

Conservation science and elephant management in southern Africa

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THE PREVAILING INCREASE IN ELEPHANT numbers across areas of southern Africa raises concern for their impact on biological diversity. Several approaches to elephant management focus on limiting numbers to alleviate these consequences. However, landscape fragmentation, fences, water supplementation as well as the shape and size of some conservation areas restrict range use and intensify the effects of elephants. We propose that the consequences of range limitation may best be addressed by restoring seasonal and regional patterns of land use. It can be achieved by linking existing conservation landscapes both nationally and internationally. This, rather than the management of numbers, should reduce local impact and help to stabilize elephant numbers regionally. We address the importance of space to elephant management by advocating a scientific approach that relies on the establishment of megaparks across southern Africa. These should facilitate local movements and regional dispersal both within and even between these parks. This will also allow for spatial dynamics (such as source-sink interactions) that stabilize numbers regionally while reducing local impacts. We believe that our proposal improves the scientific framework for conservation initiatives both nationally and regionally. It is in line with current developments in conservation science that emphasize habitat and ecosystem management. The implementation of this approach, however, needs substantial research and refinement for its validation and calls for a regional focus on conservation management, especially in view of local economic and social realities.

Introduction

There is a serious mismatch between conservation science and practice regarding elephants.^{1,2} Management that is not based on the systematic appraisal of scientific evidence is controversial.^{3,4} Indeed, Soulé *et al.*⁵ implore managers to recognize advances in conservation biology. They advocate use of 'best conservation practices based on the best science', in the same manner that medical doctors are obliged to use new treatments based on peer-reviewed research. Where

available, conservation science should guide elephant management, with due consideration for aesthetic, socio-political and ethical values.

Conservation authorities deem elephant numbers as 'too high' when they cause obvious damage to vegetation. This sentiment is the root of the so-called 'elephant problem'^{6,7} and motivated the control of elephant numbers in some southern African parks. We are concerned that even recent plans to manage elephants continue to focus on controlling their numbers to reduce their effects, and do not address the forces that cause impact and lead to large local populations. Consideration of the causes of the elephant problem, as well as advances in conservation sciences, allow us to present a fresh approach to managing the consequences that elephants have for vegetation and habitats. This approach avoids reducing numbers directly and addresses patterns of spatial use to reduce local impacts and limit regional numbers. It emphasizes the cause of the elephant problem and focuses on a systemic rather than a symptomatic treatment.

Our conservation legacy

Numerous conservation areas have been proclaimed since protected areas were first established in southern Africa in the 1890s.⁸ Many of these were created to prevent the over-killing of large mammals⁹ including elephants, whose numbers apparently then declined across most of Africa.¹⁰ The loss of habitat due to land transformation for agriculture and human settlement, compressed wildlife into protected areas and reduced their ranges.¹¹⁻¹⁴ Consequently, many wildlife populations are fragmented and isolated, some by fencing and others by rural development. For elephants this also impedes traditional migration routes.^{15,16} Given the isolation of many protected areas, it is not surprising that ecologists are concerned about the adverse outcomes of fragmentation for conservation. For instance, in 1979, Soulé *et al.*¹⁷ predicted that 'all nature reserves are, or soon will be, islands of

natural habitat in a sea of inhospitable terrain'. Closer to home, Owen-Smith¹⁸ echoed this sentiment with his opinion that 'all wildlife reserves are destined to become ecological islands in a sea of man-modified landscapes'. These opinions underlie a fundamental problem with past management practices — the dogma of running conservation areas as isolated reserves and managing populations as closed-off entities.

Within protected areas, efforts to stabilize the availability and spread of drinking water to regions that were inaccessible during the dry season, further altered the distribution of elephants and other species.^{19,20} This probably affected elephant survival, as the young are particularly susceptible to drought conditions.²¹ Improved survival may increase population size since survival of young is an important determinant of population growth.²² Both this and overt protection may have added to the rapid increase of elephant numbers throughout southern Africa,²³ which currently stands at around 260 000 individuals.²³ While populations across the region may have increased at about 4.5% per year over the last decade,²⁴ predictions that this will continue indefinitely²⁵ are unfounded. These predictions ignore evidence that population growth may be inhibited at high elephant densities.²⁶ Even so, forecasts of continuous increase at this and higher rates persist and motivate the management of elephant numbers.^{25,27,28}

Elephant management

For decades, management in many southern African parks focused on stabilizing animal numbers and their resources. This focus found support in the carrying-capacity paradigm. For instance, in the Kruger National Park (KNP), this approach gave rise to hundreds of artificially maintained water points and nearly 30 years of culling elephants.²⁹ However, a recent plan for the KNP²⁸ concedes that savannas are in a constant state of flux and aims at different intensities of elephant management across the park. The plan aims to both curb the loss of biological diversity and to improve on earlier policies that were vague²⁸ and apparently lacked an appreciation of sound ecological principles.

Elephant numbers can be reduced locally by culling, through either killing or translocation (we mean culling to refer to the removal of animals from herds, by whatever means). Contraception has been touted as an alternative method to control elephant numbers.³⁰ Unlike

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culling, contraception promises to reduce growth rates,³¹ but not numbers in the immediate future. As such, contraception does not reduce the impact nor the high numbers. Moreover, contraception is costly and impractical to implement.³¹

Reducing numbers in order to manage elephants in parks stems from interfering with the ecological processes that once characterized these systems and may have limited populations in the past.³² For instance, protection by fences reduces man-induced mortalities but also hinders both seasonal movements and long-term dispersal. Water supplementation further modifies the movements and range use of elephants³³ and may change their survival. Our latest (and unpublished) information on range utilization also shows that the overlap in dry and wet season ranges in populations restricted by fences is greater than that of populations in unfenced parks. Fencing and water supplementation could therefore be responsible for the relatively high elephant numbers in some reserves.

Several southern African countries including Namibia, South Africa, Zambia and Zimbabwe resorted to culling to address the immediate consequences of these large numbers. Over a period of about 30 years, more than 17 000 elephants were culled in South Africa,³⁴ whereas in Zimbabwe over 60 000 elephants were killed.²⁵ Others countries, such as Botswana, have never culled despite the presence of a large population of elephants. Some 25 years ago, Graeme Caughley contended that culling had become institutionalized in southern Africa and challenged wildlife managers to give up applying non-sustainable, symptomatic treatments.³⁵ Since Caughley's challenge, several workshops and symposia have focused on managing elephants. Most notable are those reported on by Jewell and Holt,³⁶ Owen-Smith,³⁷ Kerley, Wilson and Massey,³⁸ Utrecht University (see <http://elephantpopulationcontrol.library.uu.nl/>), Cumming and Jones,²⁵ SAN-Parks³⁹ and Mabunda.²⁷ The general message from these workshops is similar—there are 'too many' elephants present in many protected areas. The outcome remains the same—a need to reduce elephant numbers to protect conservation areas and biological diversity.

The long-standing split between those who support culling and those who prefer to let nature take its course apparently continues. Yet, even staunch supporters of culling acknowledge that this approach results from the dysfunctional state of

conservation areas. For instance, Pienaar,²⁹ a former warden of the KNP, states '... there are few situations where national parks or equivalent conservation areas can be regarded as self-regulating ecological units.' Similarly, Damm,⁴⁰ in a text on saving biodiversity written for the non-specialist, argues that 'the question of whether or not to cull ... has arisen only because of human interference in the dynamic processes that formerly characterized natural systems'. He suggests that perimeter fences, artificial water points and pressure in areas that surround reserves, have precluded episodic mortality and emigration. Yet contrary to our approach, Pienaar and Damm do not suggest correcting the management interferences they acknowledge have caused the problem, but instead advocate culling.

Elephants in space

Elephants are found over some 5 million square kilometres of southern Africa and well beyond the boundaries of protected areas, which account for only 16% of their actual range.²³ Under certain conditions, individuals have large ranges and move over extensive areas. Land is untransformed over much of these ranges and human densities are low, seldom exceeding five people per square kilometre.^{41,42} These conditions are conducive to conservation practices that include elephants both inside and outside parks.

Most of southern Africa's elephants live within national parks, even though they may range well beyond these reserves. In unfenced parks, typical for Botswana, Mozambique and Zambia, elephants move onto surrounding game management and communal lands. Even elephants from fenced areas, such as Namibia's Etosha National Park and South Africa's KNP, roam beyond their borders and some of these animals come into conflict with people.

A successful elephant management plan must incorporate these wider-ranging movements and deal with the problems that arise when elephants destroy crops or kill people.⁴³ More important, however, is that the expansion of conservation responsibilities to areas beyond parks requires a robust model that has scientific backing and which makes conservation sense. We therefore propose the development of a conservation approach that caters for the spatial needs of elephants and enhances rural life. Equally important, our proposal deals with the impacts on biological diversity that typically arise from the confinement of elephants.

A call for megaparks

Earlier solutions to the elephant problem assume that numbers and their consequences are closely related. However, the way that elephants affect habitats challenges this assumption as both water distribution and food quality influence how they use space.^{18–20} For instance, the distribution of artificially maintained water points determines elephant home range in the KNP — these ranges are smaller when there is a higher density of waterholes.³³ Clearly, management practices modify habitat use, influence elephant distribution and therefore their local impact.

To manage the local effects of elephants we need to deal with the factors that force elephant distribution across space and time, rather than focusing simply on numbers. Where space allows, this can be done by linking reserves and other land to expand range use opportunities and an effective conservation network for elephants. This will address landscape fragmentation as a historical cause of the elephant problem. It can also induce seasonal movements that will lead to varying intensities of impact and opportunities for vegetation to regenerate during times when elephants are absent, for instance as they shift from their wet season to dry season home ranges.²⁶ Furthermore, we advocate reducing water supplementation, especially where water influences seasonal movements, thereby altering the local distribution of the animals to allow for the seasonal recovery of vegetation. These actions should enhance the conservation goal of maintaining floral and faunal heterogeneity, as proposed for instance for the KNP.⁴⁴

Some argue that expanding the range available for elephants, which we advocate, simply increases the elephant problem. We contend that this is not the case, as factors related to the density of elephants in an area, as well as inherent environmental constraints, limit population growth when management actions, such as by providing water or limiting movements, do not interfere. Linking land that varies in resource quality has the potential to broaden conditions for the survival and reproduction of elephants. This will promote differential rates of growth across space and time and result in increasing, stabilizing or decreasing sub-populations that operate independently as part of a greater population (the *metapopulation*). As we elaborate below, the creation of 'megaparks' then allows for metapopulation dynamics to limit

numbers across the region.⁴⁵ The opinion that elephants cannot be limited naturally within conservation areas (see refs 26, 36–38) may be unfounded when applying the megapark concept, although that remains to be tested.

Conservation science and megaparks

We endorse the linking of conservation land that will promote patterns of spatial utilization to reduce the local impact of elephants. Consequently, we advocate an approach that centres on the development of sets of megaparks within the distributional range of elephants in southern Africa. We define a megapark as a cluster of existing conservation areas that either adjoin or link with one another and can include national parks and other categories of protected land. Across southern Africa, this could involve the seven or eight clusters of conservation regions with substantial numbers of elephants that currently constitute various sub-populations.

The conservation literature provides the tools to construct a spatial approach to elephant management.^{46,47} From a theoretical perspective, metapopulation dynamics⁴⁸ provide the conceptual framework for such management^{49,50} and our megapark metaphor fits into this.⁵¹ The metapopulation concept relies on spatial discontinuities in the demographic responses of elephant sub-populations to landscape heterogeneity.^{45,52} The assumption is that the dynamics of these sub-populations will differ enough to induce dispersal. Under these conditions, dispersal events can drive the growth or decline of local populations. Consequently, local populations will fluctuate in numbers, while overall numbers across the region will remain relatively stable.^{53,54} Within a megapark, populations then become connected across space and time in order to operate as a special case of a metapopulation.^{48,53} To us this seems an attractive scientific paradigm on which to model elephant conservation.⁵¹

The approach is not novel, in relation to either its underlying theory or its potential application to conservation. The notion of a population as a spatial entity goes back to the experimental work of Huffaker and his co-workers in the 1950s,⁵⁶ which became popular amongst theoreticians during the 1970s.⁵⁷ It gained momentum amongst applied ecologists following the elegant work of Hanski and his co-workers.⁴⁸ Today, the approach often underlies published conservation studies, while for a decade or so some managers use phrases such as 'metapopulation

management' in their action plans.^{58–61} Unlike other action plans that consider rare species, our approach provides a framework for limiting numbers locally by reinstating dispersal and creating so-called 'source-sink' dynamics as a type of metapopulation.^{48,53} Using a model based on source-sink dynamics, sources (where numbers increase) can be maintained where elephant birth rates exceed death rates. Conversely, in sink areas (where numbers are in decline), the death rate exceeds the birth rate, but these populations are maintained by immigration from source areas.^{45,53}

From a conservation management perspective, Owen-Smith,^{18,62,63} Martin and Taylor,⁶⁴ Gillson and Lindsay,⁶⁵ Sebogo and Barnes⁶⁶ and Bulte *et al.*⁵⁵ have all proposed management strategies for rhinos and elephants that allow for the movement of individuals from one area to another. Our approach therefore integrates earlier ideas and provides for the design of megaparks to address the elephant problem.

Initiatives to defragment conservation space, such as the development of trans-frontier conservation areas (TFCAs),^{14,67} allow for the application of the megapark idea. We are optimistic that the current debate on the management of elephants in national parks may advance conservation science into the realms of conservation practice. Many national parks are well situated for the exploration of spatial restoration as a means to reduce elephant impacts. This proposal needs substantial refinement, however, given the confounding economic and social consequences that elephants have for those people and institutions that will potentially gain from megaparks.

Megaparks in practice

Following our model, authorities can consider elephant conservation in terms of the mosaic of landscapes that surround national parks. For instance, the KNP presently covers less than one-fifth of the 100 000 square kilometres over which the Greater Limpopo TFCA eventually will stretch and where elephants may roam.⁶⁸ On an even larger scale, the proposed Kavango-Zambezi TFCA (KAZA TFCA) may extend over an area of around 300 000 square kilometres. It will include some 36 national parks, game reserves and wildlife management areas. With more than 180 000 elephants, the KAZA TFCA will support the largest contiguous population of these animals in Africa.

In practice, such megaparks provide opportunities to defragment the conser-

vation landscape, decompress elephant populations and allow for the more natural limitation of their consequences. This proposal does not call for the amalgamation of southern Africa's elephants into a single entity. Rather, we argue that many of the larger protected areas that elephants dominate can be clustered into conservation units. The implementation of the idea obviously depends on political cooperation between the countries involved. Existing land-use patterns and regional economic capabilities will also influence the design of megaparks. Despite such logistics (which are beyond the scope of our commentary), the approach allows us to test and apply advances in conservation science to address some of the causes of the elephant problem, thereby replacing the symptomatic treatments applied to elephant management for nearly half a century.

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