existing river management policies, strategies and actions. Monitoring is based on evaluating the condition of biological communities (e.g. fish, aquatic invertebrates and riparian vegetation) as well as river habitats to provide an integrated measure of the integrity or health of the river systems.



SANParks macro-invertebrate specialist, Mr Hendrik Sithole, conducting a macro-invertebrate survey using the SASS5 method. The South African Scoring System (SASS) is a biotic index based on the presence of selected families of aquatic macro-invertebrates and their perceived sensitivity to water quality changes. Macro-invertebrate families are awarded scores based on their perceived sensitivity in the range of 1 to 15 in increasing order of their sensitivity to water quality changes. SASS5 is the most updated version and is widely used in South Africa as a tool for assessing river health conditions.

The state of SANParks wetlands

Dirk Roux, Robin Petersen, Ian Russell & Ruth-Mary Fisher

Wetlands are highly productive ecosystems relatively rich in biodiversity. They also provide critical ecosystem services such as water purification and flood regulation. However, wetland research and management has lagged behind river research and management. The first South African National Biodiversity Assessment (NBA) of 2004 excluded wetlands because the available information was insufficient to assess their conservation status. The situation has since improved. On the basis of desk-top data the NBA of 2011 found wetlands to be the most threatened of all South Africa's ecosystems. Hence a wetland-based indicator is included in Outcome 10, the Ministers' Delivery Agreement.

In national parks wetlands have also not been as well researched and monitored as rivers. However, this situation is being rectified; aquatic scientists have started exploring wetlands. Focus areas are: (1) Ramsar sites, and (2) inventorying wetlands in national parks.

Ramsar sites: As signatories of the Ramsar Convention, South Africa has 20 wetlands on the List of Wetlands of International Importance (Ramsar sites). Of these, three occur either partially or wholly in national parks. The Makuleke area in Kruger NP contains freshwater wetlands. Wilderness (Garden Route NP) and Langebaan (West Coast NP) wetlands are estuarine and marine respectively.

Inventory for wetlands in national parks: Of the wetlands in South Africa, 38% constitute Freshwater Ecosystem Priority Areas (FEPAs) (Nel *et al.* 2011). These include samples of all the wetland ecosystem types in South Africa. The FEPA data reveal that only 28% of the different wetland ecosystem types are represented in national parks. Only around 3% of wetland types have more that 50% of their total area within national parks. Of some concern is that, according to the FEPA data, wetlands in parks seem to be as threatened as wetlands outside (Roux *et al.* 2013a). Priority actions are to: (1) develop inventories of wetlands in all national parks, (2) ground-truth the classification and condition of these wetlands against the FEPA data, and (3) develop rehabilitation and management plans for wetlands where necessary.

Progress during 2013

A survey in the arid Tankwa Karoo NP (Roux *et al.* 2013b) revealed numerous depression wetlands (permanent springs and temporary pans). Some have FEPA status. A more detailed survey is required to inform their restoration and management.

In Kruger, Mapungubwe and Marakele NPs wetlands are being characterised and mapped in relation to geology, geomorphology, hydrology, soils and vegetation. A remote sensing-based Global Information System inventory (on a 1:50,000 scale) will be compiled for Kruger NP.

Most of the wetlands in Agulhas NP have FEPA status. During 2013, the types and ecological condition of these wetlands were validated while aquatic plants were recorded. Field surveys were undertaken in partnership with CapeNature, Mondi Wetlands, Department of Water and Environmental Affairs (DWAF) and SANBI Working for Wetlands.

Inventories represent a first step towards comprehensive scientific understanding of wetlands. We also need more wetland research and monitoring, and to learn from existing rehabilitation projects. Hopefully our external research partners can contribute towards research on wetlands in parks. For SANParks 'progress with inventorying' is a more relevant indicator than the 'number of wetlands under rehabilitation' in Outcome 10.

Related:

Read about reconciling conservation and fisheries objectives in Langebaan on page 43

10-Second Brief:

Wetlands are defined in the South African National Water Act (Act 36 of 1998) as "land which is transitional between terrestrial and aquatic systems, where the water table is usually at or near the surface, or the land is periodically covered with shallow water and land which in normal circumstances supports, or would support vegetation adapted to life in saturated soil". Inventorying of wetlands in national parks follows from obligations of the Ramsar Convention and represents a first step towards scientific understanding of these, the most threatened of all South Africa's ecosystems.

The Matlabas is the largest wetland in Marakele NP. Research is currently underway to determine the hydrological characteristics of the wetland.

Prambergfontein is one of several spring-fed wetlands that represent distinct features across the arid landscape of Tankwa Karoo NP. Dwellings in close proximity to many of these wetlands are testimony of the historically important role that these wetlands have played in the settlement of sheep farmers.

References

Nel, J.L., Driver, A., Strydom, W., Maherry, A., Petersen, C., Hill, L., Roux, D.J., Nienaber, S., Van Deventer, H., Swartz, E. & Smith-Adao, L.B. (2011). Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources. Water Research Commission, Pretoria.

Roux, D., Russell, I., Nel, J., Van Niekerk, L., Oosthuizen, A., Holness, S., Barendse, J., Bradshaw, P., Sink, K., Biggs, H., Dopolo, M., Petersen, R., Cruywagen, K. & Fisher, R. (2013a). SANParks Global Environmental Change assessment: Aquatic ecosystems. Scientific Report 01 / 2013, South African National Parks, Skukuza. 82 pages.

Roux, D., Fisher, R. & Cole, N. (2013b). Freshwater ecosystems of Tankwa Karoo National Park: Conservation priorities and recommended actions. Internal report, South African National Park, Cape Research Centre, Cape Town. 29 pages.

Botanical diversity of national parks

Peter Novellie, Johan Baard, Hugo Bezuidenhout, Carly Cowell, Tineke Kraaij, Lufuno Munyai & Guin Zambatis

The value of plant collections

SANParks carefully maintains collections of the plant species from all national parks. These collections not only assist botanical research in national parks, but provide a baseline for fulfilling the organisation's commitments in terms of legislation, policy and international conventions. In addition to monitoring the impact of management decisions on the vegetation in accordance with NEMPAA, the plant collections are used to:

- identify the locations of threatened plant species so they can be monitored and protected;
- allow monitoring of the extent to which plant species may be lost from parks;
- document, understand and conserve plant species diversity in accordance with the CBD's Global Strategy for Plant Conservation (GSPC);
- contribute to Target 7 of the GSPC to have at least 75% of threatened species conserved in situ;
- contribute to the Outcome 10 indicator of legal measures to protect threatened species;
- monitor the impact of climate change on the vegetation;
- provide accurate identifications necessary for plant community (phytosociological) surveys used in mapping of plant communities; and
- contribute to knowledge on the extent to which unique and potentially threatened plant communities are represented in national parks.

3-Second Brief:

To meet commitments arising from the Convention on Biodiversity and national legislation, SANParks needs accurate information on the diversity and threat status of plant species and plant communities in national parks. To achieve this requires painstaking maintenance and continual updating of plant collections by dedicated herbarium curators.

Comparison between national parks with respect to diversity of broad vegetation units, plant taxa and threatened plant species

Table 6 compares botanical diversity between the national parks. It is important to note that the diversity of vegetation types and of plant species in a park is influenced by many factors, including the size of the park, rainfall regime, geology, topography, and landscapes. It is also important to note that plant diversity may be underestimated if the area has not been intensively sampled. Irrespective of its diversity of vegetation types and species, each park is of unique value in representing a particular flora.

The number of broad vegetation/landscape units provides an indication of spatial variability. This is significant because maintaining spatial heterogeneity is essential to maintaining biodiversity.

Related:

Read about climate change monitoring on page 29

Related:

Read about the importance of spatial heterogeneity on pages 6 and 25

Acrolophia lunata, commonly known as The Moonlight Acrolophia, is Endangered and was only discovered in Garden Route NP in 2009; invasive alien plants have caused two subpopulations to go extinct in the last 20 years.

Table 6: Comparison between the different parks with respect to numbers of (a) broad vegetation/ landscape units, (b) plant taxa (c) plant species in the highest threat categories – Critically Endangered (CR), Endangered (EN) and Vulnerable (VU), as per Raimondo *et al.* (2013), and (d) specimens added to the collections in 2013.

Biomes: Albany Thicket (AT), Fynbos (Fy), Forest (F), Nama Karoo (NM), Indian Ocean Coastal Belt (IOCB), Desert (D), Succulent Karoo (SK), Savanna (S), Grassland (G). Note: only the main biomes from Mucina & Rutherford (2010) are listed, small pockets of isolated biomes are excluded.

Vegetation units are taken from park vegetation maps, where they exist, or alternatively from regional vegetation maps. Scientific references are available on request to the authors.

National Park	Biomes included in the park	Number of broad vegetation/ landscape units	Total plant taxa	Total threatened plant taxa (CR, EN, VU)	Number of specimens added to the collection in 2013
Addo Elephant	5 (AT, Fy, F, NK, IOCB)	34	1319	5	--
Agulhas	1 (Fy)	11	In progress (~1800)	157	68
Augrabies Falls	1 (NK)	6	433	1	--
Bontebok	1 (Fy)	3	654	32	4
Camdeboo	3 (NK, G, AT)	9	336	2	--
Garden Route	2 (F, Fy)	27	1969	42	131
Golden Gate Highlands	1 (G)	9	846	1	--
Kgalagadi (RSA side)	1 (S)	20	489	--	--
Karoo	2 (NK, G)	7	498	2	--
Kruger	1 (S)	35	1998	7	519
Mapungubwe	1 (S)	7	375	2	--
Marakele	1 (S)	13	704	1	--
Mokala	2 (S, NK)	10	326	--	55
Mountain Zebra	3 (NK, G, AT)	13	614	7	--
Namaqua	1 (SK)	16	631	10	--
Richtersveld	2 (D, SK)	26	718	3	5
Table Mountain	2 (Fy, F)	10	2557	250	--
Tankwa Karoo	2 (SK, Fy)	13	780	8	3
West Coast	1 (Fy)	6	550	128	--

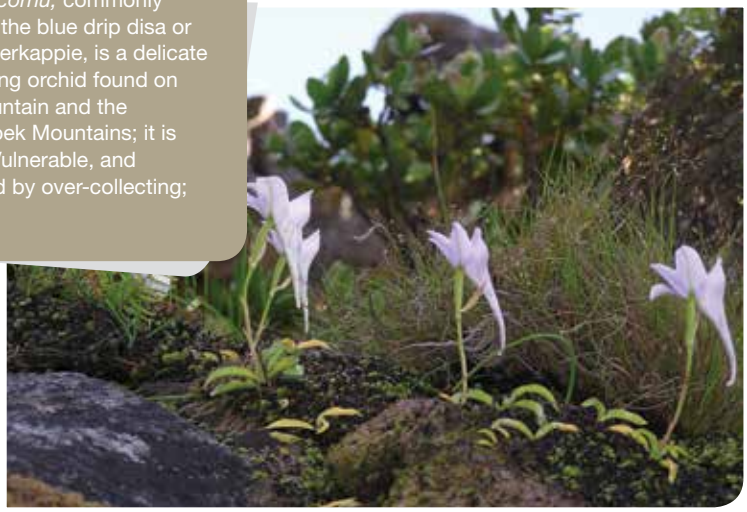
The splendid pagoda or pagoda bush, *Mimetes spendidus* (Vulnerable) shown here, is less abundant than *Mimetes pauciflorus* (three-flowered pagoda) which also occurs in Garden Route NP; the total population does not exceed 400 plants; they are threatened by alien plant invasion and too frequent fires.

Table 6 shows that the numbers of threatened plant species are many times higher in parks in the Fynbos Biome than in the other parks. This Biome is particularly rich in plant diversity and many taxa are threatened. It is of interest to compare those parks which have significant areas of Fynbos Biome with respect to the degree of overlap between them in occurrence of threatened plant species (Table 7). The low Sørensen indices of similarity (an index of 0% shows no similarity, while an index of 100% shows complete similarity, Sørensen 1948) indicate very limited overlap. This may be expected because threatened plants tend to be localised or specific to certain microhabitats rather than widespread.

The SANParks Species of Special Concern Monitoring Programme gives guidelines on generic methodology for monitoring of threatened species of plants and animals. During 2013 four threatened species were monitored by the Garden Route node, 33 by the Cape node and 11 by the Savanna and Arid node.

Serruria fasciflora (Near Threatened), commonly known as the common spiderhead, is known from only one site in the north-west of Garden Route NP; this may be its most easterly distribution; the species has suffered a 29% habitat loss owing to alien plant invasion.

Disa longicornu, commonly known as the blue drip disa or bloumoederkappie, is a delicate cliff dwelling orchid found on Table Mountain and the Jonkershoek Mountains; it is listed as Vulnerable, and threatened by over-collecting;



Left:
Leucadendron macowanii, also known as Acacia-leaf conebush, is Critically Endangered due to habitat loss and is limited to a few remaining patches on the Cape Peninsula;

Middle:
The Marsh Pagoda, *Mimetes hirtus,* is a short lived species requiring fire to stimulate germination of the soil stored seeds; listed as Vulnerable, it has already lost over 50% of its habitat, and is subject to ongoing habitat loss;

Right:
Witsenia maura (commonly known as waaiertjie) occurs in the marshes of the Cape; the population is declining due to developments in its habitat outside of protected areas.

Table 7: Numbers of co-occurring threatened species (in bold) and Sørensen's similarity index (%) compared between parks in the Fynbos Biome. (Only the categories Critically Endangered, Endangered and Vulnerable are included.)

	Bontebok	Garden Route	Table Mountain	West Coast
Agulhas	**5** 31.3	**5** 23.8	**5** 4.0	**10** 15.6
Bontebok		**1** 4.8	**1** 0.8	**0** 0.0
Garden Route			**1** 0.8	**0** 0.0
Table Mountain				**7** 10.9

Herbarium highlights during 2013

Garden Route National Park: The Garden Route collection, some of which was previously kept in other SANParks herbaria, was consolidated so that the park now has its own herbarium. In all 44 species new to Garden Route were added to the collection in 2013.

Kruger National Park: Four species new to Kruger NP were added to the herbarium, as well as three specimens that have yet to be described and identified. The rare *Barleria oxyphylla* was found in new localities. *Aloe aculeata,* last collected in 1954, was found in the Klopperfontein area. New maps were drawn up to give guidance where more collecting needs to be done.

Barleria oxyphylla

Aloe aculeata

Mokala National Park: In co-operation with the National Museum, Bloemfontein and SANBI, 55 species new to Mokala NP were added to the herbarium.

Namaqua National Park: A new plant species *Nemesia arenifera* (Scrophulariaceae), was collected by SANBI researchers in the sandveld landscape in Namaqua NP.

Richtersveld National Park: An *Indigofera* species was found in Richtersveld NP by a SANBI horticulturist. The species was last collected in the 1990s.

Nemesia arenifera
(Hester Steyn)

Indigofera species
(Ernst van Jaarsveld)

For all parks, collaboration with SANBI (Pretoria and Cape Town Herbaria as well as Botanical Gardens), Custodians of Rare and Endangered Wildflowers (CREW) project volunteers, SANParks Honorary Rangers, Environmental Monitors, professional taxonomists, National Museum (Bloemfontein) and numerous private enthusiasts contribute greatly to the upkeep of SANParks' collections.

References

Mucina, L. & Rutherford, M.C. (2010). The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. & Manyama, P.A. (2013). Red List of South African Plants. Downloaded from Redlist.sanbi.org version 2013.1.

Sørensen, T. (1948). A method of establishing groups of equal amplitude in plant sociology base on similarity of species and its application to analyses of the vegetation on Danish commons. *Biologiske Skrifter/Kongelige Danske Videnskabernes Selskab* 5: 1-34.

Note: *Unlike scientific names, which are standardised (according to internationally agreed principles), common names for plant and animal species are often specific to a region. As such, the same species is often known by different names. Equally, the same common name is often used in reference to different species. The common names mentioned in this article are not necessarily unique to a particular plant, but represent examples of some of the vernacular names by which a particular plant is known.*

Science communication training workshop

Dirk Roux

SANParks' scientists work on many fascinating research projects and pride themselves in producing reliable, relevant and useful information. However, scientific information and insights can only have the desired impact if the intended users know about them. Effective communication of science is essential for making science matter. For many scientists, communication to non-technical audiences was not part of their training and does not come naturally. They may have to acquire a new set of skills in order for their work to influence management decisions, conservation policy, public discourse and societal understanding of complex conservation issues.

Given the value-added potential of good communication, Conservation Services is keen to further motivate and equip SANParks' scientists to become passionate about, and excellent in, science communication. To this end we engaged with Nancy Baron, author of the book *Escape from the ivory tower – A guide to making your science matter*, to design a training workshop suited to our needs. Nancy is Director of Science Outreach at COMPASS and lead communication trainer for the Leopold Leadership Program in the US. COMPASS is a world leader in transforming scientists into effective science communicators, being *"dedicated to helping scientists connect themselves and their science to the wider world"* (http://www.compassonline.org/).

John Yeld from *The Argus* interviews Mahlomola Daemane on the role of ecological rehabilitation in degraded landscapes.

Related:

Read about the complexities of ecological rehabilitation on page 35

Delegates enjoy a lighter moment during a game to find out whether scientists (and journalists) are predominantly organisers, facilitators, analysts or innovators.

Under Nancy's guidance, and in collaboration with the CSIR and Marina Joubert (Southern Science), a world-class science communication workshop was hosted in Berg-en-Dal, Kruger NP, from 28 October to 1 November. Twenty conservation scientists and six journalists participated. The formidable (and somewhat intimidating) group of journalists consisted of Bibi-Aisha Wadvalla *(eNCA),* John Yeld *(The Argus),* Sarah Wild *(Mail & Guardian),* Derek Watts *(Carte Blanche),* Ken Weiss (previously *Los Angeles Times* and currently *Pulitzer Center* on crisis reporting), and Petro Kotze *(SANParks Times).* These experienced journalists shared numerous communication tips and provided scientists with exposure to simulated television and radio interviews, panel discussions and media events. Scientists also benefitted from training sessions on writing an opinion piece for a newspaper, using social media such as blogs and Twitter, and sharing your science in a one minute video clip.

The following are some reflections from the workshop:

- Scientists are generally good communicators – within their peer communities. However, for science to have impact/to change the world, research findings must be communicated to audiences outside science. Such communication poses a major challenge for most scientists and at the same time presents a significant opportunity to improve the social impact of science.
- Most, if not all, of the participants indicated that the workshop pushed them outside of their comfort zones and presented them with new and much needed skills. At the end of the workshop the group felt motivated to work at their communication skills.
- The combination of SANParks and CSIR scientists enabled useful sharing across organisational boundaries, helped to forge new professional relationships and contributed to a sense of cohesion within biodiversity science.
- It is recommended that similar workshops be organised for years to come to give all SANParks' scientists an opportunity to grow their communication skills.

During a simulated press conference, Sam Ferreira, Hector Magome and Danie Pienaar face the panel of journalists to explain SANParks' response to rhino poaching.

Related:

Read more about SANParks' integrated rhino research on page 22

2013 Savanna Science Network Meeting

Inês Ferreira & Stefanie Freitag-Ronaldson

Over 220 scientists representing 78 different scientific and conservation organisations from 14 countries came together for the annual Savanna Science Network Meeting in Skukuza, in Kruger NP, from 4-8 March. The event marked the 11th such gathering of scientists and conservation agencies to discuss the latest research relating to biodiversity, and protected areas conservation and management, specifically within the context of savannas but also drawing in relevant research and understanding from other protected areas across the globe. Delegates were 75% African and 25% international. Approximately three quarters of the delegates represented academic institutions and the rest protected area agencies. The program included 65 platform presentations, 46 speed talks and 32 poster presentations. Most of the studies presented involve collaborations between formal academic institutions, conservation organisations and training colleges, and regional parks.

The conference got underway with a keynote talk on complexity by Dr Rika Preiser from the Department of Philosophy at Stellenbosch University. The talk was of particular relevance to the morning's session on socio-ecological research, a growing focus within protected area conservation management, and encouraged the audience to think about what it means to embrace uncertainty and to be open to new ways of doing things. Subsequent presentations often made reference to the complexity of ecosystems – the difficulty in establishing cause and effect, or in separating out the problem being investigated from the environment in which it exists, as well as strategic tools for dealing with this complexity.

The topic of climate change received considerable attention, many studies reporting on what changes have already occurred in national parks, and seeking to predict further changes to ecosystem function and structure. In addition, the importance of monitoring biodiversity in order to successfully achieve adaptive management objectives was emphasised and the results of various monitoring projects presented. At a species level, a number of projects were reported back on with big cat and elephant-related studies dominating these sessions.

The meeting also hosted a plenary session, drawing on data gathered through a questionnaire to delegates, assessing scientists' perceptions around key threats to savanna protected areas, at the scales of Kruger NP and southern Africa. The discussion was aimed at identifying knowledge gaps and co-constructing additional relevant research directions based on the collective expert opinion. Top threats cited across both scales were relatively consistent, including freshwater system degradation outside of protected areas, inappropriate regional land use, poor governance at the policy implementation level, national politics and policies, global climate and atmospheric change, global political and social change, invasive species, and poor relationships with neighbouring communities.

A key objective of the savanna science meeting is to create a platform for delegates to actively engage with one another on existing research as well as to explore potential new research collaborations. Evidence of this taking place was everywhere with presenters soliciting feedback from the audience, and delegates, when not attending talks, gathering informally in small groups to discuss ideas. Conversations of this kind continued over dinner and well into the night with alternative interpretations to particular findings being offered and new research collaborations and plans being drawn up.

COMPLEXITY IN THE TIME OF ACCOUNTABILITY

Given the large degree of change, uncertainty and potential disagreement associated with protected area management, on-going learning and impartial evidence are operational necessities for conservation agencies. Science is an important component of learning, providing the evidence base that is an essential part of good decision-making to protecting natural and cultural heritage. Amidst changing external drivers and internal needs, the agency research function must also dynamically adapt to find synergy between science and policy and management direction. This report presents a partial overview of the in-house research function during 2013. We believe that it is important to share this information with our stakeholders. However, compiling the report also purposefully promotes in-house reflection and learning, and adaptation where necessary to ensure a research function that effectively serves conservation objectives in South Africa.

The 2013 Research Report highlights some of the ways in which research conducted by SANParks relates to legislation, national policies and national performance indicators. The majority of contributions to this report show that SANParks research aligns well with requirements and makes a contribution to a number of performance indicators. In a few cases performance indicators do not align well with the situation facing SANParks (reference to the complexity of rehabilitation article and the wetlands article) and alternative approaches are indicated.

Our self-evaluation in this regard comes at an appropriate time. The national performance indicators of Outcome 10 are shortly to be reviewed, offering opportunities for reflection and learning. DEA recognises the importance of evidence-based policy-making and is making provisions for constructive science-policy engagement. A Draft Environmental Sector Research, Development and Evidence Framework has been compiled with a view to bridging the gap that currently exists between policy makers and researchers by promoting dialogue. DEA is establishing various forums to ensure the necessary two-way engagement, giving researchers an opportunity to share evidence that may shape policy, and policy-makers an opportunity to share their needs for scientific evidence. The recently established National Science Policy Round Table is an important forum for SANParks to further participate in this essential science-policy dialogue.

ABBREVIATIONS

BMP	Biodiversity Management Plan
BMP-S	Biodiversity Management Plans for Species
BMS	Biodiversity Monitoring System
BRUV	baited remote underwater video
BSP	Biodiversity Social Projects
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species
CPUE	catch per unit effort
CRC	Cape Research Centre
CREW	Custodians of Rare and Endangered Wildflowers
CSD	Conservation Services Division
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DCA	damage causing animal
DEA	Department of Environmental Affairs
DWAF	Department of Water Affairs and Forestry
EM	Environmental Monitor
EPWP	Expanded Public Works Programme
EVI	Enhanced Vegetation Index
FEPA	Freshwater Ecosystem Priority Area
GSPC	Global Strategy for Plant Conservation
MPA	Marine Protected Area
NBA	National Biodiversity Assessment
NBF	National Biodiversity Framework
NEMBA	National Environmental Management: Biodiversity Act
NEMPAA	National Environmental Management: Protected Areas Act
NGO	Non-Governmental Organisation
NP	National Park
NPAES	National Protected Area Expansion Strategy
RUV	remote underwater video
SAEON	South African Environmental Observation Network
SAM	Strategic Adaptive Management
SANBI	South African National Biodiversity Institute
SASS	South African Scoring System
TPC	threshold of potential concern
UVC	underwater visual census

CONTRIBUTORS

Alexis Symonds manages policy processes in SANParks and participates in biodiversity legislative processes both nationally and internationally. She interacts widely with colleagues to compile the CSD reports for various forums and is responsible for monitoring and reporting on sustainable resource use projects. She has a passion for community-based conservation and particularly enjoys her involvement in projects that focus on the involvement and beneficiation of local communities.

Angela Gaylard is the regional ecologist for the parks in the Frontier cluster. She has a particular interest in science-management linkages and SAM. Her role in the organisation is to facilitate dialogue between scientists and managers in order to ensure scientifically rigorous management interventions that are relevant and meaningful to managers.

Regional ecologist **Carly Cowell** is in charge of the co-ordination of science-management communications between the scientific services, park management and external researchers in the Cape cluster parks. She is responsible for the development of research projects, collection and collation of data, and writing of papers, reports and plans resulting from research in a variety of arenas: fire ecology, species of special concern, habitat degradation and rehabilitation, alien and invasive species, wildlife management and resource use.

Chenay Simms is a GIS and remote sensing specialist with a background in zoology, and has previously worked for a major GIS software company. Her area of interest is applying GIS and remote sensing as tools that enable management to make better decisions about ecological problems.

Deborah Winterton is the science liaison officer at the CRC and is responsible for co-ordinating research project applications and renewals for the Cape cluster parks and Namaqua NP, as well as for liaising with researchers and park management.

Dirk Roux is a freshwater conservation scientist working at the interface between science, policy and management.

Eddie Riddell is the Water Resources Manager for Kruger NP, trained in ecology, hydrology and operational water resources management. He is responsible for using sound scientific knowledge to inform both management and governance practice for adaptive management of the lowveld river systems.

CONTRIBUTORS

Guin Zambatis is the curator of the Skukuza Biological Reference collection. Guin collects and identifies biological specimens, curates the collection and maintains the bio-ecological database of all specimens in the collection.

Harry Biggs is a specialist scientist who has worked extensively on river advocacy issues and was part of the decade-long multi-institutional multi-disciplinary Kruger National Parks Rivers Research Programme. He has a particular interest in SAM as an approach to managing national parks as part of complex socio-ecological systems.

Hugo Bezuidenhout has 24 years' experience in SANParks as a plant ecologist, geologist and soil scientist.

Ian Russell is the manager of the Rondevlei office of Garden Route NP, and conducts monitoring and research primarily on water quality, aquatic plants, fish and waterbirds in estuaries.

After completing an MSc in whale reproductive biology, **Inês Ferreira** worked in academic journal publishing for several years. She joined SANParks in 2012 as their science awareness officer and is responsible for communicating biodiversity-related research. Of particular interest to her is the visual representation of information in a manner which is creative and engaging yet retains scientific integrity.

Izak Smit is the Science Manager: Systems Ecology, GIS and Remote Sensing for the Savanna & Arid Research Unit. Izak conducts research on the use of GIS and remote sensing for detecting spatio-temporal ecological patterns that are of relevance to the effective management of national parks.

Jessica Hayes is the regional ecologist for Garden Route NP, working at the interface between science and management. She administers external research projects and facilitates dialogue between internal and external scientists, and managers to ensure effective knowledge exchange and improved management strategies.

Johan Baard has worked for Scientific Services: Garden Route NP since the amalgamation of the former DWAF with SANParks' Wilderness- and Tsitsikamma NP and the Knysna Lakes. He is responsible for invader plant control and rehabilitation planning, for the threatened plant species programme, vegetation inventories for Garden Route NP and for the management and maintenance of GIS for Garden Route NP.

Judith Botha's interest is in scientific data analysis and the setting up of systems to make sure that data are not lost and can be reused in long-term studies to help answer questions in the future.

Marine ecologist based at Rondevlei Scientific Services, **Kyle Smith** is interested in anything marine or fishy. His current research focuses on recreational and subsistence linefisheries with a particular emphasis on non-compliance and angler behaviour.

Llewellyn Foxcroft has an interest in all aspects of invasion ecology, linking basic ecological theory to applied, management-orientated problem solving. His work broadly focuses on examining patterns of invasive alien plants across SANParks and beyond. He has served as editor of *Koedoe* since 2008.

Louise Swemmer is a social scientist whose main focus is supporting the effective implementation of the 'people' objectives of SANParks through enabling, promoting and facilitating appropriate social and economic research. Louise has a keen interest in applied research with a focus on supporting SAM for benefit sharing from protected areas and in so doing building societal support for conservation.

Luanita van der Walt did BSc Botany-Zoology-Tourism, followed by a BSc Hons in Environmental Sciences. In 2011 she pursued an MSc Environmental Sciences focusing on biogeochemical landscape functionality, and plant species and functional diversity of fragmented grasslands. She graduated with distinction in 2013 (NWU Pukke) and is currently employed by the CSIR as an environmental assessment practitioner intern.

Lufuno Munyai is a biotechnician responsible for land degradation monitoring using Landscape Function Analysis according to prioritisation in the rehabilitation plans for arid and frontier parks.

CONTRIBUTORS

Mahlomola Daemane joined SANParks in 2002 with a background in botany, specialising in plant taxonomy. He also has a background in plant ecology and currently manages the Conservation Interface Programme focusing on addressing park management and science-related issues. His research interest is the degradation and restoration ecology across savanna and arid parks.

In his capacity as General Manager of the Veterinary Wildlife Services Department, **Markus Hofmeyr** attends many meetings, answers and writes gazillions of e-mails and occasionally gets the chance to do wildlife veterinary work for which he trained.

Mbulelo Dopolo is Program Manager: Marine at the CRC and has a background in estuarine and marine ecology. His areas of interest include marine ecology, conservation, fisheries science and management, and social-ecology. Current research includes reconciling conservation and fisheries objectives in gillnet fishery, Langebaan Lagoon MPA and shore-based recreational angling monitoring.

Mike Knight heads the Park Planning and Development Unit in SANParks and, as Chair of the IUCN Species Survival Commission African Rhino Specialist Group, has extensive experience in rhino conservation. He has published extensively in the field of wildlife ecology.

Mmoto Masubelele is a landscape ecologist at the CRC. His research is focused on habitat change and degradation at various spatial scales using a host of techniques including repeat photography. His research contributes to the Habitat Degradation and Rehabilitation Biodiversity Monitoring Programme for the Cape cluster parks.

Ndiviwe Baliwe is a marine research technician, with a background in freshwater and estuarine ecology, specialising in sea urchin histology. His main interests are the ecology of estuarine and marine organisms such as invertebrates and fish. Current research includes the characterisation of Langebaan Lagoon MPA, West Coast NP fish and fish larval assemblages.

Nick Hanekom is a marine ecologist who has worked primarily on invertebrate 'bait' organisms of the rocky intertidal shores of Tsitsikamma MPA and soft sediments of Swartvlei estuary.

For the past three years **Nicola van Wilgen** has been managing a project on global change and its trends and impacts in national parks. Her interests are sustainable biodiversity conservation, with a particular focus on alien species, land-use change, resource use, data analysis, climate change and communication of research results to relevant stakeholders.

Nomfundo Nkabi is a marine scientist intern, with a background in freshwater ecology and ecotoxicology. She specialised in freshwater fish histology. Her areas of interest include biology and ecology of marine fish. Current research includes land-based boat monitoring and marine debris monitoring.

Nonhlanhla Nyalungu is a marine scientist intern, with a background in estuarine ecology. Her main interest is estuarine ecology, especially impacts of freshwater reduction in estuaries and determining environmental flows for the ecological functioning of estuaries. Current research includes invertebrate (prawn) survey and boat survey monitoring.

Peggy Madonsela is a research database achiver and is responsible for capturing research and monitoring data on the SANParks Biodiversity Data Repository.

When not drinking beer **Peter Novellie** is an amateur botanist with an interest in the interface between biodiversity science, law and policy.

Peter Bradshaw works for SANParks as a GIS scientist, and has interests in botany and biogeography. He occasionally manages to delude himself that he can play bagpipes.

Rheinhardt Scholtz is responsible for the facilitation of research project registration in the Savanna and Arid parks

Rina Grant is a Science Manager: Systems Integration. Her main field of interest is plant-herbivore interactions. She is doing research on small scale utilisation of savannas by grazers and is hoping to use the understanding gained from conservation areas to inform new approaches to range management.

Robin Petersen is a freshwater ecology and geo-hydrology scientist with Scientific Services in Skukuza, Kruger NP.

Rod Randall is the General Manager: Scientific Services, Garden Route. One of his focus areas is to ensure that the research and monitoring activities of staff members are applied and related to the approved park management plan.

Ruth-Mary Fisher is the earth systems scientist working on freshwater ecosystems in the Cape parks. Currently, her biggest focus is looking at physical soil properties and how they are influenced by fire and woody alien vegetation.

Sam Ferreira is an ecologist with interests in solving ecological problems. He conducts and facilitates research on factors influencing tempo-spatial dynamics and how ecological restoration can overcome the influences of human disturbances on ecosystems. His role in SANParks is to ensure that management of large mammals is underpinned by robust scientific information.

Stefanie Freitag is the General Manager of the Savanna & Arid Research Unit. She works at facilitating and bridging between research, management and policy and is interested in generating shared understanding and incorporating different ways of knowing and learning into adaptive management approaches for protected area management and governance.

Stephen Holness is a conservation planner specialising in systematic conservation planning, particularly within a protected area management and expansion context, spatial biodiversity assessment and GIS. He has an extensive background in climate change, land degradation processes, fluvial geomorphology, integrated catchment management and rehabilitation of damaged ecosystems.

Tineke Kraaij is a vegetation ecologist working in fynbos environments with a focus on fire ecology, rare and threatened plant species, and alien plant invasions.

PHOTO CREDITS:

Alexis Symonds	Kyle Smith
André Spies	Leif Petersen
Angela Gaylard	Mahlomola Daemane
Carly Cowell	Mbulelo Dopolo
Dirk Roux	Nicola van Wilgen
Eric Reisinger	Paul Sieben
Ernst van Jaarsveld	Peter Novellie
Guin Zambatis	Peter Ryan
Hester Steyn	Rina Grant
Jaco Barendse	Robin Petersen
Johan Baard	Sam Ferreira
Kerry Sink	Steve Benjamin
Knysna Basin Project	

CONTACTS

Cape Research Centre	**Tokai**	**+27 (0)21 713 7500**
Garden Route	**Knysna**	**+27 (0)44 302 5614**
	Rondevlei	**+27 (0)44 343 1302**
	Saasveld	**+27 (0)44 871 0109**
Savanna & Arid Research Unit	**Kimberley**	**+27 (0)53 832 5488**
	Phalaborwa	**+27 (0)13 735 3451**
	Skukuza	**+27 (0)13 735 4402**

Project team: Peter Novellie, Inês Ferreira, Izak Smit, Nicola van Wilgen, Tineke Kraaij, Carly Cowell, Mahlomola Daemane

Editing team: Inês Ferreira, Peter Novellie

Design, Layout and print production: IWW, Johannesburg

APPENDIX A:

Peer-reviewed journal articles by SANParks staff
(SANParks research staff indicated in bold)

Addo Elephant National Park

Landman, M., Schoeman, D.S. & Kerley, G.I.H. (2013). Shift in black rhinoceros diet in the presence of elephant: Evidence for competition? *PLoS ONE* 8(7): e69771.

Tambling, C.J., **Ferreira, S.M., Adendorff, J.** & Kerley, G.I. (2013). Lessons from management interventions: Consequences for lion-buffalo interactions. *South African Journal of Wildlife Research* 43(1): 1-11.

Tambling, C.J., Minnie, L., **Adendorff, J.** & Kerley, G.I.H. (2013). Elephants facilitate impact of large predators on small ungulate prey species. *Basic and Applied Ecology* 14(8): 694-701.

Agulhas National Park

Geerts, S., Moodley, D., Gaertner, M., Le Roux, J.J., **McGeoch, M.A.**, Muofhe, C., Richardson, D.M. & Wilson, J.R.U. (2013). The absence of fire can cause a lag phase: The invasion dynamics of *Banksia ericifolia* (Proteaceae). *Austral Ecology* 38(8): 931-941.

Camdeboo National Park

Masubelele, M.L., Hoffman, M.T., Bond, W. & **Burdett, P.** (2013). Vegetation change (2010-1988) in Camdeboo National Park (South Africa), using fixed-point photo monitoring: The role of herbivory and climate. *Koedoe* 55(1): 1-16.

Garden Route National Park

Davies, S.J., Clusella-Trullas, S., Hui, C. & **McGeoch, M.A.** (2013). Farm dams facilitate amphibian invasion: Extra-limital range expansion of the painted reed frog in South Africa. *Austral Ecology* 38(8): 851-863.

Hanekom, N. (2013). Environmental conditions during mass mortalities of the ascidian *Pyura stolonifera* (Heller) in the Tsitsikamma Marine Protected Area. *African Zoology* (1): 167-172.

Jacobsen, N.H.G. & **Randall, R.M.** (2013). Survey of reptiles in the Wilderness section of the Garden Route National Park, South Africa. *Herpetology Notes* 6: 209-217.

Kraaij, T., **Baard, J.A.**, Cowling, R.M., van Wilgen, B.W. & Das, S. (2013). Historical fire regimes in a poorly understood, fire-prone ecosystem: Eastern coastal fynbos. *International Journal of Wildland Fire* 22(3): 277-287.

Kraaij, T., Cowling, R.M. & van Wilgen, B.W. (2013). Fire regimes in eastern coastal fynbos: Imperatives and thresholds in managing for diversity. *Koedoe* 55(1): Art. #1104, 9 pages.

Kraaij, T., Cowling, R.M. & van Wilgen, B.W. (2013). Lightning and fire weather in eastern coastal fynbos shrublands: Seasonality and long-term trends. *International Journal of Wildland Fire* 22(3): 288-295.

Kraaij, T., Cowling, R.M., van Wilgen, B.W. & Schutte-Vlok, A. (2013). Proteaceae juvenile periods and post-fire recruitment as indicators of minimum fire return interval in eastern coastal fynbos. *Applied Vegetation Science* 16(1): 84-94.

Russell, I.A. (2013). Spatio-temporal variability of surface water quality parameters in a South African estuarine lake system. *African Journal of Aquatic Science* 38(1): 53-66.

Kruger National Park

Burkepile, D.E., Burns, C.E., Tambling, C.J., Amendola, E., Buis, G.M., **Govender, N**., Nelson, V., Thompson, D.I., Zinn, A.D. & Smith, M.D. (2013). Habitat selection by large herbivores in a southern African savanna: The relative roles of bottom-up and top-down forces. *Ecosphere* 4(11): Art. #139.

Child, M.F., Peel, M.J.S., **Smit, I.P.J.** & Sutherland, W.J. (2013). Quantifying the effects of diverse private protected area management systems on ecosystem properties in a savannah biome, South Africa. *Oryx* 47: 29-40.

Delsink, A., Vanak, A.T., **Ferreira, S.** & Slotow, R. (2013). Biologically relevant scales in large mammal management policies. *Biological Conservation* 167: 116-126.

February, E.C., Higgins, S.I., Bond, W.J. & **Swemmer, L**. (2013). Influence of competition and rainfall manipulation on the growth responses of savanna trees and grasses. *Ecology* 94: 1155-1164.

Ferreira, S.M., Maruping, N.T., Schoultz, D. & Smit, T.R. (2013). Effects of the number of people on efficient capture and sample collection: A lion case study. *Journal of the South African Veterinary Association* 84(1): 1-7.

Harper, C.K., Vermeulen, G.J., Clarke, A.B., **de Wet, J.I.** & Guthrie, A.J. (2013). Extraction of nuclear DNA from rhinoceros horn and characterization of DNA profiling systems for white *(Ceratotherium simum)* and black *(Diceros bicornis)* rhinoceros. *Forensic Science International. Genetics* 7(4): 428-33.

Huchzermeyer, K.D.A, Osthoff, G., Hugo, A. & **Govender, D.** (2013). Comparison of the lipid properties of healthy and pansteatitis-affected African sharptooth catfish, *Clarias gariepinus* (Burchell), and the role of diet in pansteatitis outbreaks in the Olifants River in the Kruger National Park, South Africa. *Journal of Fish Diseases* 36(11): 897-909.

Kerry, R., Goovaerts, P., **Smit, I.P.J.** & Ingram, B.R. (2013). A comparison of multiple indicator kriging and area-to-point Poisson kriging for mapping patterns of herbivore species abundance in Kruger National Park, South Africa. *International Journal of Geographical Information Science* 27(1): 47-67.

Khalefa, E., **Smit, I.P.J.,** Nickless, A., Archibald, S., Comber, A. & Balzter, H. (2013). Vegetation canopy height from ICESat-GLAS spaceborne LiDAR with terrain correction. *IEEE Geoscience and Remote Sensing Letters* 10(6): 1439-1443.

La Grange L.J., **Govender D.** & Mukaratirwa S. (2013). The occurrence of *Trichinella zimbabwensis* in naturally infected wild crocodiles *(Crocodylus niloticus)* from the Kruger National Park, South Africa. *Journal of Helminthology* 87(1): 91-6.

Lane, E.P., Huchzermeyer, K.D., **Govender, D.,** Bengis, R.G., **Buss, P.E., Hofmeyr, M.**, Myburgh, J.G., Steyl, J.C.A., **Pienaar, D.J.** & Kotze, A. (2013). Pansteatitis of unknown etiology associated with large-scale nile crocodile *(Crocodylus niloticus)* mortality in Kruger National Park, South Africa: Pathologic findings. *Journal of Zoo and Wildlife Medicine* 44(4): 899-910.

Maputla, N.W., Chimimba, C.T. & **Ferreira, S.M.** (2013). Calibrating a camera trap-based biased mark-recapture sampling design to survey the leopard population in the N'wanetsi concession, Kruger National Park, South Africa. *African Journal of Ecology* 51(3): 422-430.

Mathieu, R., Naidoo, L., Cho, M. A., Leblon, B., Main, R., Wessels, K., Asner, G.P., Buckley, J., Van Aardt, J., Erasmus, B.F.N. & **Smit, I.P.J.** (2013). Toward structural assessment of semi-arid African savannahs and woodlands: The potential of multitemporal polarimetric RADARSAT-2 fine beam images. *Remote Sensing of Environment* 138: 215-231.

Miller, M., **Buss, P., Joubert, J., Mathebula, N., Kruger, M.,** Martin, L., **Hofmeyr, M.** & Olea-Popelka, F. (2013). Use of butorphanol during immobilization of free-ranging white rhinoceros *(Ceratotherium simum). Journal of Zoo and Wildlife Medicine* 44(1): 55-61.

Murn, C., Combrink, L., Ronaldson, G.S., **Thompson, C.** & **Botha, A.** (2013). Population estimates of three vulture species in Kruger National Park, South Africa. *Ostrich* 84(1): 1-9.

Smit, I.P.J. (2013). Systems approach towards surface water distribution in Kruger National Park, South Africa. *Pachyderm* 53: 91-98.

Smit, I.P.J., Riddell, E.S., Cullum, C. & **Petersen, R.** (2013). Kruger National Park research supersites: Establishing long-term research sites for cross-disciplinary, multiscaled learning. *Koedoe* 55(1): 1-7.

Smit, I.P.J., Smit, C.F., **Govender, N.**, Van der Linde, M. & **MacFadyen, S.** (2013) Rainfall geology and landscape position generate large-scale spatio-temporal fire pattern heterogeneity in an African savanna. *Ecography* 36(4): 447-459.

Smith, M.D., van Wilgen, B.W., Burns, C.E., **Govender, N.,** Potgieter, A.L.F., Andelman, S., **Biggs, H.C.,** Botha, J. & Trollope, W.S.W. (2013). Long-term effects of fire frequency and season on herbaceous vegetation in savannas of the Kruger National Park, South Africa. *Journal of Plant Ecology* 6(1): 71-83.

Treydte, A.C., Baumgartner, S., Heitkönig, I.M.A., **Grant, C.C.** & Getz, W.M. (2013). Herbaceous forage and selection patterns by ungulates across varying herbivore assemblages in a South African savanna. *PLoS ONE* 8(12): e82831.

Vardien, W., Richardson, D.M., **Foxcroft, L.C.,** Wilson, J.R.U. & Le Roux, J.J. (2013). Management history determines gene flow in a prominent invader. *Ecography* 36(9): 1032-1041.

Wessels, K.J., Colgan, M.S., Erasmus, B.F.N., Asner, G.P., Twine, W.C., Mathieu, R., van Aardt, J.A.N., Fisher, J.T. & **Smit, I.P.J.** (2013). Unsustainable fuelwood extraction from South African savannas. *Environmental Research Letters* 8(1):014007.

Mokala National Park

Ferreira, S., Daemane, M., Deacon, A., Sithole, H. & **Bezuidenhout, H.** (2013). Efficient evaluation of biodiversity concerns in protected areas. *International Journal of Biodiversity* Vol. 2013, Article ID 298968, 12 pages. doi:10.1155/2013/298968

Mountain Zebra National Park

Novellie, P. & **Gaylard, A.** (2013). Long-term stability of grazing lawns in a small protected area, the Mountain Zebra National Park. *Koedoe* 55(1).

Table Mountain National Park

Roets, F., Pryke, J.S. & **McGeoch, M.A.** (2013). Abiotic variables dictate the best monitoring times for the endangered Table Mountain stag beetle *(Colophon westwoodi* Gray 1832, Coleoptera: Lucanidae). *Journal of Insect Conservation* 17(2): 279-285.

Tankwa Karoo National Park

Steyn, H.M., Bester, S.P. & **Bezuidenhout, H.** (2013). An updated plant checklist for Tankwa Karoo National Park, South Africa. *South African Journal of Botany* 88: 247-251.

West Coast National Park

Barendse, J., Best, P. B., Carvalho, I. & Pomilla, C. (2013). Mother knows best: Occurrence and associations of resighted humpback whales suggest maternally derived fidelity to a Southern Hemisphere coastal feeding ground. *PLoS ONE* 8(12): e81238.

Multiple/Across Parks

Crawford, R.J.M., **Randall, R.M.,** Whittington, P.A., Walter, L., Dyer, B.M., Allan, D.G., Fox, C., Martin, A.P., Upfold, L., Visagie, J., Bachoo, S., Bowker, M., Downs, C.T., Fox, R., Huisamen, J., Makhado, A.B., Oosthuizen, W.H., Ryan, P.G., Taylor, R.H. & Turpie, J.K. (2013). South Africa's coastal-breeding white-breasted cormorants: Population trends, breeding season and movement and diet. *African Journal of Marine Science* 35(4): 473-490.

Spear, D., **Foxcroft, L.C., Bezuidenhout, H.** & McGeoch, M.A. (2013). Human population density explains alien species richness in protected areas. *Biological Conservation* 159: 137-147.

van Wilgen, N.J., Dopolo, M., Symonds, A., Vermeulen, W., Bester, E., Smith, K. & **McGeoch, M.A.** (2013). An inventory of natural resources harvested from national parks in South Africa. *Koedoe* 55(1): 1-5.

Not park-specific (but with SANParks authorship)

Beale, C. M., Rensberg, S. V., Bond, W. J., Coughenour, M., Fynn, R., **Gaylard, A., Grant, R.,** Harris, B., Jones, T., Mduma, S., Owen-Smith, N. & Sinclair, A.R.E. (2013). Ten lessons for the conservation of African savannah ecosystems. *Biological Conservation* 167: 224-232.

Brown, L.R., Du Preez, P.J., **Bezuidenhout, H.,** Bredenkamp, G.J., Mostert, T.H.C. & Collins, N.B. (2013). Guidelines for phytosociological classifications and descriptions of vegetation in southern Africa. *Koedoe* 55(1): Art. #1103, 10 pages.

Cilliers, P., **Biggs, H.C.,** Blignaut, S., Choles, A.G., Hofmeyr, J.S., Jewitt, G. & **Roux, D.J.** (2013). Complexity, modeling and natural resource management. *Ecology and Society* 18(3): 1.

Delsink, A.K., Kirkpatrick, J., van Altena, J.J., Bertschinger, H.J., **Ferreira, S.M.** & Slotow, R. (2013). Lack of spatial and behavioral responses to immunocontraception application in African elephants. *Journal of Zoo and Wildlife Medicine* 44(4S): S52-S74.

Harris, L., **Holness, S.,** Nel, R., Lombard, A.T. & Schoeman, D. (2013). Intertidal habitat composition and regional-scale shoreline morphology along the Benguela coast. *Journal of Coastal Conservation* 17(1): 143-54.

Kitshoff, A.M., De Rooster, H., **Ferreira, S.M.** & Steenkamp, G. (2013). A retrospective study of 109 dogs with mandibular fractures. *Veterinary and Comparitive Orthopaedics and Traumatology* 6(1): 51-56.

Kitshoff, A.M., De Rooster, H., **Ferreira, S.M.** & Steenkamp, G. (2013). The comparative biomechanics of the reinforced interdental crossover and the Stout loop composite splints for mandibular fracture repair in dogs. *Veterinary and Comparative Orthopaedics and Traumatology* 6: 461-468.

Mwakiwa, E., de Boer, W.F., Hearne, J.W., Slotow, R., van Langevelde, F., Peel, M.J.S., **Grant, C.C.,** Pretorius, Y., Stigter, J.D., Skidmore, A.K., Heitkonig, I.M.A., de Knegt, H.J., Kohi, E.M., Knox, N.M. & Prins, H.H.T. (2013). Optimization of wildlife management in a large game reserve through waterpoints manipulation: A bio-economic analysis. *Journal of Environmental Management* 114: 352-361.

Miller, S.M., Bissett, C., Burger, A., Courtenay, B., Dickerson, T., Druce, D.J., **Ferreira, S.M.,** Funston, P.J., Hofmeyr, D., Killian, P.J., Matthews, W., Naylor, S., Parker, D.M., Slotow, R., Toft, M. & **Zimmermann, D.** (2013). Management of reintroduced lions in small, fenced reserves in South Africa: An assessment and guidelines. *South African Journal of Wildlife Research* 43(2): 138-154.

Pyšek, P., Hulme, P.E., Meyerson, L.A., Smith, G.F., Boatwright, J.S., Crouch, N.R., Figueiredo, E., **Foxcroft, L.C.,** Jarošík, V., Richardson, D.M., Suda J. & Wilson, J.R.U. (2013). Hitting the right target: Taxonomic challenges for, and of, plant invasions. *AoB PLANTS* 5: plt042; doi:10.1093/aobpla/plt042.

Roux, D.J. & Nel, J.L. (2013). Freshwater conservation planning in South Africa: Milestones to date and catalysts for implementation. *Water SA* 39(1): 151-163.

APPENDIX B:

Peer-reviewed journal articles related to South African national parks
(not authored by SANParks staff)

Addo Elephant National Park

Cordova, C.E. (2013). C3 Poaceae and Restionaceae phytoliths as potential proxies for reconstructing winter rainfall in South Africa. *Quaternary International* 287: 121-140.

Freeman, E.W., Meyer, J.M., Putman, S.B., Schulte, B.A. & Brown, J.L. (2013). Ovarian cycle activity varies with respect to age and social status in free-ranging elephants in Addo Elephant National Park, South Africa. *Conservation Physiology* 1: 1-15.

Wartenberg, R., Weyl, O.L.F., Booth, A.J. & Winker, H. (2013). Life-history characteristics of an age-validated established invasive African sharptooth catfish, *Clarias gariepinus,* population in a warm – temperate African impoundment. *African Zoology* 48(2): 318-325.

Agulhas National Park

Conradie, B. & Garcia, M. (2013). An estimate of the recreational value of the Agulhas Plain, South Africa, with special reference to the value of plant biodiversity. *South Africa Journal of Economic and Management Sciences* 16(2): 170-182.

Augrabies Falls National Park

Barts, M., Hulbert, F. & Boone, J. (2013). A new locality record for *Pachydactylus haackei* Branch, Bauer et Good, 1996 at Augrabies National Park, Republic of South Africa. *Russian Journal of Herpetology* 12(3): 237-239.

Bontebok National Park

Wyk, A.M., Kotzé, A., Randi, E. & Dalton, D.L. (2013). A hybrid dilemma: A molecular investigation of South African bontebok *(Damaliscus pygargus pygargus)* and blesbok *(Damaliscus pygargus phillipsi). Conservation Genetics* 14(3): 589-599.

Garden Route National Park

Allanson, B.R. & Fearon, J.J. (2013). Growth rate of juvenile *Siphonaria compressa* (Gastropoda: Pulmonata). *Invertebrate Reproduction & Development* 57(1): 37-42.

Barnes, R.S.K. (2013). Spatial stability of macrobenthic seagrass biodiversity. *Marine Ecology Progress Series* 493: 127-139.

Barnes, R.S.K. (2013). Distribution patterns of macrobenthic biodiversity in the intertidal seagrass beds of an estuarine system, and their conservation significance. *Biodiversity and Conservation* 22(2): 357-372.

Bate, G.C., Smailes, P.A. & Adams, J.B. (2013). Epipelic diatoms in the estuaries of South Africa. *Water SA* 39(1): 105-118.

Cini, F. & Saayman, M. (2013). Understanding visitors' image of the oldest marine park in Africa. *Current Issues in Tourism* 16(7-8): 664-681.

Coetsee, C. & Wigley, B.J. (2013). *Virgilia divaricata* may facilitate forest expansion in the afrotemperate forests of the southern Cape, South Africa. *Koedoe* 55(1): Art. #1128, 8 pages.

Myles, P.B. (2013). Coastal route tourism: A vehicle for collaborative economic development in the Eastern Cape, South Africa. *Tourism in Marine Environments* 9(3-4):169-179.

Reinwarth, B., Franz, S., Baade, J., Haberzettl, T., Kasper, T., Daut, G., Helmschrot, J., Kirsten, K., Quick, L., Meadows, M. & Mäusbacher, R. (2013). A 700-year record on the effects of climate and human impact on the southern Cape coast inferred from lake sediments of Eilandvlei, Wilderness Embayment, South Africa. *Geografiska Annaler* 95(4): 345-360.

Golden Gate Highlands National Park

Taru, P., Chingombe, W. & Mukwada, G. (2013). South Africa's Golden Gate Highlands National Park Management Plan: Critical reflections. *South African Journal of Science* 109(11): 11-13.

Kalahari Gemsbok National Park

(Kgalagadi Transfrontier covered in Transfrontier section)

Dikgang, J. & Muchapondwa, E. (2013). The effect of land restitution on poverty reduction among the Khomani San "bushmen" in South Africa reduction among the Khomani San "bushmen" in South Africa. *Economic Research Southern Africa* (working paper 352).

Thondhlana, G. & Muchapondwa, E. (2013). Dependence on environmental resources and implications for household welfare: Evidence from the Kalahari Drylands, South Africa. *Economic Research Southern Africa* (working paper 370).

Thondhlana, G. & Shackleton, S. (2013). Cultural values of natural resources among the San people neighbouring Kgalagadi Transfrontier Park, South Africa. *Local Environment: The International Journal of Justice and Sustainability*: 1-16.

Wilson, J.W., Mills, M.G.L., Wilson, R.P., Peters, G., Mills, M.E.J., John, R., Durant, S.M., Bennett, N.C., Marks, N.J., Scantlebury, M. & Speakman, J.R. (2013). Cheetahs, *Acinonyx jubatus,* balance turn capacity with pace when chasing prey. *Biology Letters* 9: 1-4.

Kruger National Park

Abu Samra, N., Jori, F., Xiao, L., Rikhotso, O. & Thompson, P.N. (2013). Molecular characterization of *Cryptosporidium* species at the wildlife/livestock interface of the Kruger National Park, South Africa. *Comparative Immunology, Microbiology and Infectious Diseases* 36(3): 295-302.

Adams, R.A. & Snode, E.R. (2013). Unique insights into dispersion distances among calling males of Wahlberg's epauletted fruit bat in Kruger National Park, South Africa. *The Open Ecology Journal* 6: 54-60.

Amin, O.M., Evans, P., Heckmann, R. A. & El-Naggar, A.M. (2013). The description of *Mediorhynchus africanus* n. sp. (Acanthocephala: Gigantorhynchidae) from galliform birds in Africa. *Parasitology Research* 112(8): 2897-2906.

Anderson, K., Ezenwa, V.O. & Jolles, A.E. (2013). Tick infestation patterns in free ranging African buffalo *(Syncercus caffer)*: Effects of host innate immunity and niche segregation among tick species. *International Journal of Parasitology: Parasites and Wildlife* 2:1-9.

Baldeck, C. & Asner, G. (2013). Estimating vegetation beta diversity from airborne imaging spectroscopy and unsupervised clustering. *Remote Sensing* 5(5): 2057-2071.

Brooke, B., Koekemoer, L., Kruger, P., Urbach, J., Misiani, E. & Coetzee, M. (2013). Malaria vector control in *South Africa. South African Medical Journal* 103(10): 784-788.

Chirima, G. J., Owen-Smith, N., Erasmus, B. F. & Parrini, F. (2013). Distributional niche of relatively rare sable antelope in a South African savanna: Habitat versus biotic relationships. *Ecography* 36(1): 068-079.

Cini, F., Kruger, S. & Ellis, S. (2013). A model of intrinsic and extrinsic motivations on subjective well-being: The experience of overnight visitors to a national park. *Applied Research in Quality of Life* 8(1): 45-61.

Coetzer, K.L., Erasmus, B.F.N., Witkowski, E.T.F. & Reyers, B. (2013). The race for space: Tracking land-cover transformation in a socio-ecological landscape, South Africa. *Environmental Management* 52(3): 595-611.

Coghlan, A. & Castley, J.G. (2013). A matter of perspective: Residents', regulars' and locals' perceptions of private tourism ecolodge concessions in Kruger National Park, South Africa. *Current Issues in Tourism* 16(7-8): 682–699.

Davies, A.B., Eggleton, P., van Rensburg, B.J. & Parr, C.L. (2013). Assessing the relative efficiency of termite sampling methods along a rainfall gradient in African savannas. *Biotropica* 45(4): 474-479.

Hlokwe, T.M., van Helden, P. & Michel, A. (2013). Evaluation of the discriminatory power of variable number of tandem repeat typing of *Mycobacterium bovis* isolates from southern Africa. *Transboundary and Emerging Diseases* 60 (Suppl) S1: 111-120.

Holdo, R.M. (2013). Effects of fire history and N and P fertilization on seedling biomass, specific leaf area, and root:shoot ratios in a South African savannah. *South African Journal of Botany* 86: 5-8.

Jaouen, K., Pons, M.-L. & Balter, V. (2013). Iron, copper and zinc isotopic fractionation up mammal trophic chains. *Earth and Planetary Science Letters* 374: 164-172.

Khomo, L., Bern, C.R., Hartshorn, A.S., Rogers, K.H. & Chadwick, O.A. (2013). Chemical transfers along slowly eroding catenas developed on granitic cratons in southern Africa. *Geoderma* 202-203: 192-202.

Kulmatiski, A. & Beard, K.H. (2013). Root niche partitioning among grasses, saplings, and trees measured using a tracer technique. *Oecologia* 171(1): 25-37.

Kulmatiski, A. & Beard, K.H. (2013). Woody plant encroachment facilitated by increased precipitation intensity. *Nature Climate Change* 3(9): 833-837.

Kumar, K.R., Sivakumar, V., Reddy, R.R., Gopal, K.R. & Adesina, A.J. (2013). Inferring wavelength dependence of AOD and Ångström exponent over a sub-tropical station in South Africa using AERONET data: Influence of meteorology, long-range transport and curvature effect. *The Science of the Total Environment* 461-462: 397-408.

Laubscher L. & Hoffman L. (2013). An overview of disease-free buffalo breeding projects with reference to the different systems used in South Africa. *Sustainability* 4(11): 3124-3140.

Le Roex, N., Koets, A.P., van Helden, P.D. & Hoal, E.G. (2013). Gene polymorphisms in African buffalo associated with susceptibility to bovine tuberculosis infection. *PLoS ONE* 8(5): e64494.

Levick, S.R. & Asner, G.P. (2013). The rate and spatial pattern of treefall in a savanna landscape. *Biological Conservation* 157: 121-127.

Loarie, S.R., Tambling, C.J. & Asner, G.P. (2013). Lion hunting behaviour and vegetation structure in an African savanna. *Animal Behaviour* 85(5): 899-906.

Maas, M., Keet, D.F. & Nielen, M. (2013). Hematologic and serum chemistry reference intervals for free-ranging lions (Panthera leo). *Research in Veterinary Science* 95(1): 266-8.

McHale, M.R., Bunn, D.N., Pickett, S.T.A. & Twine, W. (2013). Urban ecology in a developing world: Why advanced socio-ecological theory needs Africa. *Frontier in Ecology and the Environment* 11(10): 556-564.

Miguel, E., Grosbois, V., Caron, A., Boulinier, T., Fritz, H., Cornélis, D., Foggin, C., Makaya, P.V., Tshabalala, P.T. & de Garine-Wichatitsky, M. (2013). Contacts and foot and mouth disease transmission from wild to domestic bovines in Africa. *Ecosphere* 4: Art #51.

Moustakas, A., Kunin, W.E., Cameron, T.C. & Sankaran, M. (2013). Facilitation or competition? Tree effects on grass biomass across a precipitation gradient. *PLoS ONE* 8(2): e57025.

Munyati, C. & Sinthumule, N.I. (2013). Assessing change in woody vegetation cover in the Kruger National Park, South Africa, using spectral mixture analysis of a Landsat TM image time series. *International Journal of Environmental Studies* 70(1): 94-110.

Munyati, C., Ratshibvumo, T. & Ogola, J. (2013). Landsat TM image segmentation for delineating geological zone correlated vegetation stratification in the Kruger National Park, South Africa. *Physics and Chemistry of the Earth* 55-57:1–10.

Otto, H.H.H, Gardiner, A. J. & Sharp, I.C. (2013). New larval host plant records for butterflies of the Kruger National Park and its surrounds, Limpopo and Mpumalanga, South Africa. *Metamorphosis* 24: 69-74.

Owen-Smith, N. (2013). Daily movement responses by African savanna ungulates as an indicator of seasonal and annual food stress. *Wildlife Research* 40(3): 232-240.

Ramoelo, A., Skidmore, A.K., Cho, M.A., Mathieu, R., Heitkönig, I.M.A., Dudeni-Tlhone, N., Schlerf, M. & Prins, H.H.T. (2013). Non-linear partial least square regression increases the estimation accuracy of grass nitrogen and phosphorus using in situ hyperspectral and environmental data. *ISPRS Journal of Photogrammetry and Remote Sensing* 82: 27-40.

Ramutsindela, M. & Shabangu, M. (2013). Conditioned by neoliberalism: A reassessment of land claim resolutions in the Kruger National Park. *Journal of Contemporary African Studies* 31(3): 441-456.

Scholtz, M., Kruger, M. & Saayman, M. (2013). Understanding the reasons why tourists visit the Kruger National Park during a recession. *Acta Commercii* 13(1): 1-9.

Scogings, P.F., Hjältén, J. & Skarpe, C. (2013). Does large herbivore removal affect secondary metabolites, nutrients and shoot length in woody species in semi-arid savannas? *Journal of Arid Environments* 88: 4-8.

Struwig, M. & Siebert, S.J. (2013). A taxonomic revision of *Boerhavia* (Nyctaginaceae) in southern Africa. *South African Journal of Botany* 86: 116-134.

Taylor, W., Skinner, J. & Boomker, J. (2013). Nematodes of the small intestine of African buffaloes, *Syncerus caffer,* in the Kruger National Park, South Africa. *Onderstepoort Journal of Veterinary Research* 80(1): 10-13.

Van Coller, H., Siebert, F. & Siebert, S.J. (2013). Herbaceous species diversity patterns across various treatments of herbivory and fire along the sodic zone of the Nkuhlu exclosures, Kruger National Park. *Koedoe* 55(1): 1-6.

Van Tonder, C., Saayman, M. & Krugell, W. (2013). Tourists' characteristics and willingness to pay to see the big five. *Journal of Economic and Financial Sciences* 6(3): 631-644.

Viljoen, J.J., Reynecke, H.C., Panagos, M.D., Langbauer, W.R. & Ganswindt, A. (2013). Seasonal selection preferences for woody plants by breeding herds of African elephants *(Loxodonta africana)* in a woodland savanna. *International Journal of Ecology* Article ID 769587.

Wolf, A., Doughty, C.E. & Malhi, Y. (2013). Lateral diffusion of nutrients by mammalian herbivores in terrestrial ecosystems. *PLoS ONE* 8(8): e71352.

Yessoufou, K., Davies, T.J., Maurin, O., Kuzmina, M., Schaefer, H., van der Bank, M. & Savolainen, V. (2013). Large herbivores favour species diversity but have mixed impacts on phylogenetic community structure in an African savanna ecosystem. *Journal of Ecology* 101(3): 614-625.

Zurita-Milla, R., van Gijsel, J.A.E., Hamm, N.A.S., Augustijn, P.W.M. & Vrieling, A. (2013). Exploring spatiotemporal phenological patterns and trajectories using self-organizing maps. *IEEE Transactions on Geoscience and Remote Sensing* 51(4): 1914-1921.

Mapungubwe National Park

Forssman, T. (2013). Missing pieces: Later Stone Age surface assemblages on the greater Mapungubwe landscape, South Africa. *Southern African Humanities* 25: 65-85.

Heaton, J.L. & Pickering, T.R. (2013). First records of talon cusps on baboon maxillary incisors argue for standardizing terminology and prompt a hypothesis of their formation. *Anatomical Record* 296(12): 1874-80.

Theron, N., Jansen, R., Grobler, P. & Kotze, A. (2013). The home range of a recently established group of southern ground-hornbill *(Bucorvus leadbeateri)* in the Limpopo Valley, South Africa. *Koedoe* 55(1): 1-8.

Mountain Zebra National Park

Kok, A.D., Parker, D.M. & Nigel, P. (2013). Rules of attraction: The role of bait in small mammal sampling at high altitude in South Africa. *African Zoology* 48(1): 84-95.

Namaqua National Park

Bester, S.P. & Steyn, H.M. (2013). *Nemesia arenifera* (Scrophulariaceae), a new species from the Sandveld, Northern Cape Province, South Africa, and the ectotypification of *N. viscosa. Phytotaxa* 126(1): 49-54.

Richtersveld National Park

Borovec, R. & Meregalli, M. (2013). Soil insect research in South Africa. 1. A new genus of terricolous weevils with four new species from the Richtersveld National Park (Coleoptera: Curculionidae: Entiminae: Trachyphloeini). *Zootaxa* 3646: 501-515.

Dreyer, L.L. (2013). Two new *Oxalis* (Oxalidaceae) species from the Richtersveld National Park, South Africa. *Phytotaxa* 89: 3155.

Roets, F., Oberlander, K.C. & Dreyer, L.L. (2013). Two new *Oxalis* species (Oxalidaceae) from the Ai-Ais/Richtersveld Transfrontier Park, South Africa. *Blumea - Biodiversity, Evolution and Biogeography of Plants* 57(3): 229-235.

Samuels, I., Allsopp, N. & Hoffman, M.T. (2013). How could herd mobility be used to manage resources and livestock grazing in semi-arid rangeland commons? *African Journal of Range & Forage Science* 30(1-2): 85-89.

Uhlig, M. & Dorchin, Y. (2013). A new *Termophilum* species from the Richtersveld National Park in South Africa (Coleoptera, Carabidae: Anthiinae). *Deutsche Entomologische Zeitschrift* 60(2): 241-249.

Table Mountain National Park

Chalmandrier, L., Midgley, G.F., Barnard, P. & Sirami, C. (2013). Effects of time since fire on birds in a plant diversity hotspot. *Acta Oecologic* 49: 99-106.

Okanga, S., Cumming, G.S., Hockey, P.A.R. & Peters, J.L. (2013). Landscape structure influences avian malaria ecology in the Western Cape, South Africa. *Landscape Ecology* 28(10): 2019-2028.

Saayman, M., Saayman, A. & Roussouw, R. (2012). The socio-economic impact of the Table Mountain National Park. *Journal of Economic and Financial Sciences* 6(2):439-458.

Taylor, P. & Brill, G.C. (2013). A decade of illegal fishing in Table Mountain National Park (2000-2009): Trends in the illicit harvest of abalone *Haliotis midae* and West Coast rock lobster *Jasus lalandii. African Journal of Marine Science* 35(4): 491-500.

West Coast National Park

Nel, P. & Branch, G. (2013). Assessment of the abundance and distribution of burrowing sandprawns and mudprawns *(Callichirus* and *Upogebia* species) in Langebaan Lagoon, South Africa. *African Journal of Marine Science* 35(2): 195-208.

Nyaga, J.M., Cramer, M.D. & Neff, J.C. (2013). Atmospheric nutrient deposition to the West Coast of South Africa. *Atmospheric Environment* 81: 625-632.

Pearcy A. & Beyer J. (2013). Spatial separation of intraspecific attachment sites of *Amblyomma sylvaticum* on Angulate tortoises *Chersina angulata. Acarina* 21(1): 147-150.

Multiple/Across Parks

Barker, N.P., Fearon, J.L. & Herbert, D.G. (2013). Moisture variables, and not temperature, are responsible for climate filtering and genetic bottlenecks in the South African endemic terrestrial mollusc *Prestonella* (Orthalicoidea). *Conservation Genetics* 14(5): 1065-1081. (Mountain Zebra & Karoo NPs)

Bernard, A.T.F., Götz, A., Kerwath, S.E. & Wilke, C.G. (2013). Observer bias and detection probability in underwater visual census of fish assemblages measured with independent double-observers. *Journal of Experimental Marine Biology and Ecology* 443: 75-84. (Table Mountain & Garden Route NPs)

Chaisi, M.E., Janssens, M.E., Vermeiren, L., Oosthuizen, M.C., Collins, N.E. & Geysen, D. (2013). Evaluation of a real-time PCR test for the detection and discrimination of theileria species in the African buffalo *(Syncerus caffer)*. *PLoS ONE* 8(10): e75827. (Addo Elephant, Kruger & Marakele NPs)

Cundill, G., Thondhlana, G., Sisitka, L., Shackleton, S. & Blore, M. (2013). Land claims and the pursuit of co-management on four protected areas in South Africa. *Land Use Policy* 35: 171-178. (Kgalagadi TFCA & Kruger NP)

D'Amato, M.E., Alechine, E., Cloete, K.W., Davison, S. & Corach, D. (2013). Where is the game? Wild meat products authentication in South Africa: A case study. *Investigative Genetics* 4(1): 6.

De Moor, F.C. & Day, J.A. (2013). Aquatic biodiversity in the mediterranean region of South Africa. *Hydrobiologia* 719(1): 237-268. (Various national parks with marine components)

Dikgang, J. & Muchapondwa, E. (2013). Conservation fees in the Kgalagadi Transfrontier Park between Botswana and South Africa in the presence of land restitution. *Environment for Development.* (Augrabies, Kgalagadi & Kruger NPs)

Du Plessis, L., Van der Merwe, P. & Saayman, M. (2013). Tourists' perceptions on whether South African national parks are environmentally friendly. *Acta Academica* 45(1): 187-208.

Faith, J.T. (2013). Ungulate diversity and precipitation history since the Last Glacial Maximum in the Western Cape, South Africa. *Quaternary Science Reviews* 68: 191-199. (Bontebok, Golden Gate Highlands, Kgalagadi & Kruger NPs)

Hrabar, H. & Kerley, G.I.H. (2013). Conservation goals for the Cape mountain zebra *Equus zebra zebra* – Security in numbers? *Oryx* 47(03): 403-409. (Tankwa and Mountain Zebra NPs)

McConnachie, M.M., Cowling, R.M., Shackleton, C.M. & Knight, A.T. (2013). The challenges of alleviating poverty through ecological restoration: Insights from South Africa's "Working for Water" Program. *Restoration Ecology* 21(5): 544-550.

Pool-Stanvliet, R. (2013). Die historiese verloop van die Unesco MAB- program in Suid-Afrika. *LitNet Akademies (Geesteswetenskappe)* 10(2): 418-445. (National Parks involved in biosphere reserves)

Smit, A.J., Roberts, M., Anderson, R.J., Dufois, F., Dudley, S.F.J., Bornman, T.G., Olbers, J. & Bolton, J.J. (2013). A coastal seawater temperature dataset for biogeographical studies: Large biases between in situ and remotely-sensed data sets around the coast of South Africa. *PLoS ONE* 8(12): e81944. (Garden Route & Table Mountain NPs)

Struwig, M., Siebert, S. J. & Jordaan, A. (2013). Pollen morphology of members of southern African *Boerhavia and Commicarpus* (Nyctaginaceae). *African Biodiversity & Conservation* 43(1), 15-22. (Mapungubwe & Kruger NPs)

Tarrant, J., Cilliers, D., du Preez, L.H. & Weldon, C. (2013). Spatial assessment of amphibian chytrid fungus *(Batrachochytrium dendrobatidis)* in South Africa confirms endemic and widespread infection. *PLoS ONE* 8(7): e69591. (Agulhas, Namaqua & Table Mountain NPs)

Van der Walt, J., Nel, L.H. & Rus Hoelzel, A. (2013). Differentiation at mitochondrial and nuclear loci between the blesbok *(Damaliscus pygargus phillipsi)* and bontebok *(D. p. pygargus):* Implications for conservation strategy. *Conservation Genetics* 14(1): 243-248. (Bontebok, Golden Gate Highlands & West Coast NPs)

Wittemyer, G., Daballen, D. & Douglas-Hamilton, I. (2013). Comparative demography of an at-risk African elephant population. *PLoS ONE* 8(1): e53726. (Addo Elephant & Kruger NPs)

Transfrontier Parks (including SANParks)

Barrett, G. (2013). Markets of exceptionalism: Peace parks in Southern Africa. *Journal of Contemporary African Studies* 31(3): 457-480.

Bhatasara, S., Nyamwanza, A.M. & Kujinga, K. (2013). Transfrontier parks and development in southern Africa: The case of the Great Limpopo Transfrontier Park. *Development Southern Africa* 30(4-05): 629–639.

Chaderopa, C. (2013). Crossborder cooperation in transboundary conservation-development initiatives in southern Africa: The role of borders of the mind. *Tourism Management* 39: 50-61.

Chaderopa, C. (2013). Legitimising transboundary conservation–development initiatives: A discourse analysis of policy-decision making and its implications for rural community participation. *International Journal of Tourism Policy* 5(1): 128-151.

Lunstrum, E. (2013). Articulated sovereignty: Extending Mozambican state power through the Great Limpopo Transfrontier Park. *Political Geography* 36: 1-11.

Muzeza, D., Schutte, D.W. & Snyman, R. (2013). Great Limpopo Transfrontier conservation governance in southern Africa: Understanding contestations and conflict between local resource access and biodiversity conservation. *International Journal of Innovative Research and Development* 2(6): 187-227.

APPENDIX C:

Books and book chapters
(SANParks research staff indicated in bold)

Books

Foxcroft, L.C., Pyšek, P., Richardson, D.M. & Genovesi, P. (2013). *Plant Invasions in Protected Areas. Patterns, Problems and Challenges.* Springer, Dordrecht. 656pp. DOI:10.1007/978-94-007-7750-7
http://www.springer.com/life+sciences/ecology/book/978-94-007-7749-1
ISBN 978-94-007-7749-1 ISBN 978-94-007-7750-7 (eBook)

Book chapters

Foxcroft, L.C., Richardson, D.M., Pyšek, P. & Genovesi, P. (2013). Plant invasions in protected areas: Outlining the issues and creating the links. In: Foxcroft, L.C., Pyšek, P., Richardson, D.M. & Genovesi, P. (Eds), *Plant Invasions in Protected Areas. Patterns, Problems and Challenges.* Springer, Dordrecht. Pp 3-18. DOI: 10.1007/978-94-007-7750-7_1

Foxcroft, L.C., Pyšek, P. Richardson, D.M., Pergl, J. & Hulme, P.E. (2013). The bottom line: Impacts of alien plant invasions in protected areas. In: Foxcroft, L.C., Pyšek, P., Richardson, D.M. & Genovesi, P. (Eds), *Plant Invasions in Protected Areas. Patterns, Problems and Challenges.* Springer, Dordrecht. Pp 19-41. DOI: 10.1007/978-94-007-7750-7_2

Hui, C., **Foxcroft,** L.C., Richardson, D.M., & MacFadyen, S. (2013). A cross-scale approach for abundance estimation of invasive alien plants in a large protected area. In: Foxcroft, L.C., Pyšek, P., Richardson, D.M. & Genovesi, P. (Eds), *Plant Invasions in Protected Areas. Patterns, Problems and Challenges.* Springer, Dordrecht. Pp 73-88. DOI: 10.1007/978-94-007-7750-7_5

Foxcroft, L.C., Witt, A. & Lotter, W.D. (2013). Icons in peril: Invasive alien plants in African protected areas. In: Foxcroft, L.C., Pyšek, P., Richardson, D.M. & Genovesi, P. (Eds), *Plant Invasions in Protected Areas. Patterns, Problems and Challenges.* Springer, Dordrecht. Pp 117-143. DOI: 10.1007/978-94-007-7750-7_7

Baret, S., Baider, C., Kueffer, C., **Foxcroft,** L.C. & Lagabrielle, E. (2013). Threats to paradise? Plant invasions in protected areas of the Western Indian Ocean Islands. In: Foxcroft, L.C., Pyšek, P., Richardson, D.M. & Genovesi, P. (Eds), *Plant Invasions in Protected Areas. Patterns, Problems and Challenges.* Springer, Dordrecht. Pp 423-447. DOI: 10.1007/978-94-007-7750-7_19

Foxcroft, L.C., Richardson, D.M., Pyšek, P. & Genovesi, P. (2013). Invasive alien plants in protected areas: Threats, opportunities, and the way forward. In: Foxcroft, L.C., Pyšek, P., Richardson, D.M. & Genovesi, P. (Eds), *Plant Invasions in Protected Areas. Patterns, Problems and Challenges.* Springer, Dordrecht. Pp 621-639. DOI: 10.1007/978-94-007-7750-7_28

Seydack, A.H.W. (2013). Bushpig *Potamochoerus larvatus.* In: Kingdon, J. & Hoffmann, M. (Eds), *Mammals of Africa.* Vol. 6, Bloomsbury, London. Pp 32-36.

APPENDIX D:

Reports – External scientific or technical reports
(SANParks research staff indicated in bold)

Cowell, C. (2013). Investigating the most favourable seed establishment methods for restoring Sand Fynbos on old fields. Thesis Applied Sciences, Cape Town, Cape Peninsula University of Technology. 115pp

Dopolo, M.T. (2013). Shore-based recreational angling catches and catch per unit effort adjacent to Agulhas and West Coast National Parks. In: Attwood, C., Booth, T., Kerwath, S., Mann, B., Marr, S., Duncan, J., Bonthuys, J. & Potts, W. (Eds), A Decade After the Emergency, The Proceedings of the 4th Linefish Symposium, WWF South Africa Report Series – 2013/Marine/001. 9pp

Duffy, R., Emslie, R.H. & **Knight, M.H.** (2013). Rhino poaching: How do we respond? Evidence on demand, UK. 35pp. DOI: **http://dx.doi.org/10.12774/eod_hd087.oct2013.duffy**

Knight, M.H. (2013). African Rhino Specialist Group report/Rapport du Groupe Spécialiste des Rhinos d'Afrique. *Pachyderm* 53: 7-24.

Knight, M.H., Balfour, D. & Emslie, R. (2013). Biodiversity Management Plan for the black rhinoceros *(Diceros bicornis)* in South Africa 2011-2020. Department of Environmental Affairs, Pretoria. Government Gazette, 25 January 2013, No. 6096. 80pp. **http://www.info.gov.za/view/DownloadFileAction?id=182611**

Kraaij, T. (2013). Fire regimes in eastern coastal fynbos: Drivers, ecology and management. PhD Thesis, Botany Department, Nelson Mandela Metropolitan University, Port Elizabeth. 145pp.

Le Bourgeois T., Grard, P., **Foxcroft, L.C.,** Thompson, D., Carrara, A., Guézou, A., Taylor, R.W. & Marshall, T. (2013). Pl@ntInvasive-Kruger V.1.0: Alien plants of the Kruger National Park. Cirad-SANParks-SAEON, Montpellier, France, Skukuza, South Africa. (CD-Rom)

Smith M.K.S. & Kruger N. (2013). The recreational and subsistence linefisheries in the Knysna and Swartvlei Estuaries – Some concerns and management challenges. In: Attwood, C., Booth, T., Kerwath, S., Mann, B., Marr, S., Duncan, J., Bonthuys, J. & Potts, W. (Eds), A Decade After the Emergency, The Proceedings of the 4th Linefish Symposium, WWF South Africa Report Series – 2013/Marine/001. Pp 145-160.

APPENDIX E1:

National and international conferences at which SANParks staff presented as first author

Conference/Forum/Symposium	National/ International	Host Nation	Notes	No. of first-authored papers
11th Meeting of the IUCN African Rhino Specialist Group	International	Kenya		3
11th Savanna Science Network Meeting	International	South Africa		6
48th Annual Congress of the Grassland Society of Southern Africa (GSSA)	National	South Africa	Awarded best platform presentation	2
44th Union World Conference on Lung Health	International	France		1
41st Annual Symposium on Management of Invasive Alien Plants	National	South Africa		1
10th World Wilderness Congress, Symposium on Science & Stewardship to Protect & Sustain Wilderness Values (WILD 10)	International	Spain		1
12th Ecology and Management of Alien Plant Invasions (EMAPI) Conference	International	Brazil		1
Annual Meeting of the Tree Protection Co-operative Programme (TPCP) and the DST/ NRF Centre of Excellence in Tree Health Biotechnology (CTHB)	National	South Africa		1
CITES CoP 16	International	Thailand		1
Fynbos Forum	National	South Africa		6
INSAKA	International	South Africa		5
INTECOL	International	England		1
International Meeting of Fire Effects on Soil Properties (FESP4)	International	Lithuania	Awarded best student presentation	1
Jack Skeed Memorial Lecture	National	South Africa	Invited Keynote	1
SAEON Graduate Student Network Indibano	National	South Africa	Awarded best presentation	1
South African Wildlife Management Association Symposium	National	South Africa	Invited Keynote	3
Southern African Programme on Ecosystem Change and Society (SAPECS)	National	South Africa	Invited Keynote	1
Southern African Development Countries Rhino Management Group	International	South Africa		2

Symposium of Contemporary Conservation Practice	National	South Africa		1
The Great Limpopo Transfrontier Conservation Area (GLTFCA) a decade after inception: Taking Stock of Current Socio-ecological Research.	International	South Africa		1
Thicket Forum	National	South Africa	Invited Keynote	1
Wildlife Enforcement Network Southern Africa	International	Botswana		1
World Famous Mountains Research and Public Diplomacy Conference	International	China		1

APPENDIX E2:

Conference/Symposium/Forum presentations given by SANParks research staff
(first author)
(SANParks research staff indicated in bold)

International

Annecke, W. *Table Mountain National Park Science and research: Possibilities for collaboration.* World Famous Mountains Research and Public Diplomacy Conference, Jiujiang University, China, 4-7 May 2013.

Annecke, W. *Ten years in the making: One success one failure. What can we learn about managing benefit sharing?* INSAKA: Conference on Managing for Impacts in Benefit Sharing, Glenburn Lodge, Johannesburg, 4-6 June 2013.

Barendse, J., Fabricius, C., Currie, B., **Roux, D.** & Wilson, N. *A Review of environmental stewardship in South Africa.* 10th World Wilderness Congress, Symposium on Science & Stewardship to Protect & Sustain Wilderness Values (WILD 10). Salamanca, Spain: 4-10 October 2013.

Buss, P. *Zoonotic tuberculosis: Experience from a wildlife veterinarian in South Africa.* 44th Union World Conference on Lung Health, Paris, France, 30 October-3 November 2013.

Ferreira, S.M., Mabunda, D., Magome, H. & Hendricks, H. *Management and conservation of rhino populations on state-owned land.* Side-event, CITES CoP 16, Bangkok, Thailand, 3-14 March 2013.

Ferreira, S.M., Haas, T. & Peters, G. *Commonalities in strategic responses to poaching: Collapsing criminal networks and decision support.* Southern African Development Countries Rhino Management Group, Marakele, South Africa, 11-15 November 2013.

Ferreira, S.M., Greaver, C., Smit, I., Pienaar, D. & Knight, G. *Kruger National Park: Census outcomes.* Southern African Development Countries Rhino Management Group, Marakele, South Africa, 11-15 November 2013.

Foxcroft, L.C., Pyšek, P. Richardson, D.M., Pergl, J. & Hulme, P.E. *The bottom line: Impacts of alien plant invasions in protected areas.* 12th Ecology and Management of Alien Plant Invasions (EMAPI) Conference, Pirenópolis, Brazil, September 2013.

Foxcroft, L.C., Vardien, W., Richardson, W.D., Wilson, J.R.U. & Le Roux, J.J. *Management history determines gene flow in a prominent invader: Lantana camara L. (sensu lato) in the Kruger National Park, South Africa.* 11th Savanna Science Network Meeting, Skukuza, 3-8 March 2013.

Grant, R. *Challenges in understanding and managing complex ecosystems: Reflections on advances in systems ecology over 6 years.* 11th Annual Savanna Science Network Meeting, Skukuza, South Africa, 3-8 March 2013.

Knight, M.H. *An introduction to the pros and cons of alternative rhino management strategies.* Dean, C. (Compiler), Proceedings of the 11th Meeting of the IUCN African Rhino Specialist Group, Naro Moru River Lodge, Kenya, 17-22 February 2013. Pp 365-370.

Knight, M.H. *Closure.* Dean, C. (Compiler), Proceedings of the 11th Meeting of the IUCN African Rhino Specialist Group, Naro Moru River Lodge, Kenya, 17-22 February 2013. Pp 395-396.

Knight M.H. *African rhinos: A brief update.* IUCN/SSC African Rhino Specialist Group and SADC Rhino Management Group, Park Planning and Development, Wildlife Enforcement Network Southern Africa, Gaborone, Botswana, August 2013.

Knight, M.H. & Ferreira, S.M. *Risk-benefit analysis of alternative management strategies for rhino conservation.* Dean, C. (Compiler), Proceedings of the 11th Meeting of the IUCN African Rhino Specialist Group, Naro Moru River Lodge, Kenya, 17-22 February 2013. Pp 371-392.

Landman, M., Schoeman, D.S., Hall-Martin, A.J. & Kerley, G.I.H. *Understanding the scale of elephant effects for conservation management: Integrating woody shrub responses in succulent thicket.* INTECOL, Excel, London, United Kingdom, 18-23 August 2013.

Roux, D.J. *Capacity for transdisciplinary learning: What are the key ingredients?* INSAKA: Conference on Managing for Impacts in Benefit Sharing, Glenburn Lodge, Johannesburg, 4-6 June 2013.

Scholtz, R., Kiker, G.A., **Smit, I.P.J.** & **Venter, F.J**. *Using the Maximum Entropy model in Kruger National Park to unravel woody species distributions from the past and provide a template for future research.* 11th Annual Savanna Science Network Meeting, Skukuza, South Africa, 3-8 March 2013. (Poster)

Smit, I.P.J. & Prins, H.H.T. *Predicting changes in herbivore assemblage composition, fire frequency and herbaceous biomass in semi-arid savannas under future scenarios of increased woody cover.* 11th Annual Savanna Science Network Meeting, Skukuza, South Africa, 3-8 March 2013.

Smith, M.K.S. *Understanding non-compliance issues in recreational and subsistence fisheries.* INSAKA, Monash University, Johannesburg, South Africa, 4-6 June 2013.

Strydom, T., Riddell, E., Govender, N. & Lorentz, S. *The effect of long-term fire treatments on soil hydrological and physical properties in semi-arid savannas in Kruger National Park.* 11th Savanna Science Network Meeting, Skukuza, 3-8 March 2013.

Strydom, T., Riddell, E., Govender, N. & Lorentz, S. *The effect of long-term fire treatments on soil hydrological and physical properties in semi-arid savannas in Kruger National Park, South Africa.* International Meeting of Fire Effects on Soil Properties (FESP4), Vilnius, Lithuania, 2-5 July 2013. (Awarded best student presentation)

Swemmer, L.K. *Social science research and SANParks – A savanna perspective.* The Great Limpopo Transfrontier Conservation Area (GLTFCA) a decade after inception: Taking stock of current socio-ecological research. South African Wildlife College, 24-25 July 2013.

Swemmer, L.K., Child, B., Mdungasi, P., Redman, K., Shibambu, D. & Mmatho, W. *Monitoring 12 years of environmental education in the Kruger National Park.* 11th Annual Savanna Science Network Meeting, Skukuza, South Africa, 3-8 March 2013.

Swemmer, L.K. *Protected areas and society – Costs, benefits and making the tradeoffs.* INSAKA, Monash University, Johannesburg, South Africa, 4-6 June 2013.

Swemmer, L.K. & Mmethi H. *Compensation for loss of livestock by wildlife – A case study of KNP.* INSAKA, Monash University, Johannesburg, South Africa, 4-6 June 2013.

van Wilgen, N.J., Goodall, V. & McGeoch, M.A. *Impacts and trends of climate change and other drivers in South African National Parks.* 11th Savanna Networking Meeting, Skukuza, South Africa, 3-8 March 2013.

National

Abrahams, L., Olayi, V.C., van Wilgen, N.J. & Cowell, C.R. *SANParks Cape Cluster knowledge collation project.* Fynbos Forum, Kirstenbosch Botanical Garden, 7-10 October 2013.

Adams, T. *NFEPA Wetland Ground Truthing: Updating vegetation types in Agulhas National Park.* Fynbos Forum, Kirstenbosch Botanical Garden, 7-10 October 2013.

Annecke, W. *The contribution of the social history of the Cape cluster parks to the landscape change and social history programme.* Fynbos Forum, Kirstenbosch National Botanical Garden, 7-10 October 2013.

Cowell, C. *Mapping and prioritising degraded habitats in the Cape cluster parks for restoration.* Fynbos Forum, Kirstenbosch Botanical Garden, 7-10 October 2013.

Ferreira, S.M. *Return of the fence: Risks of re-active conservation.* South African Wildlife Management Association Symposium, Skukuza, 15-19 Septmeber 2013.

Foxcroft, L.C., Pyšek, P. Richardson, D.M., Pergl, J. & Hulme, P.E. *The bottom line: Impacts of alien plant invasions in protected areas.* 41st Annual Symposium on Management of Invasive Alien Plants, Cape St. Francis, May 2013.

Govender, N, van Wilgen, B.W., **Smit, I.P.J. & MacFadyen, S.** *The current fire policy, implementation strategy and fire monitoring for the Kruger National Park.* Symposium of Contemporary Conservation Practice, Pietermaritzburg, KZN, November 2013.

Grant, R., Biggs, R., Freitag- Ronaldson, S., Swemmer, L., Dziba, L. & **Herbst, M.** *Protected areas contributing to human well-being: Provision of biodiversity related ecosystems services.* South African Wildlife Management Association (SAWMA) Symposium, Skukuza, 15-19 September 2013.

Grant, R. & Peel, M. *Is there a link between grazing induced nutritious hotspots and wild herbivore populations?* Grassland Society of Southern Africa (GSSA), 48th Annual Congress, Weesgerus, Modimolle, Limpopo, 15-19 July 2013.

Knight, M.H., Bradshaw, P. & Smart, R. *SANParks conservation of the thicket: Lessons learnt and the way forward.* Thicket Forum, 10th Annual Conference, Rhodes University, 3-5 September 2013. (Invited keynote)

Knight, M.H. *The southern Kalahari: A dynamic system.* Jack Skead Memorial Lecture, Wildlife Society, Grahamstown, August 2013. (Invited keynote)

Ngubeni, N. *Effect of bark stripping on growth and defence reactions in native trees.* Annual Meeting of the Tree Protection Co-operative Programme (TPCP) and the DST/ NRF Centre of Excellence in Tree Health Biotechnology (CTHB), University of Pretoria, 6-12 May 2013.

Roux, D.J. *Transdisciplinary learning for social-ecological change: who to learn with, what to learn about and how to learn.* Southern African Programme on Ecosystem Change and Society (SAPECS): Frontiers in Social-Ecological Research Colloquium, Kirstenbosch, Cape Town, 15-16 April 2013. (Invited keynote)

Smit, I.P.J., Landman, M., Cowling, R. & **Gaylard, A.** *Expert opinion on desired state of Sundays Spekboom thicket in Addo Elephant National Park; How much thicket is "thick(et) enough?"* Grassland Society of Southern Africa (GSSA), 48th Annual Congress, Weesgerus, Modimolle, Limpopo, 15-19 July 2013. (Awarded best platform presentation)

Smit, I.P.J. & Prins, H.H.T. *Herbivore assemblage changes in semi-arid savannas under future scenarios of increased woody cover.* South African Wildlife Management Association Symposium, Skukuza, 15-19 September 2013. (Invited keynote)

Strydom, T., Riddell, E., Govender, N. & Lorentz, S. *The effect of long-term fire treatments on soil infiltration and compaction in semi-arid savannas in Kruger National Park, South Africa.* SAEON Graduate Student Network Indibano 2013, Cape Town, Western Cape, 19-22 August 2013. (Awarded best oral presentation)

van Wilgen, N.J., McGeoch, M.A. & collaborators. *The role of and threats to Fynbos National Parks in the face of Global Environmental Change.* Fynbos Forum, Kirstenbosch Botanical Garden, 7-10 October 2013.

Williams, N. *The Organisation of Tropical Studies (OTS): African ecology and conservation.* Fynbos Forum, Kirstenbosch Botanical Garden, 7-10 October 2013.

Research and Monitoring

Interface with Legislation, Policy and Management.