APPLICATION FORM:
Nelson Mandela University
ENGAGEMENT EXCELLENCE AWARDS

(**CONSULT THE ENGAGEMENT EXCELLENCE AWARDS POLICY AND READ THE APPLICATION FORM BEFORE COMPLETING THE TEMPLATE IN ORDER AVOID A DUPLICATION OF INFORMATION.) COMPLETE THIS FORM IN TYPESCRIPT. PROVIDE ONLY THE INFORMATION REQUESTED.**

SECTION A: Application category		
• *Indicate with an **X** in the appropriate box the award you are applying for.* • *Your application will only be considered for the award you have applied for*	☒ **Engagement Excellence Award – Science, Technology and Engineering** ☐ **Engagement Excellence Award – Social Sciences and Humanities** ☐ **Engagement Excellence Team Award** ☐ **Engagement Excellence Project Award – Science, Technology and Engineering** ☐ **Engagement Excellence Project Award – Social Sciences and Humanities** ☐ **Emerging Engagement Excellence Awards** *(note that Professors and Associate Professors are not eligible for this category)*	
Surname of Applicant/Team Leader	Kerley	
First Name	Graham	
Initials	I H	
Title	Prof	
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Employment position	Prof	
Faculty	Science	
Department	Zoology	
Division	Centre for African Conservation Ecology	
Immediate line-manager	Prof N Strydom	
Eligibility: Are you permanently employed and/or on a long term (3 years or more) fixed contract? (*indicate with an **X***)	**Permanent** **X**	**Fixed term contract**
If this is an application for one of the <u>Engagement Excellence Project Awards</u>, provide a brief title and description of the project (250 words maximum)	**<u>Title:</u>** **<u>Description:</u>**	
If this is an application for either the <u>Excellence Awards or the Emerging Award</u>, provide a brief description of your engagement activities and initiatives (250 words maximum)	**<u>Description:</u>**	
If this is an application for the <u>Engagement Excellence Team Award</u>, provide • **the names of all staff members and students participating**	**<u>Staff</u>:** 1. 2. **<u>Students</u>:** 1.	

• **the nature of their involvement** • **a brief description of the team's engagement initiatives and activities** (250 words maximum)	**Description:**
Are your Engagement activities/projects/initiatives registered on the Engagement Management Information System (E-MIS) on SharePoint? If not, please ensure that they are before you submit this application. Applications that are not registered and updated on the E-MIS will not be considered for Awards. The most recent date on E-MIS for each project update (achieved when 'submit' is clicked) must be in 2015. Provide the exact titles (as featured on the E-MIS) for all of the Engagement activities/ projects/ initiatives with which you are involved. Visit http://caec.mandela.ac.za/Engagement-Information-and-Development/Engagement-Management-Information-System	**Titles:** 1.Capacity building for elephant-decision makers 2. Grysbok Environmental Education Trail 3. PredSA – an assessment of livestock predation 4. Small elephant populations in South Africa

SECTION B: Engagement categories

- *You are required to describe and report in detail on a minimum of two engagement categories (these are 1, 2, 3 and 4 below) in order to be considered for an award.*
- *If you or your team are involved in three or four of the engagement categories, report in detail on all of these categories.*
- *Applications that describe and can provide evidence of engagement activities across all four categories are encouraged.*
- *Refer to section 5 of the attached Engagement Excellence Awards policy which provides a guideline on the specific activities you should report on under each of the categories you have chosen.*

Report on your:

1. Engagement through Community Interaction, Service and Outreach:

The following projects represent engagement through Outreach and community service

1) The "Grysbok Environmental Education Trail" provides free environmental education training for schools, with the lessons aligned with the school curriculum – see http://grysbok.mandela.ac.za/
2) The "Grysbok Environmental Education Trail" also provides opportunities for students to engage in volunteering and community service activities, this through acting as trail guides for school groups.

Report on your:

2. Engagement through Teaching and Learning:

The following projects represent engagement through teaching and learning in a variety of ways:

1) The ""Small elephant populations in South Africa" project provided opportunities for postgraduate capacity building. This included (a) the experience gained in survey design, data collection and report preparation by postdoc Dr Marietjie Landman, (b) the experienced gained in data collection by two MSc students, Ms Celeste Mare and Ms Tara van der Westhuizen. This project also supported their studies through the provision of bursaries.
2) The "Grysbok Environmental Education Trail" project provided senior students with an opportunity to build their own capacity and confidence in presenting environmental education lessons. In 2017, this included Ms (now Dr) Nokubonga Mgatsa, Ms Celeste Mara and Mr Gerry Molepo. Trail guides were trained in the trail curriculum and also received small honoraria for each trail presented.
3) The "PredSA – an assessment of livestock predation" contributed to teaching and learning through specifically recruiting young or black or female authors in order to provide them with an opportunity to gain experience in the formal scientific assessment process (see appended author lists).
4) The "Capacity building for elephant-decision makers" project represents a customized training programme for a targeted group of government (at national and provincial level), who are responsible for overseeing the implementation of the legislation and regulations around elephant management in South Africa. The course was presented twice (June and August/September 2017). The curriculum for the course was developed by myself, and the course was presented by myself and Dr Marietjie Landman, as

well as Dr A Gaylard of SanParks and Mr T Mbedzi, Department of Environmental Affairs (June course) and Ms Z. Madyibi and Mr K. Mahamba, Department of Environmental Affairs (August/September course). The participants comprised officials from national (DEA and SANParks) and provincial (all 7 provinces that manage elephant populations).

Report on your:

3. Engagement through Profession/Discipline-Based Service Provision:

Although not project specific, I serve on the following:

Editorial/ Advisory boards of international accredited journals - *Journal of Arid Environments*.
- *Mammal Research*

Editorial boards of international accredited journals - *African Journal of Range & Forage Science*
- *African Journal of Wildlife Research*

I serve on the Department of Environmental Affairs Alien and Invasive Species Advisory Committee.

Report on your:

4. Engagement through Research and Scholarship:

Two of my engagement projects contribute directly to research and scholarship

1. The "PredSA – an assessment of livestock predation" project reflects a scholarly approach to locating, analyzing and synthesizing available information on the management of livestock predation in South Africa, this comprising information from the full range of relevant disciplines (ethics to ecology, law to economics). In addition, given that there is a paucity of information regarding livestock predation in communal farming areas in South Africa, a focused, independent survey was commissioned to address this information gap. This assessment represents a global first in addressing this topic at a national level through the scientific assessment process, and also contributes to developing best practice in such assessments, this through the establishment of an independent governance oversight body for the assessment, as well as the commissioning of research to address knowledge gaps. The assessment itself will represent the state of knowledge summary of the issues, this in a book form (to be published by Mandela University in 2018). The survey on livestock predation in communal areas will be prepared as a scientific publication in 2018. Further evidence of the scholarship contribution of the assessment is the publication in the South African Journal of Science, describing the assessment, its approaches and anticipated outcomes. See KERLEY, G.I.H., BEHRENS, K.G., CARUTHERS, J., DIEMONT, M., DU PLESSIS, J., MINNIE, L., RICHARDSON, P.K., SOMERS, M.J., TAMBLING, C.T., TURPIE, J., VAN NIEKERK, H.N. & BALFOUR, D. 2017. Livestock predation in South Africa: The need for and value of a scientific assessment. *South African journal of Science* 113 (3/4):17-19. http://dx.doi.org/10.17159/sajs.2017/a0198 appended below.
2. The "Small elephant populations in South Africa" project represents a significant research effort as it was necessary to review the known populations through a survey of published work and then identify, locate and obtain current data (through an online survey tool) on all these and populations. Prior to this research, it was estimated that there were about 60 such elephant populations in South Africa. This project identified a total of 85 such populations (see map below) and demonstrates that such populations are concentrated in two regions in South Africa. A novel contribution is the demonstration that a number of these populations have gone extinct, this for a variety of reasons. This research output will form the basis for a scientific publication to be prepared in 2018.

SECTION C: Descriptions

1. Describe the impact your Engagement activities have made on stakeholders/beneficiaries/communities and provide details on how these activities are acknowledged/recognized by:

1.1. External communities/stakeholders/beneficiaries: (not staff and students)	The success of the two elephant focused projects is reflected in the sign-off of the project outcomes and release of funds by the Department of Environmental Affairs. Furthermore, SANParks has initiated discussions to extend the capacity building course to more of their staff. The "PredSA – an assessment of livestock predation" project included an extensive stakeholder review process, with an invitation to participate as a stakeholder extended to the commercial and communal livestock farmers, other interest groups and government through a formal consultative process (see http://predsa.mandela.ac.za/Stakeholder-Registration). This provided an opportunity for stakeholders to review and comment on the draft assessment document, with all such input and the response by the scientific assessment team (management and authors) formally documented. In addition the PredSA process was overseen by an independent governance group representing national government (Dept Environmental Affairs and Department of Agriculture, Forestry and Fisheries), the livestock industry (National Wool Growers Association, Mohair Growers), Academia and NGOs (Wilderness Foundation) and independently chaired by Prof Andrew Leitch of Nelson Mandela University.
1.2. Internal communities/stakeholders/beneficiaries: (staff and students)	The opportunities for personal development and study support through these various projects are reflected in student participation and the provision of bursaries.

2. Describe how your Engagement activities contribute towards faculty/department/entity engagement goals and objectives. *(Refer to your Department/Faculty/Entity's strategic plan here)*

1) The four projects dealt with here arise directly from the Strategic Framework of the Centre for African Conservation Ecology.
2)

3. Describe how your Engagement activities contribute towards the achievement of Vision 2020 Engagement Strategic Goals and Objectives.

These projects align with the Vision 2020 Startegic Goals through

1) Providing a responsive learning environment conducive to excellence in teaching and learning and fostering holistic student success through providing training and capacity building opportunities for students (outside the conventional classroom setting), as well as the provision of bursaries, as done for the Grysbok Trail, Elephant populations and capacity building projects.

2) Conducting research that contributes to local, regional, national and global sustainability, this in the context of the PredSA and Elephant populations and capacity building projects

3) Promoting broad conceptualisation of research, scholarship and innovation, especially through the PredSA project.

4) Promoting the recognition of engagement as a scholarly activity, as for example shown in the Kerley et al. 2017 publication in an accredited journal.

5) Fostering the culture of reflective practice, excellence, innovation and sustainability, as evidence by the global first represented by PredSA, and the innovation of conducting focussed research aimed at knowledge-gaps in an assessment as done by PredSA .

6) Growing income streams to support the attainment of the institutional strategic goals, this shown by the R2 million raised for the PredSA project and about half a million for the elephant projects.

4. Describe how your Engagement activities contribute towards: *(Refer to any relevant media coverage, representation on boards or committees, scholarly publications, conference presentations etc.)*

4.1. Addressing the needs of society and various external communities served by the university:

The book on PredSA will be published in 2018 (first draft completed in 2017) and will serve as an invaluable resource for government policy makers, livestock managers, conservation managers and researchers.

4.2. Profiling and promoting the university's as an engaged university:

5. Describe how you have successfully integrated engagement into the Teaching and Learning and Research functions of the university. *(Refer to sections 5.1, 5.2 and 5.3 of the Engagement Excellence Awards Policy as a guideline)*

As shown by the publication of a paper (Kerley et al 2017) describing the PredSA engagement activity in an accredited scientific journal.
Furthermore, the book on PredSA will be published in 2018 (first draft completed in 2017), and will serve as a scholarly reference for teaching purposes and to guide future research (such research priorities are explicitly provided in this book).

6. Provide details of scholarly outputs/contributions made to a body of knowledge as a result of your engagement activities. *(Refer to publications, new teaching programmes, technical reports, conference proceedings, etc.)*

KERLEY, G.I.H., BEHRENS, K.G., CARUTHERS, J., DIEMONT, M., DU PLESSIS, J., MINNIE, L., RICHARDSON, P.K., SOMERS, M.J., TAMBLING, C.T., TURPIE, J., VAN NIEKERK, H.N. & BALFOUR, D. 2017. Livestock predation in South Africa: The need for and value of a scientific assessment. *South African journal of Science* 113 (3/4):17-19. http://dx.doi.org/10.17159/sajs.2017/a0198.

7. Describe the important role performed by you or the team in:

7.1. The leadership and management of the engagement activities and initiatives:

I initiated, generated the funding and led all of these activities

7.2. The level and extent of partnerships/collaborations/networks/linkages formed internally and externally:

a. Internally *(inter-departmental, inter-faculty and interdisciplinary):*	These projects are part of the Centre for African Conservation Ecology outputs activities, strengthening the profile of this entity.
b. Externally *(at local, national and international level):*	a. The Pred SA project brought together 43 authors from a broad range of institutions across South Africa (see author list below, and authorship of the Kerley et al 2017 paper), demonstrating extensive collaboration. b. The partnerships with the funders for PredSA (DEA, DAFF, livestock industry) represent strong collaborative relationships, providing funds and insights. **c.** The partnerships with DEA and SANParks for the elephant course reflects both funding opportunities as well as their contributions to presenting these courses. **d.** The networking among the elephant course participants strengthens their ability to better manage elephant populations in South Africa

SECTION D: Signature

Applicant Signature		Date	25 May 2018

SECTION E: FOR OFFICE USE
(Administered by the Engagement Office)

Resolution regarding application from Awards Committee:	
Feedback to applicant:	

SECTION F: Portfolio of Evidence

Attach any relevant documents as a portfolio of evidence to support your application. **Limit this portfolio of evidence to a maximum of 20 pages.** This can include photographs, promotional material, commendations from stakeholders/beneficiaries etc., publication references, (extracts from) annual or project reports to funders/sponsors etc., or any other relevant materials that may serve as evidence.

List of supporting documents submitted along with this application as addendums:

Please ensure that the documentary evidence below is clearly cross-referenced with the relevant section and number in the application template, for example Section B1 or Section C4.

1. B2 – Example of course structure the June and August/September "Capacity building for elephant-decision makers" courses
2. B2 – course participants for the June and August/September "Capacity building for elephant-decision makers" courses.
3. B2 – Author and reviewer lists of the "PredSA – an assessment of livestock predation" project.
4. C1 – The Process Custodianship group of PredSA
5. B4 – Kerley et al 2017.
6. B4 – Map of current small elephant populations in South Africa

B2: Example of course structure the June and August/September "Capacity building for elephant-decision makers" courses

Capacity-building Course for Elephant Decision-makers

	Monday 28 August	Tuesday 29 August	Wednesday 30 August	Thursday 31 August	Friday 1 September
07:30		**Breakfast**	**Breakfast**	**Breakfast**	**Breakfast**
08:00					
08:30		**Lecture:** History of and changing approaches and lessons to elephant management (Graham Kerley)	**Lecture:** Impacts of elephant on biodiversity (Marietjie Landman)	**Lecture:** The refugee species concept and the Knyna elephant population (Graham Kerley)	**Workshop:** Lessons learnt and the way forward for delephant decsion-making in South Africa
09:00					
09:30					
10:00		*Tea*		*Tea*	*Tea*
10:30			*Tea*		
11:00	**Arrival at Kuzuko Lodge, Addo Elephant National Park, and booking into accommodation**	**Lecture:** Elephant decision-making in the face of uncertainty (Marietjie Landman, NMU)	**Lecture:** Impacts of elephant on biodiversity (Marietjie Landman)	**Lecture:** Strategic adaptive management as applied to elephant issues (Graham Kerley)	**Wrap-up, course assessment and feedback**
11:30					
12:00					**Departure (packed lunch)**
12:30	**Lunch**	**Lunch**	**Lunch**	**Lunch**	
13:00					
13:30					
14:00	**Introduction, course structure and expected outcomes (Graham Kerley, NMU)**	**Lecture:** Biology of elephants (Graham Kerley & Marietjie Landman)	**Lecture:** Value of elephants (Graham Kerley)	**Field trip:** Impacts of elephant on biodiversity (Marietjie Landman)	
14:30					
15:00	**Lecture:** Legislative framework for elephant decision-making in South Africa (Khuthadzo Mahamba, DEA)	*Tea*	*Tea*		
15:30					
16:00		**Field trip:** Biology of elephants (Graham Kerley & Marietjie Landman)	**Field trip**		
16:30	*Tea*				
17:00	**Workshop:** Perceptions and challenges of decision-makers in terms of elephant policy and management (Graham Kerley)				
17:30					
18:00					
18:30					
19:00	**Dinner**	**Dinner**	**Dinner**	**Dinner**	

B2: Participants for the June "Capacity building for elephant-decision makers" course.

Province	Organization	Delegate
Western Cape	Cape Nature	Mr C. van Tonder
North West	Department of Rural, Environment and Agricultural Development	Mr J. Power
	North West Parks Board	Mr P. Nel
Eastern Cape	Department of Economic Development, Environmental Affairs and Tourism	Ms P. Mzazi-Geja
	Eastern Cape Parks and Tourism Agency	Mr S. Mkhulise
Gauteng	Department of Agriculture and Rural Development	Mr M. Keretetse
Limpopo	Department of Economic Development, Environment and Tourism	Mr S. Chuene
Kwa-Zulu Natal	Ezemvelo KZN Wildlife	Mr S. Mbongwa
Mpumalanga	Mpumalanga Tourism and Parks Agency	Mr J. Eksteen
	Department of Environmental Affairs	Mr A. Muingi
	Department of Environmental Affairs	Mr N. Mbedzi
	Department of Environmental Affairs	Ms T. Mashua
	Department of Environmental Affairs	Mr M. Cindi
	South African National Parks	Mr J. Adendorff

Participants for the August/September "Capacity building for elephant-decision makers" course

Province	Organization	Delegate
North West	Department of Rural, Environment and Agricultural Development	Mr D. Buijs
	North West Parks Board	Mr M. Keabetswe
Eastern Cape	Department of Economic Development, Environmental Affairs and Tourism	Mr T. Tyali
	Department of Economic Development, Environmental Affairs and Tourism	Mr M. Xalu
	Eastern Cape Parks and Tourism Agency	Ms L. Gerber
Limpopo	Department of Economic Development, Environment and Tourism	Mr C. Blignaut
Kwa-Zulu Natal	Ezemvelo KZN Wildlife	Dr D. Druce
Mpumalanga	Mpumalanga Tourism and Parks Agency	Mr T. Steyn
	Department of Environmental Affairs	Ms H. Mafumo
	Department of Environmental Affairs	Ms Z. Madyibi
	Department of Environmental Affairs	Mr K. Mahamba
	Kuzuko Lodge	Mr G. de Lange

B2

Authors

The identified topics (i.e. the chapters and their contents) of this assessment were addressed by multi-author teams that included one Lead Author, several Authors and Contributing Authors. Authors were drawn from a range of sectors and regions of South Africa and together represented a balance of expertise and perspectives for each of the topics. These authors are listed below, with abridged biographies their affiliation and email address.

Babatopie E. Akinyemi (PhD) is a Post-doctoral fellow and lecturer in the Department of Agricultural Economics and Extension at the University of Fort Hare, Alice, South Africa. He holds B. Agric. Tech (Hons), M.Sc Agric and PhD in Agricultural Economics, from The Federal University of Technology, Akure, Nigeria, University of Ibadan, Nigeria and University of Fort Hare, South Africa, respectively. His research focuses on the effects of land fragmentation on technical efficiency of farmers in Nigeria, rural household willingness to pay for community-based ecotourism in Wild Coast, South Africa and prevalence of NEET status among rural youths and drivers of youth participation in agricultural activities in South Africa.

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Nico L. Avenant (PhD) is Curator, Senior Specialist Scientist and HOD in the Department of Mammalogy at the National Museum in Bloemfontein. He is also a Research Fellow, post-graduate Supervisor and Guest Lecturer at the University of the Free State. His research interests include small mammal ecology, with a specific focus on predator-prey relations and the management of mesopredators.

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Dave Balfour (PhD) is an ecologist with wide ranging interests and a focus on ecological processes, larger mammals and conservation governance. He is member of the IUCN/SSC African Rhino and African Elephant Specialist Groups and has extensive experience working at the interface between science and protected area management. He currently consults on a freelance basis.

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Andre J. Botha (BTech) is a Special Projects Manager at the Endangered Wildlife Trust where his primary focus is the conservation of African vultures and reducing the impact of wildlife poisoning. He is also the Overarching Coordinator for the drafting of the CMS Conservation Multi-species Action Plan for African-Eurasian Vultures and the co-chair of the IUCN SSC Vulture Specialist Group.

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Nicole Broadbent (MPhil) is an environmental ethicist, completing a PhD on African wildlife ethics. Her research interests include human-wildlife conflict management, captive wildlife management ethics, and human-animal interaction theory.

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Jane Carruthers (PhD) is Emeritus Professor at UNISA and an internationally renowned environmental historian who has extensively researched protected areas and the rise of ecology in South Africa. She was lead author for a chapter in *Scientific Assessment of Elephant Management in South Africa*.

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Harriet Davies-Mostert (D.Phil) is Head of Conservation at the Endangered Wildlife Trust and Fellow of the Eugène Marais Chair of Wildlife Management, Mammal Research Institute, University of Pretoria. Her research interests include large carnivore conservation and management, the data-science-policy interface, and the contribution of the wildlife economy to biodiversity conservation and sustainable development.

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Marius Diemont (LLM) is a Partner of Webber Wentzel. His area of legal expertise includes natural resources and environmental law. He is head of the Environmental Practice Group. In 2006/7 he was a Special Advisor to the former Minster of Environmental Affairs & Tourism.

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Emmanuel Do Linh San (DSc) is an Associate Professor in the Department of Zoology and Entomology at the University of Fort Hare. His research interests include small carnivore and rodent ecology, with a specific focus on spatial, temporal and dietary ecology. He is the Founder and Executive Director of ASCaRIs (African Small Carnivore Research Initiatives).

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Marine Drouilly (MSc) is a wildlife biologist currently finishing her PhD on the socio-ecological factors affecting negative interactions between small-livestock farmers and mesocarnivores in the Karoo. She is focusing on black-backed jackals and caracals but has experience in the management of human-wildlife conflicts involving leopards, polar and brown bears, coyotes and harriers.

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Lihle Dumalisile (MSc) is a Production Scientist specializing in mammal ecology. Her responsibilities and interests entail providing science-based decision support to policy makers and implementers in matters relating to wildlife management, with special focus on small to medium-sized mammals. She is the Gauteng Province representative in the South African Scientific Authority.

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Jillian Gardner (PhD) is a bioethicist and senior lecturer in Bioethics and Health Law in the Steve Biko Centre for Bioethics at the University of Witwatersrand. She is a member of the Wits Animal Research Ethics Committee and National Health Research Ethics Council. Her research interests are in reproductive health ethics, clinical ethics, public health ethics and medical professionalism.

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Jan Glazewski (LLD) is a Professor at UCT where has been teaching and publishing in the area of marine and environmental law since 1986. He was involved in the inclusion of an environmental right in both the South African and Namibian constitutions. His book *Environmental Law in South Africa* has been updated regularly and in 2016, he co-edited (with Surina Esterhuyse) a 22 chapter multi-disciplinary work titled *Hydraulic Fracturing in the Karoo: Critical Legal and Environmental Perspectives* (Juta and Co 2016).

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Heidi-Jayne Hawkins (PhD) has a background in nutritional plant physiology and is currently working on the impact of fire and herbivory on below-ground nutrient cycling and trophic cascades. She is Director of Research at Conservation South Africa (an affiliate of Conservation International) and Research Associate at University of Cape Town. Her work includes multidisciplinary projects that focus on rangeland management and human-wildlife conflict.

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Graham I.H. Kerley (PhD) is Director of the Centre for African Conservation Ecology and Distinguished Professor of Zoology at Nelson Mandela University. His research interests focus on animal resource use and its consequences, this for both herbivores and predators. He has a further interest in environmental history and integrates the application of his work through the field of conservation biology. He has extensive conservation governance experience, having served on the boards of Eastern Cape Parks and SANParks. He was lead author for a chapter in *Scientific Assessment of Elephant Management in South Africa*.
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Kelly Marnewick (PhD) has researched large carnivores including range use, population surveys, human-carnivore conflict and reintroductions. She has been active in the conservation sector for over 15 years and has implemented conservation action at various levels from working with farmers to influencing large retailers to make more carnivore-friendly decisions. She has a keen interest in wildlife trade and its impacts on conservation.

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In order to promote the good governance of this assessment, a Process Custodian Group (PCG) was established to serve as an independent oversight body. The core function of the PCG was to ensure that an equitable, rigorous and transparent process was followed. The role of the PCG was not to determine or critique the content of the assessment. The PCG met at key junctures to review the process that had been followed and to ensure that it was fundamentally fair. The PCG consisted of six individuals, drawn from government, NGOs, industry and the research community and was chaired by an independent Chairperson. Members of the PCG were:

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Livestock predation in South Africa: The need for and value of a scientific assessment

Predation of livestock in South Africa has been estimated to cost in excess of ZAR1 billion in losses per year[1] and has complex social, economic and ecological drivers and consequences. In this context, livestock can be broadly defined as domesticated animals and wildlife (the former excluding poultry and the latter including ostrich, *Struthio camelus*) managed for commercial purposes or human benefit in free-ranging (or semi-free ranging) circumstances that render them vulnerable to predation. This conflict between livestock producers and predators, and the attempts to manage it, has persisted for over 350 years, with the most notable outcome being the eradication of the majority of the apex predators across much of South Africa.[2] In contrast, the mesopredators, black-backed jackal (*Canis mesomelas*) and caracal (*Caracal caracal*) are by all accounts thriving, at least as measured by their impact on livestock production. Increasingly, attempts to manage livestock predation give rise to deep polarisations, particularly between animal rightists and livestock producers, which further confounds an already complex situation. This complexity hampers the development of policy and regulations with regard to managing livestock predation. A recent global review of the scientific merit of studies on the efficacy of various predator control interventions highlighted the paucity of adherence to acceptable scientific methods in these studies, and recommends 'suspending lethal control methods' while appropriately designed studies are undertaken.[3] Treves et al.[3] did not identify any valid (by their criteria) studies undertaken in South Africa. This example highlights the need for a scientifically robust basis for policy and management of livestock predation issues.

We support the principle of evidence-based policy and management, and propose that a formal scientific assessment[4,5] will provide scientifically robust and policy-relevant insights to address this challenge. Here we provide the framework for such an assessment on livestock predation in South Africa, and anticipate some of the emergent values of this assessment.

The Nelson Mandela University, through the Centre for African Conservation Ecology, has partnered with the Department of Environmental Affairs; the Department of Agriculture, Forestry and Fisheries (through the Red Meat Research Development Planning Committee); Cape Wools; and the SA Mohair Growers Association, and initiated the process of undertaking a scientific assessment on the issue of predation on livestock in South Africa (hereafter PredSA). PredSA was formally launched in June 2016 when it received the endorsement of the Minister of Environmental Affairs and the Department of Agriculture, Forestry and Fisheries. Approximately ZAR2.5 million has been committed to the assessment, which is anticipated to be 18 to 24 months in duration, starting May 2016.

PredSA will be conducted as an independent, science-based assessment, along the lines of the Elephant Management Scientific Assessment.[6] The assessment process will be grounded in five driving principles: *legitimacy*, *saliency* and *credibility*, which are underpinned by *transparency* and which is broadly *participatory.*

An independent six person Process Custodian Group has been appointed with the sole function of ensuring that the process of conducting the assessment is fair. The lead authors have been identified and the first workshop, which deals with the scoping and structure of the assessment, has been conducted. The next step, that of crafting an initial First Order Draft, is underway with the full complement of authors anticipated to be about 50 individuals.

PredSA will be compiled by recognised experts from academia and management who volunteer their input. The coverage will be comprehensive and include diverse topics in order to provide the context and detail that are relevant to policy development.

Understanding an issue requires a historical perspective, and thus the historical background to the longer-term predator–livestock interactions – contextualising historic socio-political and economic changes – within what is now the Republic of South Africa will be addressed. From the pre-colonial era onwards, human activities – specifically around pastoralism – have been negatively impacted by predation on domestic livestock with conflict as the usual consequence. This long-term perspective will also highlight how views, policy and approaches to livestock predation have changed.

Knowing the role players is key to managing them. Black-backed jackal and caracal are the dominant predators of livestock in South Africa.[1] Thus, PredSA will, in particular, explore the specific biological and ecological aspects of these two species that determine their role as livestock predators. A cornucopia of other species is implicated in livestock predation in South Africa, including lion (*Panthera leo*), leopard (*Panthera pardus*), cheetah (*Acinonyx jubatus)*, Cape fox (*Vulpes chama*), African wild dog (*Lycaon pictus*), side-striped jackal (*Canis adustus*), spotted hyena (*Crocuta crocuta*), brown hyena (*Hyaena brunnea*), serval (*Leptailurus serval*), baboon (*Papio ursinus*), honey badger (*Mellivora capensis)*, bushpig (*Potamochoerus larvatus*), crocodile (*Crocodylus niloticus*), feral domestic dogs (*Canis lupus familiaris*), and various corvids and raptors. For all these species (and any others that may be identified through PredSA processes), we will evaluate the evidence of them attacking livestock (excluding poultry), identify which livestock are attacked, and categorise the severity of this predation. The ecology and behaviour of the main livestock predators will be reviewed to determine how these affect the interaction with livestock. PredSA will allow us to determine which factors play a role in livestock predation, as well as to identify any potential gaps in the knowledge base which require future research.

What predation control methods are available and what are their outcomes and desirability? Historically, and currently, predation management has focused on ways to remove (so-called lethal control) or exclude the problem species from a specific area.[7] However, emerging evidence suggests that not all predators are problem animals, and that territorial individuals may act as a catalyst to exclude potential problem individuals.[8] Public opinion against lethal control has grown[9], while new insights have been gained into the environmental or ecological effects of such control (for example see Minnie et al.[10]). As a result, there seems to be a shift from attempts to eradicate predators to non-lethal methods to reduce predation, and to approaches in which only problem individuals are removed. These interventions, their efficacy and trends in their application need to be analysed and presented in a policy-relevant framework.

South Africa is not alone in experiencing problems with predation of livestock, as this phenomenon emerges across the world wherever livestock and predators co-occur. It is therefore fitting to identify and assess the various management strategies and internationally recognised best practices employed beyond our borders, and identify those that are most likely to be effective under South African circumstances. Special attention will be paid to those studies which replicate our semi-arid conditions and the types and sizes of predators involved, e.g. comparing coyotes (*Canis latrans*) and dingoes (*Canis lupus dingo*) to jackals. Given that South Africa lags behind the rest of the world in terms of scientifically evaluating the efficacy of livestock predation interventions[3,11], these lessons should extend to the design and implementation of sound scientific experiments, so that the outcomes are credible and applicable.

Although black-backed jackal and caracal are heavily persecuted in South Africa, we lack a clear understanding of the ecosystem-level consequences this persecution may have. Both these species vary in their roles in food webs, ranging from mid-ranking mesopredators that regulate small mammal and rodent communities[12] to apex predators that impact on a wide range of prey[13]. PredSA will review the functional role of black-backed jackal and caracal across a range of landscapes, from those inclusive of apex predators to those dominated by humans and livestock. In the western USA, coyote persecution resulted in a reduction of available forage for cattle because of high levels of competition with abundant lagomorphs.[14] Therefore, understanding the functional role of mesopredators in agro-ecosystems provides a more holistic basis for management actions and predicting their outcomes.

The basis of conflict around livestock predation is the impact this predation has on human well-being, or perceptions thereof. The presence of carnivores on rangelands can lead to losses of stock, expenditure on measures to prevent these losses, or, depending on the level of investment in and/or efficacy of the latter, costs incurred through a combination of the former and latter. Both stock losses and investments in predator control measures translate into a reduced bottom line for farmers. This affects wildlife-based operations as well as small and large stock farmers. Economic theory suggests that predator control efforts would be expected to kick in once losses reach a certain level, but actual investment decisions are influenced by a range of social factors and perceptions. The consequences of predation mitigation interventions are not well understood, which results in the investments in these actions not necessarily delivering intended outcomes. Livestock predation is widespread, thus losses incurred by farmers are believed to have a significant impact on the economic value of the industry, which translates into loss of employment opportunities as well as income, and, for some, their livelihoods. Conversely, changes in biodiversity brought about by changes in the relative abundance of livestock predators may impact on producer and consumer surplus associated with rangeland-based activities, as well as on society in less tangible ways. There are distributional issues too. While predator-control activities can provide direct income-earning opportunities in rural areas, the well-being of other members of society may be negatively affected by these activities.

A review of the legal framework in terms of the law relevant to management and control of predators in South Africa, and an analysis of its shortcomings that may impact on the efficacy of management practices and policy, is required. PredSA will outline the current status of South African law applicable to the management and control of predators, and assess the legislative gaps and contradictions in order to assist the relevant authorities in the development of policy and regulations. In making policy decisions, the regulatory authority is often confronted with differing interpretations of the law that appear to present options or alternative approaches. This review is intended to assist policymakers to develop legislative mechanisms that are in accordance with the law, or, when the law is seen to be lacking, to provide a sound legal basis to implement policy or legislation that is aligned with the constitution and legislation. The conclusions and recommendations will be drawn from legislation as it is generally accepted to be, and on interpretations of common law, as well as a consideration of customary law.

From an ethical perspective, the key issue with respect to livestock and predation is that it entails conflict. There are obvious conflicts of interest between livestock owners and predators. Furthermore, local communities, wildlife conservationists, ecotourists, and farmers have interests that differ and may clash. Conflicts of interest often lead to more worrying kinds of conflict, with those seeking to protect their interests ending up at loggerheads with one another. We also often find ourselves torn between competing moral obligations: our duties to our fellow humans may conflict with our duties to other species or the environment as a whole. This dilemma represents a significant challenge for policymakers. In such situations, the best that they can do is to try to carefully weigh up all of the ethical obligations and the competing interests, to come up with approaches that result in the best overall outcomes for all relevant stakeholders. This goal cannot be achieved without being in possession of the most relevant information required to be able to do this kind of weighing up. The better equipped decision-makers are with all of the relevant data, facts, perceptions, points of view and other relevant information, the better the policies they will be able to devise. In fact, it is an ethical obligation for policymakers to ensure that they have done their best to gather all of the necessary information to be able to make the most appropriate decisions. This is why this scientific assessment is not just important – it is also imperative.

In addition to bringing together the information and views relevant to livestock predation and its management in South Africa in a policy relevant fashion, this scientific assessment will deliver a number of further benefits. PredSA also provides an opportunity for those with conflicting views on predator management approaches to recognise and understand the alternative perspectives, and the broader implications of management approaches. This assessment process should therefore turn this area of tension into a commitment to finding a shared solution to the problem. This relaxation of tension is one of the outcomes of the scientific assessment on elephant management in South Africa.[6] Prior to this assessment, the so-called elephant debate was driven by strong views and tensions, whereas much of this acrimony has subsequently declined. The Norms and Standards for Elephant Management[15], developed in parallel with the assessment, have now been implemented.

Another emergent aspect of the PredSA assessment is that it will identify agreed-upon gaps in our knowledge. Such gaps may reflect specific hypotheses that require testing, or information that is required to test such hypotheses. Other gaps in our knowledge may relate more to the social dimensions of the issues related to predation, establishing a need for exploratory, qualitative research. These identified areas can be used to guide research needs and priorities in predation management – for both researchers and research funders. Given the multidisciplinarity of the assessment process, it can be predicted that novel and stimulating areas of research will be identified, and research synergies previously not thought of will be generated.

Adaptive management – the approach whereby management interventions are treated as experimental tests of predictions arising from hypotheses of complex systems' behaviour[16] – has the ability to advance the understanding of such systems and thereby assist managers to achieve desired goals. The management of livestock predation is ideally undertaken through such adaptive management approaches, as the system is complex and we have much to learn, including the validity of prevailing hypotheses or hypotheses emerging from PredSA. Thus,

outcomes of PredSA will guide adaptive management approaches and strengthen relations between livestock managers and scientists, as the former can be seen as running a series of experimental manipulations which yield data for the latter to interpret. This relationship adds a further opportunity for the strengthening of research capacity in South Africa, where every livestock farmer may become a 'citizen scientist'.

We conclude that science can and must provide valid inputs into the challenges and policy needs of livestock predation management in South Africa through the PredSA scientific assessment process. Furthermore, we predict that PredSA will give a much needed boost to building transdisciplinary research capacity and raise the standards of research on livestock predation and management in South Africa.

References

1. Van Niekerk HN. The cost of predation on small livestock in South Africa by medium sized predators [MSc thesis]. Bloemfontein: University of the Free State; 2010.
2. Boshoff AF, Landman M, Kerley GIH. Filling the gaps on the maps: Historical distribution patterns of some larger mammals in part of southern Africa. Trans R Soc S Afr. 2016;71:23–87. https://doi.org/10.1080/003591 9X.2015.1084066
3. Treves A, Krofel M, McManus J. Predator control should not be a shot in the dark. Front Ecol Environ. 2016;14:380–388. https://doi.org/10.1002/ fee.1312
4. Scholes RJ, Schreiner G, Snyman-van der Walt L. Scientific assessments: Matching the process to the problem. Bothalia. In press 2017.
5. Von der Heyden S, Lukey P, Celliers L, Prochazka K, Lombard AT. Science to policy – Reflections on the South African reality. S Afr J Sci. 2016;112(11/12), Art. #0183, 6 pages. https://doi.org/10.17159/sajs.2016/a0183
6. Scholes RJ, Mennell KG, editors. Elephant management: A scientific assessment for South Africa. Johannesburg: Wits University Press; 2008.
7. Du Plessis JJ. Towards a sustainable management strategy for *Canis mesomelas* and *Caracal caracal* on rangeland [PhD thesis]. Bloemfontein: University of the Free State; 2013.
8. Avenant NL, Du Plessis JJ. Sustainable small stock farming and ecosystem conservation in southern Africa: A role for small mammals? Mammalia. 2008;72:258–263. https://doi.org/10.1515/MAMM.2008.041
9. Natrass N, Conradie B. Jackal narratives: Predator control and contested ecologies in the Karoo, South Africa. J S Afr Stud. 2015;41:753–771. https:// doi.org/10.1080/03057070.2015.1049484
10. Minnie L, Gaylard A, Kerley GIH. Compensatory life-history responses of a mesopredator may undermine carnivore management efforts. J Appl Ecol. 2016;53:379–387. https://doi.org/10.1111/1365-2664.12581
11. Coppinger R, Coppinger L, Langeloh G. A decade of use of livestock guarding dogs. Proc Vertebrate Pest Conf. 1988;13:209–214.
12. Avenant NL. The caracal, *Felis caracal* schreber, 1776, as predator in the West Coast National Park [MSc thesis]. Stellenbosch: University of Stellenbosch; 1993.
13. Klare U, Kamler JF, Stenkewitz U, Macdonald DW. Diet, prey selection, and predation impact of black-backed jackals in South Africa. J Wildl Manage. 2010;74:1030–1042. https://doi.org/10.2193/2009-211
14. Ranglack DH, Durham S, Du Toit JT. Competition on the range: Science vs. perception in a bison–cattle conflict in the western USA. J Appl Ecol. 2015;52:467–474. https://doi.org/10.1111/1365-2664.12386
15. South African Department of Environmental Affairs. National norms and standards for the management of elephants in South Africa. Government Gazette 30833; 2008.
16. Biggs HC, Slotow R, Scholes RJ, Carruthers J, Van Aarde R, Kerley GIH, et al. Towards integrated decision making for elephant management. In: Scholes RJ, Mennell KG, editors. Elephant management: A scientific assessment for South Africa. Johannesburg: Wits University Press; 2008. p. 537–586.

B4 - Map of current small elephant populations in South Africa

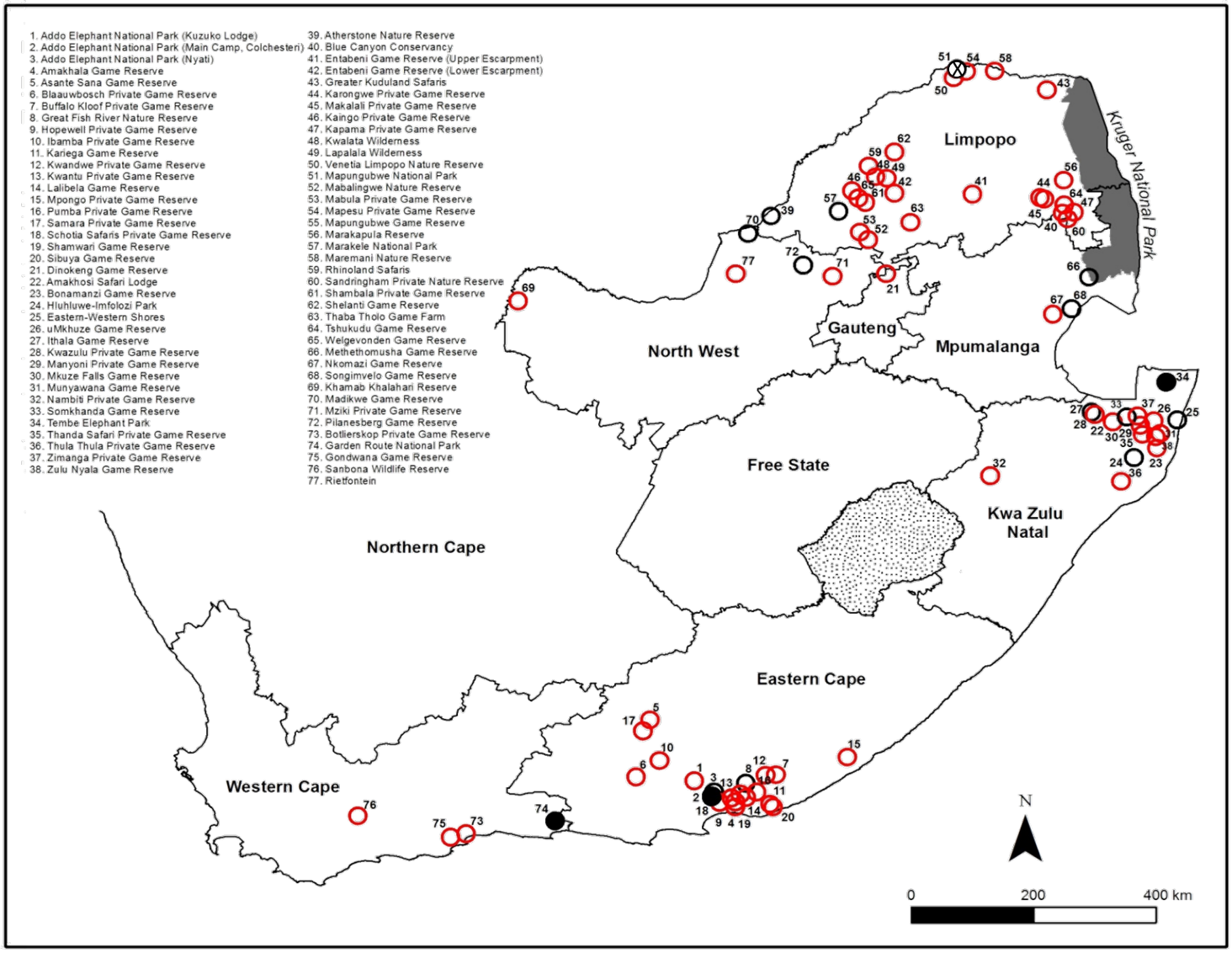

Figure 1: Locations of the 77 state (black circles) and privately (red circles) owned small elephant populations in South Africa. Included are the three naturally occurring (relict, filled circles) and a single naturally recruited (crossed circle) populations.