Livestock Predation and its Management in South Africa: A Scientific Assessment

Editors

Graham Kerley, Sharon Wilson and Dave Balfour






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Graham I. H. Kerley, Sharon L. Wilson and Dave Balfour

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Chapter 1

INTRODUCTION – THE NEED FOR, AND VALUE OF A SCIENTIFIC ASSESSMENT OF LIVESTOCK PREDATION IN SOUTH AFRICA

Lead Author: Balfour, D.[1]
Author: Kerley, G.I.H.[1]

[1]*Centre for African Conservation Ecology, Nelson Mandela University, South Africa*

INTRODUCTION

For two millennia attempts have been made to prevent predation on livestock, but the problem is still with us. The arrival of domestic livestock in southern Africa about 2000 years ago (Pleurdeau **et al.***, 2012) would have initiated a then novel form of human-wildlife conflict, this driven by the killing of livestock by indigenous predators, and attempts by pastoralists to protect their livestock. The archaeological record appears to be silent on how early pastoralists tried to protect their livestock, although Horsburgh (2008) identified many jackal* **Canis mesomelas** *remains in archaeological sites – could these represent retaliatory killings? More recently, early historical records from the 15th Century onwards (e.g. material in Skead, 2011) provide some hints. These include early descriptions of the use of dogs, herding of livestock, as well as retaliatory attacks on predators.*

LIVESTOCK predation in South Africa has been estimated to cause losses exceeding R1 billion annually (Van Niekerk, 2010). The costs are carried by individual livestock farmers, with cascading socio-economic effects across society (Kerley *et al.*, 2017). Clearly this is a substantial problem, and ways to limit the costs and consequences of livestock predation are required. Modern pastoralists are faced with a particularly complex challenge, as they have to protect their livestock within a framework of economic, regulatory and societal restrictions, which reflect increasing awareness of how wild animals are treated and the need to conserve biodiversity (Kerley *et al.*, 2017). Regulatory authorities, in developing effective policy and legislation, are constrained by the same pressures, as well as by the limited scientific information relevant to the drivers of livestock predation, the efficacy of various management interventions and the consequences (unintended or otherwise) of these interventions for biodiversity and ecosystem process (e.g. Treve, Krofel & McManus, 2016). Predator management may have both perverse outcomes (e.g. Minnie, Gaylard & Kerley (2016) show earlier reproduction in managed jackal populations) and unexpected positive outcomes for biodiversity (e.g. Minnie, Kerley & Boshoff (2015) show that livestock are sometimes withdrawn from high risk areas, leading to a relaxation of domestic herbivore pressures).

Addressing the problem of livestock predation requires appropriate, robust, evidence-based information, accessible to both policy makers and livestock managers. There is a plethora of "research" undertaken on predator-livestock interactions, but not

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all of it represents robust science, directly relevant to the information needs of managers or policy makers. Furthermore, the relevant information is scattered and hard to access. The work has been focused on "commercial" farming areas, with few studies in areas where pastoralism is a communal undertaking. There are also many gaps in the research. Thus a need exists for a policy-relevant synthesis of the issues, and its distillation into an agreed-upon set of guiding statements useful to policy development. This information can also be used to identify gaps in our knowledge and hence guide research.

The process to produce such a synthesis is known as a scientific assessment (Scholes, Schreiner & Snyman-van der Walt, 2017), and is an increasingly relied-upon approach to tackle complex problems (see below). The need for such an assessment was identified by industry role players and the relevant government departments, based upon the scale and complexity of the livestock predation issues in South Africa. A diverse team with technical expertise in the fields of biology, economics, ethics, law and humanities was assembled to conduct the assessment. The team followed a rigorous process to collate and interrogate available knowledge regarding livestock predation, relying on their collective expertise and that of a large number of independent reviewers. The document which follows is a global first in terms of the generation of a policy-relevant synthesis on livestock predation.

Box 1.1 Defining livestock

The term livestock generally refers to animals that are managed for food or fibre production or to serve as draught animals. Although typically (Thompson, 1995) applied to conventional agricultural settings and domesticated animals (e.g. cattle, sheep, pigs, horses), the term can be extended to cover a diversity of taxa such as fenced wildlife, fish, managed game birds such as pheasants, or even silk moths. The objectives of their management can extend to the provision of sport or satisfying cultural requirements.

For the purposes of this assessment, livestock are broadly defined as comprising 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 (Kerley *et al.*, 2017).

WHAT IS A SCIENTIFIC ASSESSMENT?

The nature of the decisions which need to be made by society range from those that are primarily value driven (e.g. whether to legalise the death penalty) to those that are largely technical (e.g. regulation of the use of radio wave frequencies); from decisions that are inherently simple with a high level of insight into the important factors (although they may involve complicated procedures; e.g. trade agreements between countries) to decisions that are complex with a high level of uncertainty regarding the outcome of different interventions (e.g. decisions around the conservation of natural resources or climate change). The expertise of scientists is commonly harnessed to inform these societal decisions and the input is conventionally made through "expert reports" or "scientific reviews" (Scholes *et al.*, 2017).

It is only over the past few decades that the task of informing decisions on much more complex issues (e.g. see Cilliers *et al.*, (2013) where they explain complex or "wicked" problems, as distinct from technically complicated matters without social ambiguity) has been seriously engaged by experts. These involve choices for which there is no clear technical solution, around which there is commonly disagreement on how best to intervene, and where there is a high level of societal interest in the outcome. Tackling problems and decisions of this nature has highlighted weaknesses in the traditional approaches of science informing

decisions. These weaknesses became clear towards the end of the 20th century when solutions were being sought to deal with the increasing "hole" in the ozone layer (World Meteorological Organization, 1985). Out of this process emerged what may be considered to be the first "scientific assessment". The approach taken was very different to that of expert reports and scientific reviews in a number of respects which are expanded on in this chapter. It has also subsequently been further developed with the establishment of the International Panel on Climate Change to inform decisions on climate change responses, as well as the Millennium Ecosystem Assessment which sought to address the problems of biodiversity loss and ecological degradation (Scholes *et al.*, 2017).

What is it that distinguishes a scientific assessment from the more traditional report or review? What are the specific characteristics of a scientific assessment? When is it appropriate to invoke the methodology of a scientific assessment? What are the procedures to follow? The concept of a scientific assessment continues to evolve. There is no universally-agreed definition and set of procedures for conducting such an assessment, but there are a set of core principles which are widely accepted (Mach & Field, 2017). A useful summary synthesis of the history and the essential elements of a scientific assessment, and how it has been changing over the past three decades, is presented by Scholes *et al.* (2017). Core to this understanding are three elements; context, process and governance. The context is dealt with below, while process and governance are dealt with in more detail in the next section.

Context

Management in the context of complexity, change and uncertainty must be adaptive. Those taking decisions must regularly review the problems that they are addressing and the extent to which their interventions are succeeding. Where the desired responses are not being achieved, the review process should lead to different decisions followed at a suitable period by further review. The record of evidence, the logic underpinning a decision, and the outcome must be explicit. In the realm of natural resource management this is known as "adaptive management" (Norton, 2005), more generally (in the social sciences, for instance), this is known as reflexivity. The review process commonly requires a science-based assessment. The input from the assessment can be unidirectional, in which information and insights are contributed to an end-user by the "expert" or scientist or it can be more interactive in which there is a two-way flow of information between stakeholder, including scientists, with the joint generation of new perspectives through dialogue (an approach known as co-generation or co-production). Which approach to take depends on the nature of the questions being asked and the level of engagement of stakeholders. There are many instances where it is entirely appropriate to seek a simple expert opinion or to review in a unidirectional manner. This is often the most cost effective way to review and inform straightforward decisions (Table 1.1). Where the question is of high societal interest and contention, and where the technical aspects of the issues are complex, a two-way flow of information, in which the technical aspects of the specialists are integrated with other societal considerations such as value, culture, resource availability *etc.*, is more likely to result in a robust and widely accepted outcome. It is in these circumstances that a "scientific assessment" is a suitable approach to informing decision making. Scientific assessments are also more suited to deal with multi-disciplinary issues, including those that involve very different worldviews and conceptual bases (a domain known as transdisciplinarity). Scientific assessments, on the whole, do not include undertaking original research. Rather they rely on existing literature which may be peer reviewed but need not necessarily be so.

History of this assessment

The Centre for African Conservation Ecology at the Nelson Mandela University (previously Nelson Mandela Metropolitan University) has conducted research focused on the small livestock industry and the environment since 1992. Within this broad theme, focus on providing sound, scientifically-based perspectives to industry and to policy makers relating to the mitigation of problems caused by predation on stock and specifically jackal and caracal was identified as a priority. Integral to the success of such a research programme was the buy-in and support of the key stakeholders. In this case the key stakeholders were the red meat producers, the wool and mohair growers and the relevant regulatory and policy departments of Government i.e. the Department

Table 1.1. Broad assessment types with their attributes, target audiences, processes and anticipated outcomes (Modified from Scholes *et al.*, 2017).

Assessment type	Attributes
Expert report	Typically an expert report is aimed at a client and is governed by an agreement. There is/are specific questions to be addressed and the process is conducted over a few weeks or months by a selected individual or team. They may be reviewed by other, not necessarily independent, experts and the methodology used need not be explicit. Expert reports are used for technical but uncontroversial topics and they often make clear recommendations.
Scientific review	Scientific reviews are aimed at scientific specialists who are assumed to understand the technical terminology and will form their own judgements. The questions addressed arise from the science community, and are usually restricted to a single issue which is treated exhaustively. Scientific reviews are conducted by one to a few specialists over a year or so and are rigorously peer reviewed, typically by three independent and anonymous reviewers. They are governed by implicit scientific norms of fair attribution and measured language and explicit personal opinions are discouraged, although they may be tacit. Scientific reviews are appropriate to cutting edge research.
Scientific assessment	A scientific assessment is aimed at decision makers (stakeholders) in society assumed to be intelligent but not necessarily technical experts. The questions are posed by the stakeholders. The language used aims to be free of technical terminology but with use of summary tables and explanatory diagrams. There is a governance structure to establish legitimacy and credibility and a scientific assessment is conducted by a large and diverse team of experts. Subjective expert judgements are often required, but they are made explicit, along with statements of confidence. They are independently reviewed by other experts and by stakeholders, often amounting to large numbers of documented comments and responses which are placed in the public domain. The process typically takes 18 to 36 months, following an extended period of organization and is appropriate to problems which are both technically complex and socially contested. The output is policy relevant but should not be policy prescriptive.

of Agriculture, Forestry and Fisheries (DAFF) and the Department of Environmental Affairs (DEA).

In 2008 DEA embarked on a path of strengthening the evidence basis for policy setting and evaluation. This lead to a "Research, Development and Evidence Framework" (RD&E framework) being published in 2012 (Department of Environmental Affairs, 2012; von der Heyden, Lukey, Celliers, Prochazka & Lombard, 2016). A key driver behind the development of this framework was the need to better set targets and to identify more appropriate evidence portfolios for the performance outcomes that the President requires members of his cabinet to agree to, and to be measured against. Of the twelve high level performance outcomes, *Outcome 10* relates to the protection and enhancement of environmental assets and natural resources. In developing the RD&E framework, three aspects of evidence-based approaches to policy and performance monitoring were identified. Briefly these are i) appropriate data and factual information, ii) suitably analytical reasoning to contextualise the facts and iii) structured stakeholder commentary and opinion on the issue under consideration. It was in this

setting that the initiation of a Scientific Assessment was identified as an appropriate approach to the livestock and predation issue. The RD& E framework has subsequently taken on a greater significance within the Department of Environmental Affairs with the publishing of the report *Evidence and policy in South Africa's Department of Environmental Affairs* (Wills *et al.*, 2016) and the adoption of the National Biodiversity Research and Evidence Strategy – 2015 to 2025 (Department of Environmental Affairs, 2016).

Critical attributes of a scientific assessment

Considering assessments more broadly, Ash *et al.* (2010) argue that there are three qualities of an assessment that are necessary, although not sufficient, for the assessment to be successful. The three qualities are *legitimacy*, *saliency* and *credibility*.

Legitimacy is important to reduce the chances of the findings of the assessment being ignored by relevant stakeholders such as industry, communal farmers or policy makers. For an assessment to have legitimacy implies that a formal need for the assessment has been recognized by a mandated institution. Legitimacy establishes an "authorizing environment". For an assessment to claim legitimacy also requires that it is perceived to have been conducted through an unbiased process which deals appropriately with the values, perspectives and concerns of the society for which it is being conducted. For this reason it is important that an assessment is inclusive of a range of stakeholders, institutions, disciplines and viewpoints. It is important to be able to *demonstrate* the fairness and inclusion – this is commonly achieved through a formal and recognized governance structure which ensures adherence to a set of pre-determined rules that regulate the process.

Saliency relates to the focus of the questions that are addressed by the assessment. It is important that the pertinent questions (and only these questions), as posed by the stakeholders, are answered. This implies that it is not appropriate to deviate into what the individuals who are conducting the assessment think is interesting or to allow new questions to emerge during the assessment without full engagement with stakeholders. This means that assessments represent the questions considered salient at the time: substantive new research and changing social circumstances would require a new assessment.

Credibility refers to the standards of scientific and technical rigour that are apparent through the assessment process. For this reason it is important that the individuals involved are individually recognised for their expertise in the field and their independence – not as representatives of an institution or philosophy. Equally, it is important that there is a rigorous, broad and transparent peer review process that critically considers both the factual information and the logical flow of the assessment. In this regard it is critically important for reviewers to comment on the traceability of assertions to primary sources or flagging them as "conjecture" or "expert judgment". For these reasons the credibility and experience of the assessment leader and management team is an important factor in delivering a high quality of work on large and complex assessments.

THE PREDSA PROCESS AND GOVERNANCE

From the section above we understand that a scientific assessment is a product that is useful to decision-makers operating in the public arena, dealing with complex technical issues involving stakeholders with differing views and expectations. For this reason it is important that the assessment has legitimacy. Much of the legitimacy is established through process and governance. This section deals with the process and governance of the scientific assessment of livestock predation and its management in South Africa (PredSA); it is descriptive of the specific approach taken in this assessment, but see Scholes *et al.* (2017) for a more wide ranging discussion of the topics.

Governance and process

The PredSA unfolded over four phases (Figure 1.1). There were two key aspects to the first phase, Phase 1, which involved both the establishment of a broad mandate (i.e. an assessment of the impact of predation on livestock in South Africa) and the securing of the funding to enable the assessment to be financed. In this process the Department of Environmental Affairs as the custodian and regulator of national biodiversity, as well

as the Department of Agriculture, Forestry and Fisheries as the regulator of national agricultural production were approached with a proposal detailing the potential for a Scientific Assessment of the form established by the Elephant Management Assessment (Scholes & Mennell, 2008). Concurrently the "producers" or "industry" (these include the National Wool Growers Association, Cape Wools, the Red Meat Producers Organisation), through their representative organisations and liaison forums (e.g. the Predator Management Forum) were approached as they are the bodies who manage both livestock, and indirectly biodiversity, on the ground and are most directly affected by policy and regulation affecting predation, livestock and biodiversity.

As the proposal had not originated within government or industry, it was important to ensure that there was real support for the idea of a scientific assessment on predation and livestock nationally, i.e. that the proposal had legitimacy. The measure used to gauge this support was the commitment of funding to the assessment. With a total budget in the region of R2,000,000, the process of gaining support and commitment as well as signing the agreements with Nelson Mandela University took approximately four years.

Phase 2 involved the recruitment of staff to manage the assessment, the establishment of the appropriate governance structures and processes, the development of databases, the development of a website (http://predsa.mandela.ac.za/) and the public launch of the assessment. A small management team, led by Graham Kerley with a project manager and an assistant and input from Bob Scholes and Greg Schreiner (who led the assessment on shale gas in the Karoo), drafted a PredSA process document – essentially the governance rules of the assessment (these rules pertained to mandate, decision making procedures, meetings *etc.*), which was designed to ensure that fair process was followed and that legitimacy of the assessment was thus enhanced. A key component of the governance was the establishment of a Process Custodian Group (PCG; Figure 1.2). The role of the PCG was to serve as an independent oversight body to ensure that the assessment was perceived to have been implemented in an unbiased manner, with procedural fairness and which considered appropriate values, concerns and perspectives of different actors.

The PCG members were not asked to comment on the *content* of the assessment, only on the *process* by which it was conducted. To this end their specific responsibilities were to provide feedback to the Project Leader regarding the following:

- Has the assessment process followed the pre-agreed guidelines?
- Do the proposed author teams have the necessary expertise, range of perspectives and show balance?
- Does the assessment, as indicated by the Zero order Draft (i.e. the expanded outline of the table of contents) cover the material issues expected by the primary stakeholders of such an assessment?
- Are the identified expert reviewers independent, qualified and balanced?
- Have the review comments received from the expert and stakeholder reviewers been adequately addressed and have the responses been adequately documented?

In order to achieve this mandate, the composition and affiliation of the PCG members was important. A six-person PCG was selected; each appointed in their own right and for their own expertise and judgement, but to ensure appropriate representivity, there was one representative from each of:

- The Department of Environmental Affairs (selected by the department);
- The Department of Agriculture, Forestry and Fisheries (selected by the department);
- The National Wool Growers Association (selected by the Predator Management Forum);
- South African Mohair Growers Association (selected by the Predator Management Forum);
- SANParks, representing the research community;
- The Wilderness Foundation Africa, representing NGOs and civil society.

There was an independent Chairperson from senior management at Nelson Mandela University in order to prevent conflicts of interest arising through a member who could be perceived as being part of a stakeholder group chairing the PCG.

Because of the need for both saliency and credibility, a multistep process was followed (see Scholes *et al.*, 2017 and Figure 1.3). The management team workshopped the first draft of the structure of the assessment as well as appropriate experts to serve as potential lead authors,

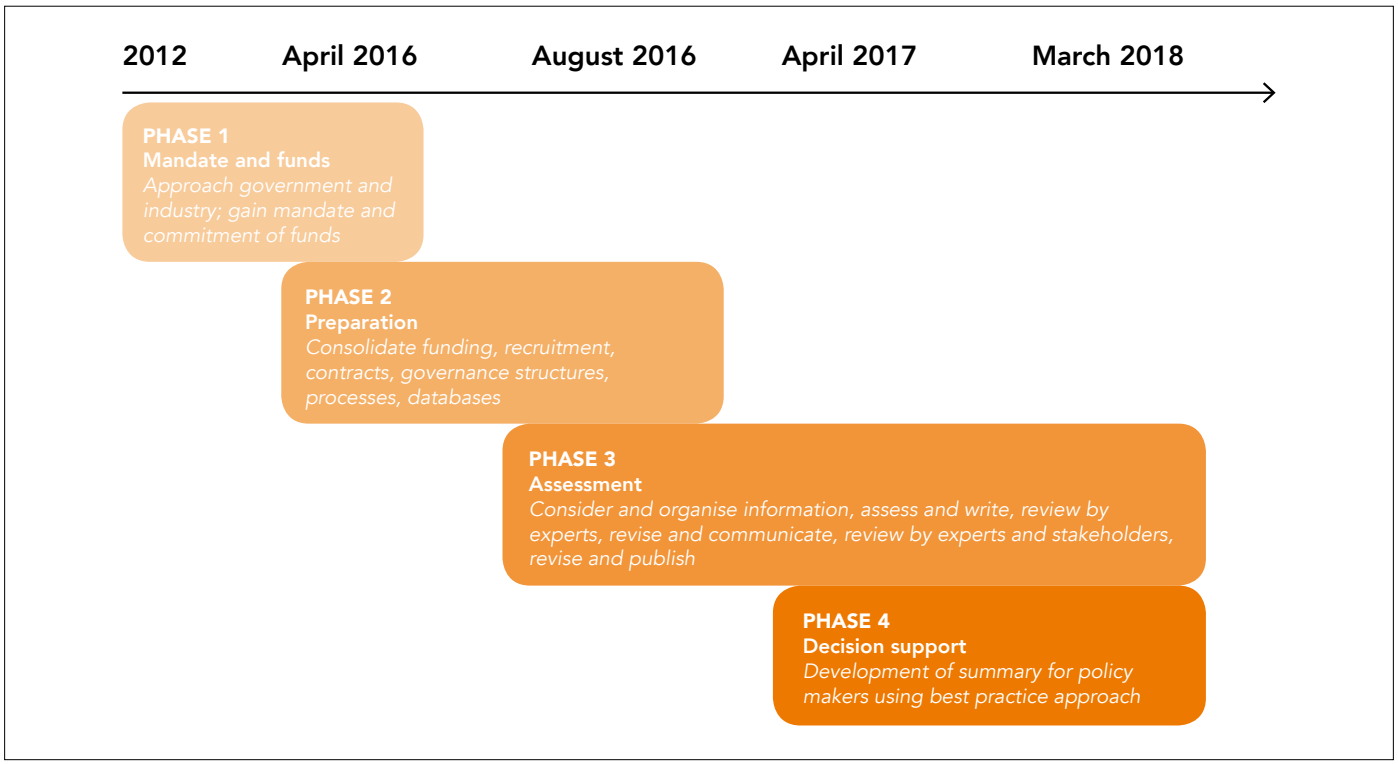

Figure 1.1. The four phases of the Scientific Assessment of Livestock Predation in South Africa.

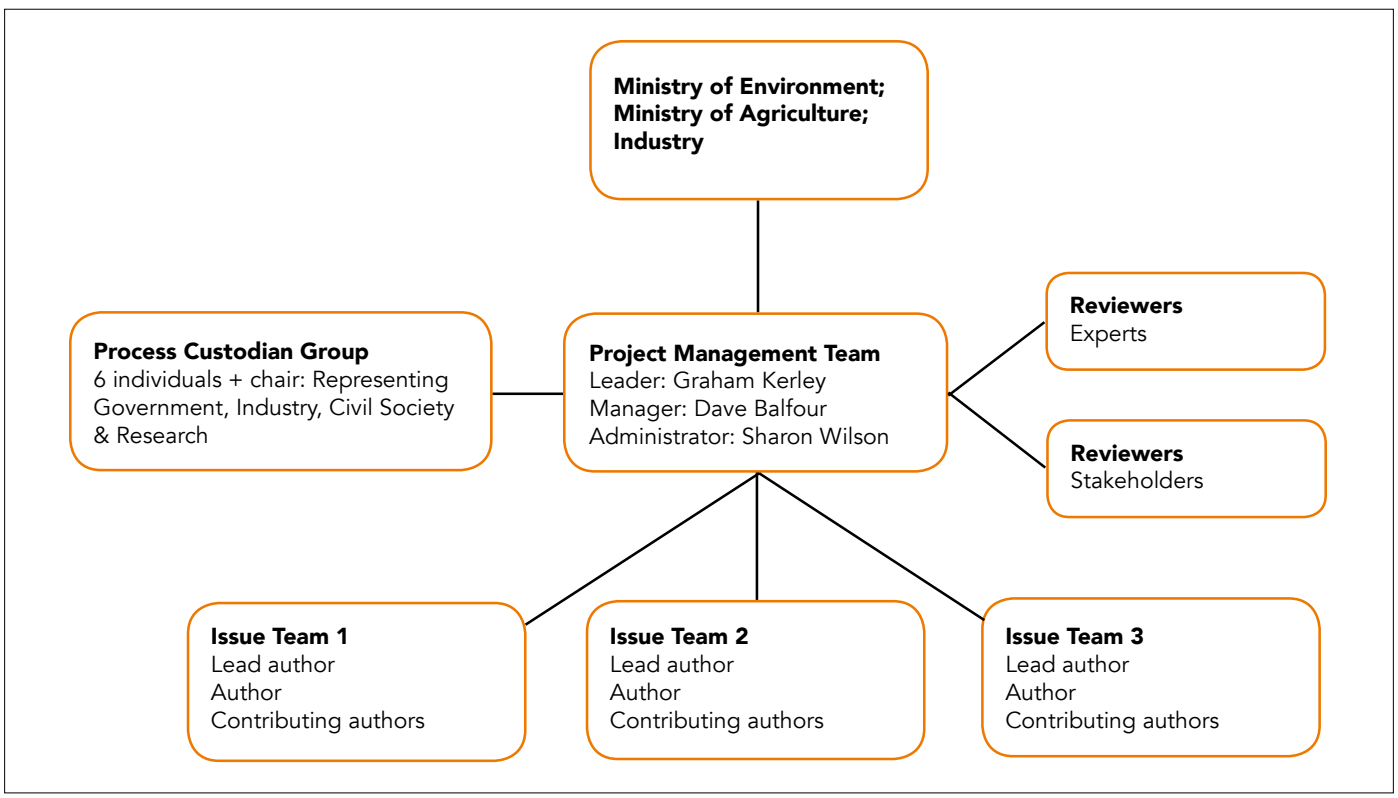

Figure 1.2. The governance structure for the Scientific Assessment of Livestock Predation in South Africa.

authors and or reviewers. From this list a final selection of preferred Lead Authors was chosen for their established expertise. In this selection attempts were made to favour younger individuals as there is evidence that participation in an assessment was beneficial to younger people (Scholes *et al.,* 2017). A brief bio-sketch was developed for each of the Lead Authors.

Following the establishment of the PCG, a draft structure of the final assessment, detailing the specific issues to be addressed (in chapter form) together with proposed Lead Authors i.e. the experts, was presented to the PCG, together with the full list of potential Lead Authors, for a "statement of no objection" in terms of the criteria that they had been mandated to use to evaluate the stages of the assessment. No objection was received for the Lead Authors but the management team was strongly encouraged to seek opportunities to ensure greater representation of black and female authors. This was done. Having established who the lead writing individuals were, the next step was to hold the Lead Author workshop (Figure 1.3). The purpose of this workshop was to introduce Lead Authors to each other and to begin to flesh out the structure of the document. The interactive process served well to gain the buy-in and sense of common purpose of the writing team.

This was followed by a process of each Lead Author identifying and inviting Authors for their chapter and entering into a four month writing period. At the end of the writing period, the entire writing team was invited to a workshop to present and receive commentary from the other members of the larger writing team. In this process the final structure of the document was agreed on and gaps and duplicated effort were identified and resolved. After a further six week writing period the First Order Draft (FOD) was submitted to the expert reviewers. Three reviewers were identified for each chapter and where possible one of them was international. Review comments were processed and the comments together with the responses were fully documented and made available on the website for scrutiny. This level of transparency is seen as being an important element of maintaining legitimacy. This was followed by a set of public announcements in both the industry forums as well as the public press that the Second Order Draft (SOD) was available for comment – the stakeholder review process, in which the FOD expert reviewers were encouraged to participate as well, to ensure that their comments on the FOD had been adequately addressed. The open availability of the SOD lasted five weeks.

The processing of the comments from the stakeholder review process was managed in the same manner as for the FOD and was followed by the final author workshop resulting in the Final Draft of the assessment. This, together with a Summary for Policy Makers, was presented to the PCG for final sign-off on the process. Following this the manuscript was copy edited and submitted for publication. The Summary for Policy Makers was drafted by the Project Leader and the Project Manager together with the Lead Authors.

STRUCTURE OF THE ASSESSMENT

Chapter 1 introduces the problem, scientific assessments and the approach to this specific assessment. Chapter 2 deals with the historical context of the conflict between land users and predators in South Africa highlighting variability in our spatial understanding of the phenomenon, as well as how perceptions have changed over time. Chapter 3 deals with the current state of knowledge regarding estimates of the size and nature of the impacts of predation on livestock and highlights areas where we have very poor formal knowledge such as in communal rangelands. Chapter 4 deals with the ethical considerations in the management of livestock predator impacts. Chapter 5 explores the legal context of managing predator livestock impacts. Chapter 6 reviews the past and current predator and predation management practices, both in South Africa as well as internationally. Chapter 7 deals with the two most abundant predators that impact on small livestock farmers – the jackal and the caracal. Chapter 8 deals with the impacts of altering the density and ecology of meso-predators on the biodiversity of the rangeland ecosystems where most livestock are farmed in South Africa, and Chapter 9 deals with the role and impact of predators other than caracal and jackal. In addition a Summary for Policymakers is provided.

EMERGENT ISSUES

Although this scientific assessment is focused on the compilation of policy-relevant information, it is also important to recognise the value of issues that emerge through the process (Kerley *et al.*, 2017). Examples include the need for robust decision-making and management

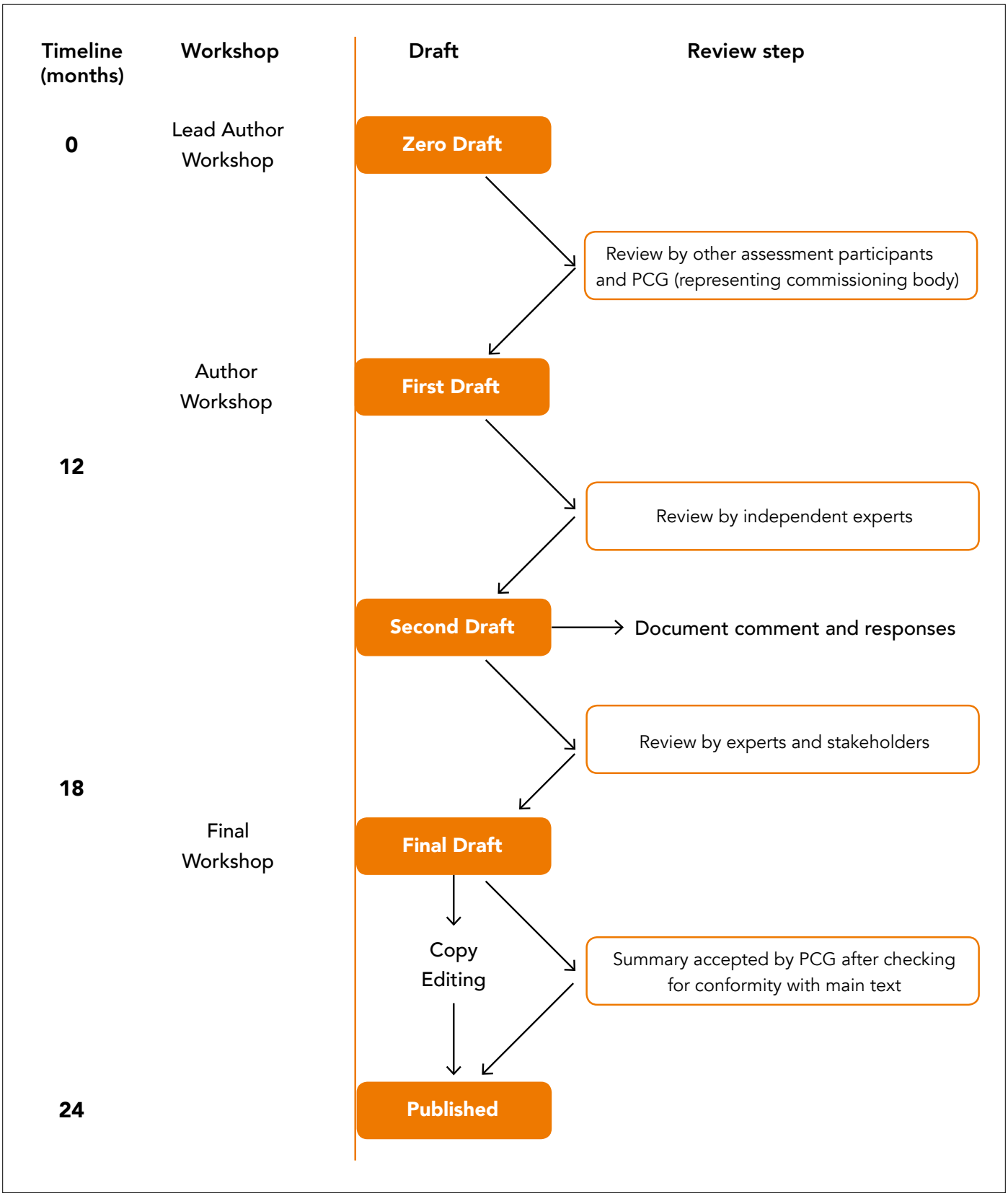

Figure 1.3. The timeline and process undertaken for the Scientific Assessment of Livestock Predation in South Africa.

approaches, recognising that the understanding of the livestock predation issue reflects the baseline that may alter over time (so-called shifting baselines (Pauly, 1995)), and the paucity of, but clear need for, research on the nature of livestock predation in communal rangelands. These issues are briefly described below.

Adaptive management

Decision making around complex issues is not a simple task, and can be seen to have two fundamental components. These comprise identifying and involving appropriate stakeholders, and the basis for the decisions and how their outcomes are assessed. These components are clearly intertwined, as for example it is important that stakeholders that will be affected by the outcomes of management interventions are able to participate in the decision-making in an informed manner with regards to the knowledge-base, objectives and possible (and eventual) outcomes of these decisions (Biggs *et al.*, 2008). Within the livestock predation environment, the set of stakeholders is diverse, and ranges from farm workers, farmers, provincial and national government authorities tasked with dealing with biodiversity management and agriculture, legal authorities, and civil society elements interested in issues as diverse as workers' rights and animal rights. A poorly recognised but increasingly important group are eco-tourists, as they provide one of the justifications for the re-introduction of apex predators (e.g. Hayward *et al.*, 2007). Their responses to livestock predation management interventions may have significant economic repercussions, and as a group they are very familiar with the power of social media. In this respect, the stakeholder challenges around livestock predation closely mirror those of elephant management (see Biggs *et al.*, 2008). Important distinctions are that elephant management is largely single species focused, relatively constrained geographically (there are less than 100 elephant populations in South Africa) and the processes to address the complexity around elephant management are well advanced (Scholes & Mennel, 2008). In this respect, elephant management serves as a powerful heuristic model for South African society to address the stakeholder issues around livestock predation. A further link between these two complex issues is the process of Strategic Adaptive Management developed by South African National Parks (SANParks), as a tool to address complex issues, including *inter alia* elephant management (Roux & Foxcroft, 2011).

Adaptive Management as a concept for approaching complex issues emerged from the recognition of the need for a systematic approach that was based on robust information and which led to predictable outcomes. The principles were first formulated by Taylor (1911), considered to be the father of industrial engineering, and developed for the ecological context by Holling (1978). More recently SANParks has refined and developed the approach with the aim of achieving strategic conservation objectives, hence the term used within SANParks of "Strategic Adaptive Management" (see Roux & Foxcroft, 2011, and other papers in the 2011 special issue of *Koedoe* Vol 53(2) - http://www.koedoe.co.za/index.php/koedoe/issue/view/82). A key principle of adaptive management is "learning by doing". Where adaptive management differs from other approaches espousing this approach, is that in adaptive management the problem is formulated as a hypothesis, from which (multiple) testable predictions arise, and that management interventions should reflect tests of these predictions. Failure of management interventions suggests that the original hypothesis does not adequately describe system behaviour and needs to be revised as per the lessons from these interventions (Roux & Foxcroft, 2011). In this respect, adaptive management has been referred to as management by hypothesis, and management actions can be interpreted as experiments to test our system understanding. Thus, documented monitoring of outcomes is an essential feature of adaptive management. Adaptive management can therefore be seen as a feedback learning loop (Figure 1.4). Importantly, the full suite of stakeholders can learn through this process, not just about an agreed upon understanding of how the system behaves, but also from the lessons learnt as adaptive management is applied. This process can therefore be expected to have the added benefit of providing common ground for stakeholders and a maturation of all stakeholders' understanding of the system. This can be expected to reduce tensions between stakeholders.

The relevance of the application of adaptive management to the field of livestock predation is clear, but to date little attention has been paid to undertaking this formally. The strategic objectives of stakeholders

can be articulated in terms of the reduction in the conflict and a decline in livestock predation. Clearly, and as demonstrated in this Scientific Assessment, the system is complex, and there may be unforeseen or perverse outcomes of management interventions (e.g. Minnie *et al.*, 2016). The PredSA assessment identifies many management approaches to mitigating livestock predation. There is evidence that some of these approaches are less successful than others (Chapter 6). The challenge is for the policy makers, managers and other stakeholders to develop a shared set of strategic objectives and formulate a set of interventions that can be expected to allow us to move towards these objectives, and away from those demonstrated to have failed. Clearly, resources will need to be set aside to drive this approach, as well as to monitor and evaluate the outcomes, and to pass on the lessons learned. In essence, this assessment and the resulting policy shifts serve as components in an adaptive cycle and should be seen as such. The understanding generated through this assessment is part of a progressive and adaptive process aiming to improve the management of predation and livestock in South Africa.

Shifting baselines and lifting baselines

The situation with regard to the nature and extent of livestock predation, the identity of the key predators and appropriate management responses is not static. The large scale eradication of the apex predators in the 18th and 19th centuries (Boshoff, Landman & Kerley, 2016) largely relieved livestock owners of concerns around lions *Panthera leo,* spotted hyenas *Crocuta crocuta* and African wild dogs *Lycaon pictus* over much of South Africa. Prior to this, written accounts were largely dominated by concerns of attacks by lions on livestock (and people), as summarised in Skead (2007; 2011) and Boshoff & Kerley (2013). Bearing in mind that transport of people and goods was dependent on the availability of draught animals, such attacks could leave

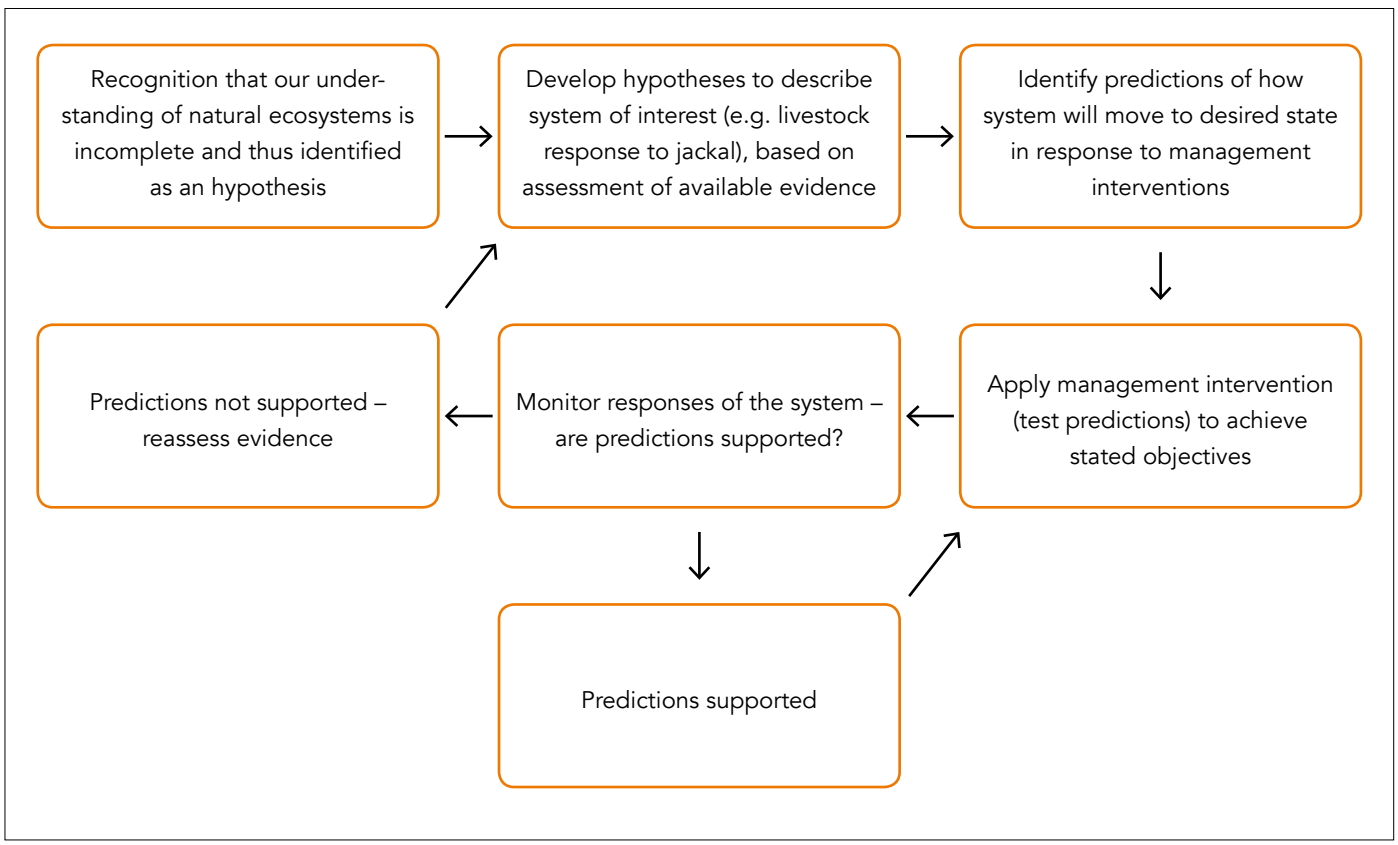

Figure 1.4. A simplified schematic of adaptive management, with the definition of the "desired state" reflecting the strategic objectives of system management.

travellers stranded. Responses to these threats include 19th century travellers' wagons being driven at night, when it was hoped that the noise of the party (whips cracking, shouts of the drovers) would deter lions from attacking (Boshoff & Kerley, 2013). Writings of the time are also replete with accounts of determined attacks on lions and other apex predators by livestock owners who seemed focused on killing all large predators. In contrast, these same writings rarely mention concerns of jackal attacks on livestock, and jackal killing seems to be more focused on collecting skins for making "karosses" (but see descriptions of KhoiSan concerns around jackal-predation of their sheep mentioned in the Van Riebeck diaries in the 17th Century (Skead, 2011)). Similarly, the caracal hardly features in 17th to 19th Century accounts.

Lions were progressively eradicated from the present-day Western Cape, Free State and Eastern Cape provinces by 1838, 1870 and 1879, respectively (Skead, 2007; Skead, 2011; Boshoff & Kerley, 2013). Thus, many generations of livestock farmers have since been operating under the "shifted baseline" (*sensu* Pauly, 1995) of jackal and caracal being the focus of their concerns (du Plessis, Avenant & de Waal, 2015). Memories of a different suite of predators have thus largely been lost. However, recently large predators have been re-introduced into areas from which they had been eradicated (e.g. Hayward *et al.*, 2007), for both conservation and ecotourism objectives. Inevitably, these re-introductions lead to escapes into neighbouring pastoral areas. Banasiak (2017) identified at least 75 conflict events arising from such escapes in the Eastern Cape Province since the 1990s, with livestock at the centre of most of these events (see also Chapter 9). So, while re-introductions of large carnivores may meet conservation and economic objectives, it is also important to recognise that some stakeholders may bear the brunt of unintended consequences. Typically these stakeholders see such emerging conflicts as due to "invaders", forgetting that the presence of these large predators used to be the norm (Roman, Dunphy-Daly, Johnston & Read, 2015). This reflects a need to "lift the baselines" and to educate these stakeholders as to the fact that the presence of these large predators is the pre-colonial norm under which these ecosystems evolved, as well as to the broader value of such conservation outcomes, and to promote investment in mechanisms to reduce these conflicts if we are to continue to celebrate such conservation successes.

Addressing livestock predation in communal farming areas

Conflict over livestock predation can be expected to occur wherever livestock are exposed to predators. Early on in the PredSA process, the bias towards studies of livestock predation in so-called commercial farming areas was recognised, with a dearth of studies in the South African formal literature relating to communal farming areas. The background to this pattern is beyond the scope of this assessment, but it is important to recognise this bias in attempts to gather policy-relevant information. It was also clear that simply recording a gap in information would be deeply unsatisfactory. This because there are clearly many people in South Africa who have good knowledge of the issue – it is simply not recorded. To address the matter, PredSA partnered with an NGO, Conservation South Africa, who currently have established programmes in the rural and communal farming areas of the Northern Cape, Eastern Cape and in Mpumalanga and are working with communal rangeland farmers on matters to do with livestock and biodiversity. Together a questionnaire survey was developed and over 270 people were interviewed across the three areas using the established forums and in the local vernacular. This process was run in parallel with the drafting of the Second Order Draft and the results and the findings are incorporated into the relevant chapters (Hawkins & Muller, 2017). The reviewers of the affected chapters were approached for comment on the additional material so as to ensure that there was no shortcutting of due process. Thus, although collecting novel data is not the norm for a Scientific Assessment (Scholes *et al.* 2017), this innovation is seen as being an enriching contribution to a uniquely South African situation, and as being consistent with the approach being taken by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) process when incorporating Indigenous and Local Knowledge into an Assessment (Sutherland *et al.*, 2013; IPBES, 2016).

WAY FORWARD

The PredSA is a significant step forward for South African society to address the conflicts and costs of livestock predation. We know of no precedent worldwide. Replicating this approach in other nations will represent a powerful approach to reduce global levels of conflict between predators and livestock owners.

This document represents a compilation by a group of experts of what we know and what we don't know and, to some extent, what we need to know about livestock predation. It is compiled by experts, largely for an informed audience. The material contained in this assessment is aimed at both livestock managers and those with an interest in biodiversity management in South Africa as well as policy makers. Given the cultural and linguistic diversity of livestock managers in South Africa, this document, although currently only available in English, should also be made available in multiple languages. The opportunity also exists to communicate the information in the form of "extension documents" that can be made available to livestock managers, extension officers and other stakeholders. The power of modern multimedia (video and audio) can also be harnessed to make this information more broadly available.

This PredSA assessment should not be seen as the final step in addressing this issue. By their very nature, scientific assessments are living processes, and should catalyse the further generation of knowledge, whether through stimulation of strategic research activities (e.g. research on livestock predation in communal areas highlighted above) or lessons learnt from adaptive management. This will by definition make it necessary to revise and update scientific assessments on a regular basis, as is done for the climate and biodiversity/ecosystem services assessments (IPCC, 2013; IPBES, 2016). In this respect, the record of the process in developing the PredSA assessment allows for the process to be replicated by future generations of assessment practitioners, and this document provides the foundation for an ongoing learning process that will hopefully lead to a reduction in conflict around livestock predation in South Africa.

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CAPE WOOLS SA

Predators are valued as part of South Africa's natural heritage, but are also a source of human-wildlife conflict when they place livestock at risk. Managing this conflict ultimately falls to individual livestock farmers, but their actions need to be guided by policy and legislation where broader societal interests are at stake. The complexity of the issue together with differing societal perspectives and approaches to dealing with it, results in livestock predation management being challenging and potentially controversial.

Despite livestock predation having been a societal issue for millennia, and considerable recent research focussed on the matter, the information needed to guide evidence-based policy and legislation is scattered, often challenged and, to an unknown extent, incomplete. Recognising this, the South African Department of Environmental Affairs together with the Department of Agriculture, Forestry and Fisheries, and leading livestock industry role players, commissioned a scientific assessment on livestock predation management. The assessment followed a rigorous process and was overseen by an independent group to ensure fairness. Over 60 national and international experts contributed either by compiling the relevant information or reviewing these compilations. In addition an open stakeholder review process enabled interested parties to offer their insights into the outcomes. The findings of the scientific assessment are presented in this volume.

"Livestock Predation and its Management in South Africa" represents a global first in terms of undertaking a scientific assessment on this issue. The topics covered range from history to law and ethics to ecology. This book will thus be of interest to a broad range of readers, from the layperson managing livestock to those studying this form of human wildlife conflict. Principally, this book is aimed at helping agricultural and conservation policymakers and managers to arrive at improved approaches for reducing livestock predation, while at the same time contributing to the conservation of our natural predators.

NELSON MANDELA
UNIVERSITY