Immunocontraception of the female African savanna elephant (*Loxodonta africana*) in South Africa: from pipe dream to policy

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Abstract

Globally, African savanna elephants have been assessed as 'endangered'. Consequently, additional threats and losses due to human–elephant conflict (HEC) could further exacerbate the species' decline. In stark contrast, South Africa's elephant populations are mostly confined within fenced-in reserves that impede natural processes such as migration. As ecosystem engineers, elephant population growth herein should be limited. Within South Africa, elephant management has evolved as differing wildlife philosophies from utilitarian conservation ('nature for man') to biocentric preservation ('nature for nature') and a combination thereof, have been practiced. Traditionally, both HEC and population control have been largely synonymous with lethal control, i.e. culling. However, with the increase of public or expert input to Policy, lethal control is not favoured by the public. As an alternative, immunocontraception of female African savanna elephants through non-invasive, native porcine zona pellucida (pZP) vaccinations has been employed successfully and is currently adopted in 43 elephant reserves across South Africa. Current legislation now recommends culling as the last population management resort. Newly promulgated legislation calls for wellbeing and welfare to be carefully measured in all biodiversity management decisions taken to minimise threats to biodiversity. As a keystone species, elephant is a direct driver of biodiversity change. Accordingly, and in light of these developments, all population management options, including immunocontraception, must be fully considered in South Africa's largest national park, the Kruger.

Keywords: African elephant, coexistence, decision-making, human-elephant conflict, immunocontraception, lethal control, management, policy, population control, wellbeing.

Introduction

Human–wildlife conflict (HWC) is a multi-species and emerging global concern that is regarded as an escalating and broad-spectrum problem for wildlife conservation (Seoraj-Pillai and Pillay 2017). Within their global and South African-specific review of conflict species, Seoraj-Pillai and Pillay (2017) discovered several high- to moderate-scale conflict species listed by The International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN 2022), including African savanna (*Loxodonta africana*) and Asian (*Elephas maximus*) elephants. In 2021, the global assessment of African elephants was revised, and, for

the first time, both the African savanna and the forest elephant were officially recognised as being distinct and listed separately (Gobush et al. 2021a). The African savanna elephant has declined by >50% in the past 75 years and is now assessed as endangered (Gobush et al. 2021b). This species is regarded as an IUCN conservation priority, and the HWC situation could hasten its risk of extinction (Seoraj-Pillai and Pillay 2017).

Non-lethal mitigation and management actions relevant to species' biological needs are widely regarded as critical to human–wildlife co-existence. This is especially true of long-lived, mega-herbivores such as African savanna elephants, whose movements and behaviours over space and time are driven by human interactions in confined spaces. This is typical within South Africa's enclosed reserves (Delsink 2021). Fences pose significant challenges to both the drivers of elephant behaviours (Evans and Adams 2018) and conservation management (Woodroffe et al. 2014; Evans and Adams 2016). Here, HWC may be exacerbated by increasing elephant density and, thus, elephant population control has become an important focus.

Discussion

In South Africa, the promulgation of the Game Theft Act 105 of 1991 (Presidency of the Republic of South Africa 1991) allowed for the ownership of 'game', subject to national and provincial law. Since the mid-1980s, there has been an increase in the number of smaller, fenced reserves that contain elephants. Ownership and management of these reserves is through various entities, including national- or provincial-level state ownership, as well as communal or private ownership. A survey conducted by the Elephant Specialist Advisory Group (ESAG) (Pretorius et al. 2019) in 2015 reported that there are approximately 78 discrete elephant populations in South Africa. Of these reserves, 57 are privately owned and 21 are state-owned or managed. These include the Greater Kruger Complex consisting of the Kruger National Park (KNP) and nine adjacent private reserves that are open to KNP. The national herd totals approximately 28 000 elephants, with the Greater KNP complex comprising 78% (~21 650) of the total and the balance (22.8%; ~6430) in private/provincial/community ownership.

Elephants have long been the focus of management's attention, especially in southern Africa. Within the KNP, the management of these mega-herbivores has been discussed since the 1940s (Worster 2018) and, recently, was critically reassessed (Biggs et al. 2008; Scholes et al. 2008; Carruthers 2017). The KNP is an excellent case study of the evolution of elephant management in South Africa. During the 1900–1940s, management of the KNP was described as a 'preservationist approach except for those species considered as vermin' and further that this was 'naïve and unsophisticated' (Carruthers 2017, pp. 5–8). Ironically, the 'preservationist' perspective included elephants and other herbivores, but targeted species such as carnivores that preyed on herbivores. During the 1960–1990s, KNP management gained an ecological perspective, but the policy was based on a 'rigid steady state', i.e. set to produce repeatable high productivity year on year for balance and order (Worster 2018). During this period, elephant culling was introduced, marking a significant managemental shift. During the period 1967–1997, a total of 14 629 elephants were culled (Slotow et al. 2008; Whyte 2001a) to maintain the population at approximately 7000 (Whyte 2001b).

The translocation of adult elephants from KNP was initiated in 1993 and, during the period 1994–2006, 741 elephants (502 family group individuals, 128 bulls) were translocated (Grobler et al. 2008). During the latter years of culling, orphans from cull groups were grouped in cohorts and relocated as 'family groups' to new reserves. This led to significant behavioural

abnormalities, and some of the orphan populations have still not recovered demographically, genetically and behaviourally (Slotow et al. 2000, 2008). As a result, only intact family groups were moved subsequently. Currently, elephant translocations from KNP and, secondarily, private reserves, are rarely conducted. From 2001 to 2006, 195 elephants were translocated from outside the KNP to other reserves (Grobler et al. 2008; Pretorius et al. 2019).

Elephant culling is no longer socially acceptable (Lötter et al. 2008; Slotow et al. 2008) and has been further questioned on both ethical and legal grounds (Slotow et al. 2021). Today, there are few suitable habitats available for relocation. As such, this created the need for an alternative option for elephant population control. Since 1996, Humane Society of the United States (HSUS) and Humane Society International (HSI) have funded novel research on the use of the non-steroidal and non-invasive immunocontraception of wild African savanna elephant populations using porcine zona pellucida (pZP) immunocontraception (Fayrer-Hosken et al. 2000). Field trials were initiated in 1996 to test the vaccine efficacy in free-ranging elephants within the KNP (Fayrer-Hosken et al. 1997, 2000). These were successful and a pilot study was implemented to test the vaccine efficacy as a population control mechanism at Greater Makalali Private Game Reserve (GMPGR) in 2000 (Delsink et al. 2002); (Delsink et al. 2006, 2007).

In 2006, the Minister of Environmental Affairs called for a Scientific Roundtable (SRT) to review the management of elephants in South Africa. A summary of this SRT concluded that 'there is no compelling evidence for immediate, large-scale reduction of elephant numbers in the KNP' (Owen-Smith et al. 2006, p. 389). However, it added that 'in some protected areas including the KNP, elephant density, distribution and population structure may need to be managed locally' (Owen-Smith et al. 2006, p. 38). The findings of the SRT led to a further Assessment of Elephant Management in South Africa (Scholes et al. 2008). In 2008, the Assessment was released as a publication, with chapters dedicated to reproductive control, translocation, culling and ethics. The Elephant Assessment culminated in the promulgation of the National Norms and Standards of the Management of Elephants in South Africa (NN&S Government of the Republic of South Africa 2008) in February 2008. This was a significant milestone in elephant management. The NN&S is arguably the single most influential policy document regarding the logistical and practical management of elephants in South Africa. It is commendable that the NN&S acknowledged that elephants should be managed in a manner that recognises the 'persistent and necessary interplay between ethics, the well-being of elephants and conservation and human well-being'; and of their sentient nature, highly organised social structure and ability to communicate' (pp. 8–9). The NN&S recognises immunocontraception as the primary action for population control and stipulated lethal control (problem animals) only as a last resort (Annexure VI). The original NN&S have been revised and gazetted, but later repealed. The revised NN&S await gazetting for implementation, with pZP immunocontraception remaining the recommended method of population control.

In a parallel process, the pZP vaccine and its effects have been researched for the past 25 years (Druce et al. 2011; Bertschinger et al. 2018). Research has included behavioural studies, and no adverse social and behavioural consequences have been reported (Delsink et al. 2013a; Druce et al. 2013). The findings support the efficacy of pZP vaccine in African elephant cows in providing non-lethal, minimally invasive and humane population management method. Currently (2023) in South Africa, ≥1500 female elephants across 43 reserves are enrolled for treatment within the project 'Immunocontraception of free-ranging African elephant (*L. africana*) cows on game reserves in South Africa' as registered by the University of Pretoria's

Animal Ethics Committee (REC 155-19) and managed by the University of Pretoria's (UP) Veterinary Population Management Laboratory (VPML), in line with the NN&S.

However, the road of pZP immunocontraception program from 'pipe dream to a humane policy' for controlling elephant population numbers and human–elephant conflict has encountered many challenges. As mentioned, South Africa's elephant management was facilitated by widely diverging wildlife conservation principles from utilitarianism to biocentrism (Loreau 2014; Ihemezie et al. 2021) over the past decades. After the 'rigid steady state' of absolute numbers in the KNP during the culling era, it moved to a 'landscape management' approach (Ferreira et al. 2017) through 'fear-based methods' (SANParks 2012 to date; SANParks 2013), essentially using deterrents that are primarily based on aversion conditioning to deter or alter elephant movement. This clearly shows that the elephant management approach has diversified. One of the management tools implemented was the closing of many waterholes and artificial water sources in the KNP (Gaylard 2015; Ferreira et al. 2017). Such water sources increase the access to habitat that would otherwise be less accessible to especially subadult and older elephants during dry periods. Today, management is focused on the way in which elephants utilise the landscapes, rather than on the absolute numbers of elephants. To mitigate the effects that elephants may have on the system, methods referred to as 'fear landscapes' (where fear-based deterrents are deployed) are being investigated but are considered by many as controversial (Cromsigt et al. 2013; Bleicher 2017). The fear landscape methodology induces a fear response in elephants through the application of a range of increasingly aggressive methods, such as, for example, from rocks packed around trees, to the introduction of noises, to pitfalls and disturbance culling (SANParks 2013; Slotow et al. 2021). These methods discourage elephants from utilising landscapes within their home range. These 'experimental methods' as they are referred to in the KNP Elephant Management Plan, are included in a generalised and non-specific 'research' clause contained within the still to be gazetted 2018 NN&S. Some methods, such as, for example, disruptive moving, shock collars, lethal shooting and elephant pitfalls (SANParks 2013, pp. 56–58), are controversial because of their aggressive approach and appear at odds with the Policy's Guiding Principles as well as with the Animals' Protection Act 71 of 1962, as they 'wantonly and unreasonably caus[e] unnecessary suffering to any animal' (Slotow et al. 2021, p. 21).

According to Carruthers and others, stakeholder engagement in KNP management has also evolved considerably over the years (Carruthers et al. 2008; Carruthers 2017). When the culling decision was implemented in 1967, it was purely an internal KNP managemental decision, with limited public and KNP Board input. However, approximately 30 years later, the culling moratorium was imposed, and the policy was reviewed with greater contributions from 'external' scientists, the animal welfare movement, and the general public. This stakeholder engagement has certainly contributed to the current robustly voiced contributions during the public consultations on the NN&S.

In a highly publicised court case referred to as the 'Lion Bone case', South Africa's annual export quota for trade in lion bones and derivatives from captive-lion breeding operations for commercial purposes, and the application to declare the 2017 and 2018 lion bone quotas unlawful and unconstitutional, was reviewed [National Council of the Society for Prevention of Cruelty to Animals versus Minister of Environmental Affairs and Others (86515/2017); http://www.saflii.org/za/cases/ZAGPPHC/2019/337.pdf]. In this landmark judgement, Judge J. Kollapen stated that 'our constitutional and legal obligations that arise from Section 24 [of the Constitution], National Environmental Management Biodiversity Act 2004 (NEMBA) and the Plan [Lion Biodiversity Management Plan] require the consideration of animal welfare

issues'. The recently assented National Environmental Management Laws Amendment (NEMLA; Presidency of the Republic of South Africa 2022) bill amends NEMBA, requiring that animal wellbeing be taken into consideration in biodiversity management and in associated decision-making processes (Slotow et al. 2021). The Kollapen judgement and the amended NEMLA bill highlight the importance of animal wellbeing as critical components of animal management policies for all species. In the case of elephant, biodiversity and habitat management are often synonymous with some form of elephant population control, lethal or otherwise. Therefore, wellbeing and welfare must form an integral part of the decision-making process regarding the management of this highly social and sentient being.

Research in and implementation of pZP immunocontraception has made tremendous progress since the initial trial in 1996. This has included demonstrating the efficacy of (1) reducing the pZP dose from 600 µg to 400 µg for primary and from 400 µg to 200 µg for boosters, (2) the application of applying a single booster in Year 1 and (3) the application of a blanket treatment approach in larger populations of unidentified animals. The 100% contraception efficacy achieved in smaller populations is marginally reduced in larger unidentified populations because individuals may have been missed during the repeated vaccinations (Bertschinger et al. 2018). Indeed, population growth rate has been stabilised at between 1% and 3%, compared with an average of 8.9% prior to immune-contraception at GMPGR (Delsink et al. 2013a; Bertschinger et al. 2018). In larger reserves such as Tembe Elephant Park and Addo Elephant National Park, significant impacts on calving rate have been observed (Bertschinger et al. 2018). Reversibility, following cessation of treatment, has also been demonstrated in several cows (Bertschinger et al. 2018; Fayrer-Hosken et al. 2000). Furthermore, no adverse medium-to long-term social or behavioural consequences, nor any significant changes in elephant range use during or after the implementation of immunocontraception (Delsink et al. 2013a; Druce et al. 2013) have been observed. Additional research using faecal progesterone metabolite concentrations (FPMC) as indicators of cyclic ovarian activity in pZP-treated elephant cows has demonstrated that 'contrary to previous expectations, pZP treated cows do not necessarily cycle all year round, as they are likely to show periods of anoestrus during the dry months and especially when severe droughts occur' (Ahlers et al. 2012; Benavides Valades et al. 2012; Bertschinger et al. 2012; 2018, p. 6). In addition, pZP research in horses and donkeys has shown that a high percentage of animals experience a variable period of anoestrus following the first two pZP treatments (Joonè et al. 2017; French et al. 2020). These were important departure points for both the NN&S (Government of the Republic of South Africa 2008, 2018) and NEMLA (Presidency of the Republic of South Africa 2022). The current KNP elephant management policy has evolved from a focus on absolute numbers to managing the way in which elephant utilises the landscape and therefore, the potential impacts. However, it is questionable whether or not the management scales are biologically relevant to elephant (Delsink et al. 2013b), i.e. whether management interventions are driven by elephant-specific spatial and temporal scales and their associated zone of influence, as opposed to the zone of management, and whether the new NEMLA amendments and considerations are fulfilled.

Conclusions

Previously, lethal control was largely synonymous with elephant management in South Africa and, second to translocation, the only available option. Elephant immunocontraception was certainly initially seen as a 'pipe dream' with government and wildlife managers doubtful that high success rates, easy implementation and affordable operational costs would be attainable. However, the advances in pZP immunocontraception research have demonstrated close to 100% rates in efficacy, easy implementation across a wide-spectrum of biomes, population

sizes and reserve conditions, and affordability when measured against other options. HSI has financially assisted some reserves and provincial authorities not only with pZP implementation, but together with other NGOs, the supply and fitment of satellite collars to monitor elephant movements. This simultaneously reduces population growth rates and mitigates against possible human–elephant conflict with communities that surround these protected areas. This demonstrates that pZP immunocontraception has an important role to play in long-term human–elephant co-existence strategies. With culling now gazetted as the last resort in South Africa's NN&S, immunocontraception certainly has become an effective elephant management tool. This has also been recognised by current Policy, with pZP immunocontraception being recommended above all other methods. Of the 43 reserves currently under immunocontraception treatment, 22 reserves have treatment from 1 to 5 years, 11 reserves have treatment from 5 to 10 years, five reserves have treatment from 10 to 15 years, three reserves have treatment from 15 to 20 years and two reserves have treatment from 20 to 25 years, demonstrating consistent and increased use of pZP treatment as the main population management control method in South African reserves outside of KNP (A. K. Delsink, pers. comm.). This reflects on how this methodology has brought about a revolution in how elephant management is seen and facilitated in South Africa. When applied correctly and responsibly, pZP immunocontraception provides an effective, humane alternative to lethal population control, with the alignment of policy, conservation and welfare. This must be uniformly applied across all elephant population management frameworks in South Africa. The pZP elephant immunocontraception journey in South Africa can serve as an important benchmark for governments and wildlife managers alike, encouraging consideration of fertility control for wildlife population management around the world.

Data availability. Information on immunocontracepted treatment populations across South Africa for the project 'Immunocontraception of free-ranging African elephant (*Loxodonta africana*) cows on game reserves in South Africa' are available on request from the UP VPML.

Conflicts of interest. AKD and JJvA are employed by HSI-Africa full- and part-time respectively. MLS is employed by the UP and is the head of the VPML, which receives partial funding from HSI-Africa. HJB is Professor Emeritus of UP.

Declaration of funding. HSI-Africa is a partial funder of the UP VPML. HSI covered expenses for MLS and JJvA to attend the Botstiber Institute of Wildlife Fertility Control's (BIWFC) 9th International Conference on Wildlife Fertility Control. BIWFC covered expenses for AKD to attend and present at same conference.

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