SANPARKS 2013 RESEARCH REPORT:

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

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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 safeguarding 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 Plenaar) 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
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.

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.

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.
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.

References


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.

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.
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.

Reference


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.

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.

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 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.

**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.

**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 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.

The GSPC [http://www.cbd.int/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.


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.
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.


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.

**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](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.

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).
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.

![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.](image-url)
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*.

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.

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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.

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

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<td>37</td>
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<td>10</td>
<td>32</td>
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</table>

* 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.

<table>
<thead>
<tr>
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<th># papers</th>
<th># papers with SANParks authors</th>
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<tr>
<td>Augrabies Falls</td>
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<tr>
<td>Camdeboo</td>
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<td>1</td>
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<tr>
<td>Garden Route</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Golden Gate Highlands</td>
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<td>0</td>
</tr>
<tr>
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<tr>
<td>Kruger</td>
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</tr>
<tr>
<td>West Coast</td>
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<td>1</td>
</tr>
<tr>
<td>Multiple Parks</td>
<td>20</td>
<td>3</td>
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<td>Transfrontier (including SANParks)</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>144</strong></td>
<td><strong>43</strong></td>
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</table>

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

Sam Ferreira, Markus Hofmeyr & Mike Knight

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.
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

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).
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


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.
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.

<table>
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<th>Zone</th>
<th>Number of marked trees &gt; 5m tall</th>
<th>Per cent tree mortality assessed to be due to elephants over 4 years</th>
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<tr>
<td>High elephant density</td>
<td>728</td>
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</tr>
<tr>
<td>Low elephant density</td>
<td>635</td>
<td>14%</td>
</tr>
</tbody>
</table>

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.
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
Climate monitoring in SANParks

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

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.

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.
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.

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 reformatting of the template, and will be distributed for comment in the second quarter of 2014.

Reference
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.

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.
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

Mahломola 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.

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.

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.
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.
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.

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.
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.
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 1635km² 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).

<table>
<thead>
<tr>
<th>National Park</th>
<th>MPA(s)</th>
<th>Zonation / Restrictions</th>
<th>Importance and value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addo Elephant</td>
<td>Bird Island</td>
<td>No-take</td>
<td>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.</td>
</tr>
<tr>
<td>Garden Route</td>
<td>Tsitsikamma</td>
<td>No-take</td>
<td>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.</td>
</tr>
<tr>
<td>Table Mountain</td>
<td>Table Mountain National Park</td>
<td>Large control zone within which there are six ‘no-take’ areas: St. James, Boulders, Castle Rock, Paulsberg, Cape of Good Hope and Karbonkelberg.</td>
<td>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.</td>
</tr>
<tr>
<td>West Coast</td>
<td>Langebaan</td>
<td>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</td>
<td>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 (<em>Siphonaria compressa</em>, right, Knysna Basin Project), and provides productive summer feeding grounds for large numbers (&gt; 15 000) migrant water birds.</td>
</tr>
<tr>
<td>West Coast</td>
<td>Malgas, Jutten and Marcus Islands</td>
<td>Control zone: No shore fishing allowed but boat-based fishing is permitted.</td>
<td>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.</td>
</tr>
<tr>
<td>West Coast</td>
<td>Sixteen Mile Beach</td>
<td>Control zone: No shore fishing is allowed but boat-based fishing and recreational catching of rock lobster is permitted.</td>
<td>Conserves a representative area of the exposed sandy beaches in the South-western Cape Bioregion.</td>
</tr>
</tbody>
</table>
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

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 (Thyrsites atun), 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.
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 1,000km² 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.

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 smoothhound 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.
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).

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.
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, while 17% 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.

Reference
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

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: 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.
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.

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.
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.

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.

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.

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.
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.
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 these wetlands have played in the settlement of sheep farmers.

References
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.

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.

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.

Read about climate change monitoring on page 29

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 (NK), 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.

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

The splendid pagoda or pagoda bush, *Mimetes splendidus* (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;

**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;

**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;

**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.)

<table>
<thead>
<tr>
<th>Herbarium Highlights During 2013</th>
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<tr>
<td><strong>Garden Route National Park:</strong> 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.</td>
</tr>
<tr>
<td><strong>Kruger National Park:</strong> 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 <em>Barleria oxyphylla</em> was found in new localities. <em>Aloe aculeata</em>, 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.</td>
</tr>
</tbody>
</table>
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.

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


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/).
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.
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

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

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

**Addo Elephant National Park**


**Agulhas National Park**


**Camdeboo National Park**


**Garden Route National Park**


Kruger National Park


Mokala National Park


Mountain Zebra National Park


Table Mountain National Park


Tankwa Karoo National Park

West Coast National Park


Multiple/Across Parks


Not park-specific (but with SANParks authorship)


APPENDIX B:

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

Addo Elephant National Park


Agulhas National Park


Augrabies Falls National Park


Bontebok National Park


Garden Route National Park


**Golden Gate Highlands National Park**


**Kalahari Gemsbok National Park**

(Kgalagadi Transfrontier covered in Transfrontier section)


**Kruger National Park**


**Mapungubwe National Park**


**Mountain Zebra National Park**


**Namaqua National Park**


**Richtersveld National Park**


**Table Mountain National Park**


**West Coast National Park**


**Multiple/Across Parks**


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)


Transfrontier Parks (including SANParks)


APPENDIX C:

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

Books


Book chapters


APPENDIX D:

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


## APPENDIX E1:

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

<table>
<thead>
<tr>
<th>Conference/Forum/Symposium</th>
<th>National/International</th>
<th>Host Nation</th>
<th>Notes</th>
<th>No. of first-authored papers</th>
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<tbody>
<tr>
<td>11th Meeting of the IUCN African Rhino Specialist Group</td>
<td>International</td>
<td>Kenya</td>
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<tr>
<td>11th Savanna Science Network Meeting</td>
<td>International</td>
<td>South Africa</td>
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<tr>
<td>48th Annual Congress of the Grassland Society of Southern Africa (GSSA)</td>
<td>National</td>
<td>South Africa</td>
<td>Awarded best platform presentation</td>
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<td>44th Union World Conference on Lung Health</td>
<td>International</td>
<td>France</td>
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<tr>
<td>41st Annual Symposium on Management of Invasive Alien Plants</td>
<td>National</td>
<td>South Africa</td>
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<tr>
<td>10th World Wilderness Congress, Symposium on Science &amp; Stewardship to Protect &amp; Sustain Wilderness Values (WILD 10)</td>
<td>International</td>
<td>Spain</td>
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<tr>
<td>12th Ecology and Management of Alien Plant Invasions (EMAPI) Conference</td>
<td>International</td>
<td>Brazil</td>
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<tr>
<td>Annual Meeting of the Tree Protection Co-operative Programme (TPCP) and the DST/NRF Centre of Excellence in Tree Health Biotechnology (CTHB)</td>
<td>National</td>
<td>South Africa</td>
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<td>CITES CoP 16</td>
<td>International</td>
<td>Thailand</td>
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<tr>
<td>Fynbos Forum</td>
<td>National</td>
<td>South Africa</td>
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<tr>
<td>INSAKA</td>
<td>International</td>
<td>South Africa</td>
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<td>INTECOL</td>
<td>International</td>
<td>England</td>
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<td>International Meeting of Fire Effects on Soil Properties (FESP4)</td>
<td>International</td>
<td>Lithuania</td>
<td>Awarded best student presentation</td>
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<td>Jack Skeed Memorial Lecture</td>
<td>National</td>
<td>South Africa</td>
<td>Invited Keynote</td>
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<tr>
<td>SAEON Graduate Student Network Indibano</td>
<td>National</td>
<td>South Africa</td>
<td>Awarded best presentation</td>
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<tr>
<td>South African Wildlife Management Association Symposium</td>
<td>National</td>
<td>South Africa</td>
<td>Invited Keynote</td>
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<tr>
<td>Southern African Programme on Ecosystem Change and Society (SAPECS)</td>
<td>National</td>
<td>South Africa</td>
<td>Invited Keynote</td>
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<td>Southern African Development Countries Rhino Management Group</td>
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<td>Event</td>
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<tr>
<td>Symposium of Contemporary Conservation Practice</td>
<td>National South Africa</td>
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<td>The Great Limpopo Transfrontier Conservation Area (GLTFCA) a decade after inception: Taking Stock of Current Socio-ecological Research.</td>
<td>International South Africa</td>
<td></td>
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<tr>
<td>Thicket Forum</td>
<td>National South Africa</td>
<td>Invited Keynote</td>
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<tr>
<td>Wildlife Enforcement Network Southern Africa</td>
<td>International Botswana</td>
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<tr>
<td>World Famous Mountains Research and Public Diplomacy Conference</td>
<td>International China</td>
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</tbody>
</table>
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.


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.


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.


Smith, M.K.S. *Understanding non-compliance issues in recreational and subsistence fisheries.* INSAKA, Monash University, Johannesburg, South Africa, 4-6 June 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. & Mmathi, H. *Compensation for loss of livestock by wildlife – A case study of KNP.* INSAKA, Monash University, Johannesburg, South Africa, 4-6 June 2013.

National


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)


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.


Research and Monitoring
Interface with Legislation, Policy and Management.