**IUCN Motion: Management and regulation of selective intensive breeding of large wild mammals for commercial purposes**

**Introduction**

This report gives a brief overview of progress in terms of actions undertaken in southern Africa relating to the IUCN motion on ‘Management and regulation of selective intensive breeding of large wild mammals for commercial purposes’ adopted in 2016. It should be noted that there is no coordinated process to address the implementation and reporting on this Motion at an international scale.

**Scientific assessments**

A group of South African scientists has been working on an assessment of the risks of intensive and selective breeding of wild animals on biodiversity and the biodiversity economy of South Africa. Using the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services’ (IPBES) conceptual framework, the potential risks of selective breeding and intensive management of wild animals to South Africa’s biodiversity and the biodiversity economy were assessed. Eight potential risks/issues were identified using the best available scientific literature, information obtained from members of the wildlife sector and biodiversity conservation experts, and a national dialogue process. From these eight potential risks, 19 potential impacts (harms/stressors) were described with specific concerns highlighted under each impact. Each impact was subsequently assessed and scored on the quality of scientific evidence available (extent of the evidence and level of expert agreement), the probability of occurrence within the industry, and the likely impact on an ecosystem and species level respectively. The quality of the evidence was evaluated for scientific rigour using the ‘uncertainty approach’ as used by the UK National Ecosystem Assessment. This approach consists of a set of uncertainty terms derived from a 4-box model and complemented, where possible, with a ‘likelihood of manifestation’ scale. A hierarchical ranking method was used to rank the impacts on a gradient from highest to the lowest impact at an ecosystem and threatened species level respectively.

The report, entitled ‘An assessment of the potential risks of the practice of intensive and selective breeding of game to biodiversity and the biodiversity economy’, is in final draft stage. After expert review it will be submitted to the Scientific Authority of South Africa, who will then use the content to advise the Minister of Environmental Affairs on policy and other matters. In summary, this report concludes that there are several concerns and their associated direct and indirect impacts related to the practice of selective breeding and intensive management of game that pose a significant risk to South Africa’s biodiversity and the biodiversity economy (see Appendix 1 for a summary).

A summary was presented by the lead author as a plenary presentation at the Symposium of Contemporary Conservation Practice in November 2017 ([www.conservationsymposium.com](http://www.conservationsymposium.com)).

A second publication on Intentional Genetic Manipulation as a conservation threat was published in January 2018. This publication specifically makes reference to the IUCN Motion:

Russo, I.R.M., Hoban, S., Bloomer, P., Kotzé, A., Segelbacher, G., Rushworth, I., Birss, C. and Bruford, M.W., 2018. ‘Intentional Genetic Manipulation’ as a conservation threat. Conservation Genetics Resources, pp.1-11.

Abstract

*Wildlife ranching including the hunting, collection, sales and husbandry of wild animals in captivity, is practised worldwide and is advocated as an approach towards the conservation of wild species. While many authors have explored the biological impacts of intensive wild population management, primarily with respect to disease transmission (especially in ungulates and fish), the evolutionary and demographic effects of wildlife ranching have been examined less intensively. We discuss this issue through the case of intensive wildlife management in southern Africa. The genetic consequences of this global practice, with an emphasis on Africa, were addressed by a motion passed at the 2016 IUCN World Congress- ‘Management and regulation of intensive breeding and genetic manipulation of large mammals for commercial purposes’. Here, we highlight concerns regarding intensive breeding programs used to discover, enhance and propagate unusual physical traits, hereafter referred to as ‘Intentional Genetic Manipulation’. We highlight how ‘Intentional Genetic Manipulation’ potentially threatens the viability of native species and ecosystems, via genetic erosion, inbreeding, hybridisation and unregulated translocation. Finally, we discuss the need for better policies in southern Africa and globally, regarding ‘Intentional Genetic Manipulation’, and the identification of key knowledge gaps.*

In summary, both scientific assessments are highlighting significant biodiversity and broader biodiversity economy threats, and both are suggesting policy interventions to reduce the risks.

**Regulation**

Following an increase in number of landowners wanting to engage in the practice of intensive and selective breeding of game in Namibia, the Namibian Ministry of Environment and Tourism has been proactively engaging in processes to review threats, policy and legislation. This process has involved convening a seminar with international specialists, including the IUCN Antelope Specialist Group, and those with experience in the potential issues and risks. Following this various measures have been incorporated into the draft conservation Bill that would make provision for better regulation of the practise of selective breeding, as well as to empower the Minister to regulate the import and export of animals.

In South Africa there have been no policy changes and the practice is still expanding. There is still a strong push from industry for expansion of this practise in South Africa, including seeking to influence government policy and resource allocation through the ‘Wildlife Economy’ initiative. It is believed that at least part of the reason for the loss of hunting market share to Namibia is due to the reputational issues associated with intensive breeding and hunting of captive bred wildlife, including lions; Namibia on the other hand is seen as a destination where animals are ‘wild’ and where fair chase exists.

Provincial conservation authorities in South Africa are still struggling with regulating this issue, in the face of declining resources, increasing demand, and the push for economic beneficiation as part of the ‘Wildlife Economy’ initiative of national government.

**Industry processes**

Within the hunting industry there are some positive developments. The South African Hunters and Game Conservation Association has highlighted, in particular, the reputational and associated economic risks of this practice to the wildlife economy of South Africa. This organisation has also sponsored research into aspects of the risks of the practice of intensive breeding, particularly a scientific assessment of the increase in impermeable fencing in wild systems. This is due for publication shortly.

There have also been interesting changes within the hunting industry with the split of the Professional Hunters Association of South Africa primarily relating to a dichotomy within its members for support for the practice of hunting of captive bred animals. A new organisation representing ethical and professional hunters opposed to such practices has emerged.

A process to develop industry standards and certification has been initiated in South Africa. The intention of the industry-developed and implemented standards are to prevent practices that are extremely high risk, while the voluntary certification standards developed in conjunction with government are intended to allow market forces to incentivise best practice. These processes are at an initial stage but it is hoped ultimately that the certification will reduce some of the risks and this process needs to be supported, including to ensure that it achieves its initial purpose of providing for informed market choice and real incentives for landowners engaged in conservation-compatible practises.

**Challenges/obstacles encountered in the implementation of this Resolution**

Given the economic drivers for intensive and selective breeding there are always going to be tensions and challenges between regulators and industry.

One of the main challenges at present is for governments to have a full understanding of the risks, and therefore justification for and an appreciation of regulatory and market-based approaches required. This will be partially addressed for South Africa when the Scientific Authority release their report and recommendations in 2018, and when Namibia gazette their new environmental legislation.

The other key challenge is to ensure greater transparency regarding activities and products to allow for effective consumer choice e.g. for a prospective hunter to know that the animal in a ‘wild’ area was released there from a captive facility where artificial selection for horn and body size was practiced etc. Presently there is no ready way for hunters or other consumers to get this information.

An overarching challenge is that there is no effective subregional or international coordination or reporting mechanism in place. There has been no progress in this regard, although South Africa has a ‘Wildlife Forum’ that is supposed to discuss some of these issues.

**Future actions needed for the implementation of this Resolution**

There is urgent need to:

1. Create a uniform and coherent legal and regulatory framework, within and across countries, to manage the risks associated with this practice.
2. Develop an effective certification system to allow for consumer choice and for effective incentives for landowners undertaking conservation-compatible practices.
3. Establish an effective international forum or forums (at least at a subregional scale) to discuss issues and recommend common approaches.

Ian Rushworth, 31 January 2018, updated 16 February 2018

Appendix 1: DRAFT summary of issues, impacts, concerns and key findings in terms of the biodiversity risks related to the intensive and selective breeding of game species in South Africa (not for circulation)

| **Issue** | **Impact** | **Concerns** | **Key findings** |
| --- | --- | --- | --- |
| Intentional breeding for selected traits | Expression of deleterious attributes that may lead to physical, behavioural and lethal outcomes | Breeding practices, such as inbreeding, line breeding and artificial selection for specific phenotypic traits, which increase the physical expression of rare alleles, may lead to conditions that could compromise the wellbeing of the individual animal.Where deleterious co-segregating traits are linked to selected genes, i.e. colour genes or horn length, and are non-lethal, they can be transmitted to other individuals within the subpopulation, and ultimately to several subpopulations as a consequence of translocations, increasing their occurrence within the broader population (see Chapter 5). These deleterious traits could lead to lower reproductive potential, as well as an altered ability to adapt to environmental change | Many genes control complex mammalian traits such as coat colour and ornaments. The expression of these genes, the interactions among them, as well as genotype-phenotype-environment interactions need to be investigated for the novel colour variants in the South African wildlife industry. This is imperative for the well-being of the individual animals and for understanding the short-term and long-term consequences for the industry and for the wildlife species involved. Even though there has been little work done on the genetic basis for colour transmission in African game species, it is well established that the selection of specific traits through a process of inbreeding or otherwise is very likely to lead to the expression of recessive deleterious attributes that may lead to physical, behavioural and lethal outcomes. It is further virtually certain that breeding practices, such as inbreeding, line breeding and artificial selection for specific phenotypic traits, for example colour variants, are taking place within sectors of the Wildlife industry. The extent of the impact is likely to be limited to the individual and the specific population if no translocation or selling of individuals takes place. However, where individuals, that carry deleterious genes, are translocated to other populations the extent of the impact may increase to species level. This will however depends on the pattern of inheritance and how many animals in a larger population may possess a specific colour allele. Breeding with the wild type phenotype and unrelated individuals will decrease homozygosity at other loci (and potentially at the loci for e.g. colour) but depending on the breeding success of the animal with the trait, the trait may still persist in the new population. Theoretically we predict that there will be dilution.The level of impact of these concerns will depend on the potential of the affected individual to reproduce. Where the impacts of the deleterious trait are such that it prevents or significantly lowers the potential of the individual to reproduce the impact on the broader population would be insignificant, however the impact on the individual may be high. |
|  | Loss of genetic and allelic diversity resulting in decreased fitness and reduced adaptive potential. | Removal of the process of natural selection, including mate selection and selection by differential mortality will reduce the evolutionary potential of populations to adapt to environmental change, especially in light of environmental and climate change.Using a small subset of the available gene pool (number of founders) and deliberate inbreeding thereafter can result in the fixation of certain genetic traits. Deleterious mutations will tend to accumulate, because selection is less effective in small populations. Both the founder effect and inbreeding result in the loss of allelic diversity (loss of rare alleles).In the short term inbreeding depression can affect birth weight, survival, reproduction and resistance to disease, predation and environmental stress; in the long term it reduces the evolutionary potential of populations to adapt to environmental change. | It is well established with a high level of agreement in the scientific literature that a loss of genetic diversity is highly likely to result in decreased fitness and in the long term reduce the evolutionary potential of populations to adapt to environmental change. It is further virtually certain that inbreeding and line breeding are used in the Wildlife breeding sector as methods to increase certain rare phenotypic characteristics in animal populations and that several colour variant populations were established from very small founder populations. The extent and severity of the impact will however be related to the proportion of animals of a particular species that are in intensive breeding facilities versus the wild. The risk is thus especially high for species with low population numbers in the wild, but much lower for common or Least Concern species. The highest level of impact will be on the individual exposed to these practises. We cannot accurately predict how species will respond to future challenges, however, implementation of sound practices could safeguard populations or species in future. Monitoring of aspects such as genetic diversity, disease risks and outbreaks, etc. should be implemented. |
|  | The mixing of genes from naturally separated gene pools leading to the breakdown of natural evolutionary processes and/or possibly leading to outbreeding depression | Animals that may be less adaptable to current environment due to the loss or gain of genetic traitsHybrid subpopulations may have a greater probability of extinctionHybrids may have negative impacts on native species through introgression | There is good evidence, that with the expansion of the wildlife industry over the past few decades, there has been increased human-mediated movement (translocation) of animals, within and outside their natural distribution ranges, with unclear consequences for the species themselves or their impact on other. Despite many decades of research scientists are only now coming to grips with understanding local adaptation and species responses to various impacts. Thus the concept has been established in the literature but there is still a lack of evidence. However, until empirical evidence is available, one should always use a precautionary principle – some actions cannot easily be undone (e.g. introgressive hybridization leading to extinction of a parental gene pool). The duration of this impact, as evidenced by the bontebok example, can be considered permanent and will impact the entire species.  |
|  | Physiological stress as a result of poorly adapted animals to their current environment | Colour patterns of many species assist in their ability to adapt to their environment and play a role for example in camouflage and thermoregulation. The artificial selection for colour variants, such as black springbok in arid environments, may lead to increased physiological stress as a result of the increased cost of thermoregulation.Movement of animals to habitats outside of their natural environmental tolerance may lead to physiological stress and lower performance. | When specific traits, such as coat colour, are selected using artificial selection, the adaptive value of the trait is seldom considered. This may have unforeseen consequences and is likely to counter natural selection pressures that adapt an animal to its environment. It has been established in the scientific literature that colour variation is likely to influence an animal’s thermoregulation. However, the physiological consequences of different coat hues are poorly understood and both positive and negative consequences have been documented depending on the environmental conditions. It has also been established that colouration may influence camouflage and social interactions such as mate selection. Evidence to support this however is still limited and further research is suggested. The probability of colouration affecting the thermoregulation of an individual and as a consequence the productivity of the animal is likely for as long as the animal is kept outside of its natural environmental tolerance.  |
|  | Domestication of wild species resulting in a loss of their natural ability to adapt to wild conditions. | Process of domestication that in the short term leads to the habituation of animals to humans but in the long term leads to the selection for more timid animals that adapt better to a captive environment and might be less adaptable to wild conditions.Erosion of the social structure and behaviour of intensively-bred animals over time resulting in a loss of their natural ability to adapt to wild conditions i.e. predator naivety.Resource selection and the inability to adapt to changing environmental conditions i.e. droughts. | It is well established in the scientific literature that over time domestication results in diverse phenotypic and behavioural changes to wild animals, including decreased flight responses, increased sociality, earlier reproduction, and modification of endocrine and metabolic systems. The probability that the process of domestication will take place within intensive breeding facilities is virtually certain and the impacts or effects of domestication is permanent with respect to the individuals within intensive breeding facilities. However, the severity of this activity will be related to the proportion of animals of a specific species that are intensively bred versus the wild (more severe for rare animals) as well as the time frame that the individuals are subject to these conditions.  |
| Impacts on wild populations through unsustainable movement of animals from the wild into captivity, introduction and genetic introgression of genetically altered animals into wild populations and increased risk of introduction of species to habitats where they do not naturally occur.  | The natural genetic composition, evolutionary trajectory and adaptive potential of wild populations is compromised as a result of deliberate or accidental introductions of captive populations/animals which have undergone genetic changes. | It is expected that intensively-bred specimens will differ from wild populations as a result of different selection pressures (see Chapter 4). Animals which escape from these intensive breeding facilities could have direct and indirect negative impacts on wild populations. It is further expected that these farmed specimens will have severely reduced life-time fitness compared to wild counterparts with intermediate hybrid fitness. It is not just the target species i.e. those which are intentionally bred, but also parasites associated with these animals that may have undergone genetic modification. The release of such parasites into the wild may impact upon hosts, which are not adapted to these parasites (see Chapter 8). The number of animals with selected traits may become dominant in the wild through sheer mass of presence as the industry grows. The morphological changes that are present within intensive and/or selective-bred individuals do not allow for the species to survive within the wild. These may be as a result of the reduced ability to feed correctly or survive in sub-optimal conditions in comparison to captivity.This change in the genetic composition may result in populations that are unable to adapt to environmental changes and consequently face an increased extinction risk.  | The evidence to support the validity of this impact is established but incomplete as it relates to the wildlife industry. The assortative mating between captive and wild animals may mean that the genetic, behavioural and morphological differences exhibited in captive-bred specimens are not necessarily passed into wild counterparts, however it may result in captive-bred individuals becoming more dominant within the population and thus wild counterparts are eventually reduced. It is a virtual certainty that animals are and will be introduced from captive facilities into extensive systems (the stated intention is hunt such animals), however the impact of these introductions are uncertain at this stage as well as the scale at which these may occur. The evidence presented suggests that introductions of captive-bred specimens, which have an altered genetic composition, is unlikely to impact the broader biodiversity but has the potential to impact rare and threatened species over time. The individual welfare concerns are considered high and such will need to be monitored over time, especially when the evidence confirms that individuals bred in captivity do undergo certain changes in relations to behaviour, morphology and physiology and thus captive-bred game species may exhibit different traits to their wild counterparts. The direction in which these changes occur is also influenced by the selective and methodical management actions undertaken at each captive facility. Appropriate interventions from permitting authorities within the various provinces will be required in order to ensure that such changes do not negatively impact the species. Furthermore, this low frequency of breeding between captive and wild individuals may also mean that any deleterious genetic changes acquired in captivity and expressed in their offspring, may result in a reduced fitness and thus lower probability of survival of these specimens in the wild. The potential for genetic issues to manifest themselves when captive-bred animals are released into the wild is probable and thus a degree of caution and understanding is required. This is an area which would require further research and investigation in terms of game populations in South Africa. It is noted that animals undergo morphological changes as a result of captivity. The impact of small founder populations, often as a result of the cost associated with establishing an initial population, and the selective management actions associated with such, results in an exacerbated time scale. These morphological changes result in animals which may no longer be able to survive in the wild and thus the concern of such being released into the wild being no longer relevant. This does however impact upon the individual’s contribution to the conservation status of the species. In order for such species to be released into the wild successfully, suitable management actions need to be established within captive facilities to limit these morphological changes.  |
|  | Out of range introductions into habitats which are suitable could lead to species becoming established within the landscape thereby impacting upon the habitat and/or local native species | The introduction of species outside of their natural distribution range may have the potential to outcompete indigenous species for available resources thereby contributing to the localised extinction of such species. The habitat into which extralimital species are introduced may be impacted upon to such an extent that irreversible changes occur within the structure and composition of the habitat leading to a reduction in veld condition. This in turn may impact upon indigenous antelope species. Out of range introductions may also result in unintentional hybridisations. | The evidence of this impact is established but incomplete because the impacts have not yet been fully investigated within South Africa and currently rely on theoretical hypotheses. It is virtually certain that out of range introductions are taking place, the scale of which is however uncertain. The intensive breeding of species is unlikely to have any additional net impact over and above that caused by existing out of range translocations between extensive and semi-extensive properties. The evidence does suggest that the introduction of non-native species presents a real threat to biodiversity, this may however be limited to a cadastre level only, especially when such are not managed accordingly. Introductions can provide a degree of conservation value when managed correctly. It is not likely to impact upon the species level, except in instances where out of range introductions result in welfare concerns. This uncertainty should however invoke the precautionary principle to some extent and thus any introductions should only take place after careful consideration and with the necessary interventions available (research into impacts, the ability to remove, etc.) to ensure that irreparable damage is limited. It is suggested that conservation experts do however need to look into the future to address climatic and environmental changes and manage for such as opposed to looking backwards as to which species were present in an area and trying to replicate such. This however does present a number of ethical dilemmas which are beyond the scope of this report.  |
|  | The removal of wild specimens of naturally rare species or species with currently small population sizes, in South Africa or other African countries can lead to population declines resulting in a lower overall conservation status and a higher extinction risk for these species.  | A number of high value game species are being captured from the wild and brought into intensive breeding facilities. For species with small population sizes in the wild or rare species, the continuous sourcing or “leakage” from wild populations will reduce wild population sizes and can increase extinction risk of the species. For species that are not very successful breeders in intensive facilities, new wild-caught individuals have to be regularly brought into intensive breeding facilities. This has a negative impact on the free-roaming or wild populations.For certain high value species, it is cheaper to source animals from other African countries for intensive breeding in South African breeding facilities. This may have a negative impact on populations in those countries as well as the overall conservation status of those species. | The evidence on this impact, specifically with regard to species in the South African wildlife industry (e.g. roan, sable, blue duiker, oribi and cheetah) is established but incomplete (high agreement based on limited evidence). There is a certain level of continuous “leakage” of wild animals into captive facilities (for commercial purposes), and this activity may have an impact on some species, where removals are at unsustainable levels. Some species that are rare or threatened due to small population size, are very sensitive to even small removals from the wild populations. The probability of this activity/impact occurring in the industry is virtually certain, but the impact on broader diversity is unlikely, as it is a scale issue and will depend on the current status of the species in the wild and the sensitivity of the population to removals. It is, however, highly likely that there will be an impact at the species level and where species disappear from the system completely, through the disruption of the targeted species’ ecological function in the landscape.  |
| Significant increases in the extent of impermeable fences with associated negative biodiversity impacts | Fragmentation of the landscape through impermeable fencing restricts movement of free-ranching species and reduces habitat availability | Intensification of impermeable fences fragments the landscape and has a range of negative ecological impacts. Impermeable predator-proof fences for high-value game species reduce the habitat available for free-ranging populations of threatened species such as wild dog (*Lycaon pictus*), cheetah and pangolin (*Smutsia temminckii*). Impermeable fences are often electrified and designed in a way that leads to the unintentional mortality of non-target species. | Fencing in general may have both positive and negative outcomes. Fencing in general whether for game farming or agricultural purposes is a permanent fixture in the South African landscape from a local (property) to a national scale. Impermeable fencing is widely regarded as undesirable and the evidence for that is well established. It is virtually certain that fencing for intensive game farming practices is on the increase, and with increased impermeable fencing comes greater fragmentation of the landscape. For intensive breeding projects (smaller parcels of fenced land) the length of fences per unit area is higher than for extensive areas. The full extent of such fences (smaller parcels of fenced land) is not fully known at this stage. It is highly likely that fragmentation will have a negative impact on broader biodiversity and especially on free-ranging threatened species such as cheetah, wild dog and pangolin which could lead to reduced populationperformance, possible local extinctions and a declining conservation status of the species. Poorly designed electrified fences have been identified as a key contributor to the mortality of non-target species. Electrocution and entanglement are the main causes of mortality. Scientific studies on the impact of impermeable fences specifically for smaller parcels of fenced land do not exist. |
|  | High concentrations of animals in small areas with impermeable fences for intensive breeding purposes results in habitat degradation within such areas | Unusually high densities of animals in small breeding camps may cause overstocking resulting in overgrazing and increased trampling effects, leading to habitat degradation and loss of plant species diversity.Overgrazing and trampling in small camps may result in erosion and loss of soil.Severe grazing patterns may result in an increase of undesirable woody species and some poisonous plant species. Transformation of natural veld to planted pastures with a homogenised structure and composition.Excessive or complete removal of certain vegetation strata such as the woody component from intensive breeding camps.Land intensification practices negatively affects ecosystem functioning and services. | A large proportion of game ranches in South Africa practice intensive breeding of game. They confine these high value species or colour variants in relatively small camps, and it is estimated that the area of game farms currently under such camps is about 6% (or 1 022 785 ha), and it is virtually certain that it will increase in the future. At present, because the activity is largely unregulated, little is known about the number of animals and camp sizes in which high value animals are kept. Although there appears to have been no monitoring of the impacts in these small camp systems in South Africa, there is well established evidence to show that animals kept at densities higher than ecological capacity have a negative impact on veld condition and productivity, habitat integrity and species diversity. It is not clear to what extent supplemental feeding mitigates the impacts related to high grazing intensity, but this will not mitigate the impacts of trampling and hoof action of animals kept at high densities. It is anticipated that a similar trend to what has happened in the Little Karoo with ostrich will happen in other biomes in relation to the intensive production of game, with degradation of habitat in game camps (already estimated to cover more than one million hectares with exponential growth forecast), and with additional areas being required over and above those used for traditional agriculture for the production of feed for the rapidly growing captive population. Some breeders of colour variants do keep their animals in more extensive systems, and from a veld management perspective, there should be no negative impacts if this is within the ecological capacity of those environments.It is highly likely that homogenisation, and therefore degradation of habitats, irrespective of the way in which it occurs, generally will have a negative impact on biodiversity. To date very little research has been conducted in this field at the scale where concerns have been raised but it is highly likely that sensitive and threatened habitats and non-target species will be adversely affected. Target species farmed with are however unlikely to be affected.  |
| The intensification of management practices and subsequent control of species that are likely to impact negatively on the commercial objective of breeding programmes. | The killing of predators and other conflict species may result in a reduction in population numbers or elimination from certain areas with limited opportunity for recolonization, which in turn may lead to a change in the conservation status of the species and thereby furthering the extinction risk of these species.  | The control of predators and other perceived damage causing animals within the agricultural, communal and more recently the wildlife ranching landscape is well documented. The high economic value of species bred in intensive systems is likely to perpetuate the problem of indiscriminate killing of perceived damage-causing animals. Predators are not the only species deemed to increase human-wildlife conflict within the game ‘ranching’ sector. Species that may be the cause of increased management interventions and potentially lower profit margins may also be targeted through systematic control and removal. The population sizes of large apex predators are by implication small and as such the indiscriminate and uncontrolled killing of these species is likely to result in population declines, thereby furthering the extinction risk of the species and reducing sustainable utilisation opportunities. Removal of top-order predators from systems can have effects at an ecosystem level, cause trophic cascades and meso-carnviore release. This in turn can cause increased human-carnivore conflict and increased losses, in particular to sheep and goat farmers which are more vulnerable to meso-carnvore pressure. | It is well-established and virtually certain that the destruction of predators and other ‘problem animals’ is unlikely to decrease within the current economic climate and high value of intensively and selectively bred game. The return on investment in intensive breeding and breeding for colour variations is still such that entrants into the market will continue to invest and thereby ensure that predators or other species likely to impact upon animals considered as an investment, are removed from the system. Bothma ([2005](#_ENREF_50)) cited in Boast ([2014](#_ENREF_41)) further suggests that the low breeding rates and decreased survival of colour phenotypes may result in blame being attributed to carnivore damage and thus increased intolerance towards these species. It is well-established that the intensive management and control of predators is occurring within the wildlife industry, and will continue as long as these activities are undertaken. However, the impact on the target species will be evident long after the activities are no longer considered viable. It is further likely that these actions will occur throughout the areas in which these activities are undertaken. The removal of predators or considerable reduction in numbers will likely have an impact upon the conservation status of these species. It is however the responsibility of both conservation agencies and landowners alike to ensure that this is avoided. Pitman *et al*. ([2016](#_ENREF_297)) indicates that the current leopard population in the Limpopo province is declining as a result of various factors – illegal offtake (snaring, poisoning and illegal hunting), hunting and those removed as damage causing animals. It is not feasible to conserve large predators only within the confines of formal protected areas and thus landowners within the broader agricultural landscape need to become custodians of such species rather than adversaries.  |
|  | The disruption of social structures of species targeted for removal may exacerbate the conflict potential, as a result of the constant removals of individuals as well as within the receiving environments. This in turn could lead to a decline in the survival rate of the affected population. Constant removals of dispersers may further lead to a loss or disruption of dispersal opportunities, thereby increasing the local extinction risk. Relocations may increase conflict and reduce reproductive performance and increase mortalities. | The constant removal of predators has the potential to disrupt social hierarchies of other predator species. This in turn may exacerbate conflict leading to further declines of predator populations. The survival of removed problem predators may be low in the receiving environment and may result in increased intraspecific competition as well as increased losses in the receiving environment with the decreasing availability of safe areas for relocations. The constant removal of individual predators from within a particular area may result in the disruption of a species social behaviour over a broader area.The continued translocation of problem animals, either predator or other species impacting upon an intensive breeding operation, may disrupt the ecological processes within the receiving environment. Existing populations within the receiving environment may be forced to utilise more resources defending a particular territory than it would have prior to such introductions. This increased resource demand may impact upon breeding success. | The negative attitude towards predators within the agricultural landscape is and always has been present, which has resulted in previous removals and translocations and thus the evidence is well established to support this impact. These ‘control’ options of predators from within areas in which intensive game ranching takes place is unlikely to decrease and as demonstrated is highly likely to increase ([Pitman et al. 2016](#_ENREF_297)) as predator management is a key management intervention in ensuring the return on investment is protected. Thus the occurrence within the industry is virtually certain. The impact upon broader biodiversity is likely as predator removal may create an unnatural predator hierarchy and the Meso-predator release theory is well established and the probability of increased conflict between these predators and landowners is high. A further risk is that this conflict may spread into non game ranching areas as well. The impact of predator removal upon the species and individuals is highly likely as a new competitive environment is created. Translocation of problem predators may not always be the most desired option. However, public perception is often the deciding factor. In the event that problem predators are to be translocated, success should be measured by the resolution of the problem caused by the animal and not necessarily the survival of the animal post release, settlement in the recipient area and reproductive output as success may be dependent upon the age and sex of the individual, which factors are often outside the control of mitigation relocations. Post release monitoring at both the release and capture site will assist in determining if the problem has been resolved, as well as ensuring that the same problem has not been created in the release area. In order to ensure that the translocation of predators are not detrimental to both environments it is important to ensure that suitable management actions are implemented. Translocations and predator removal are however unlikely to be undertaken by private landowners and thus the impact of such will last as long as such actions are not coordinated correctly. The potential for conservation agencies and NGO’s to manage the translocation of predators, and associated management actions, will be reliant on the necessary funding. Without which, such translocations will not take place or the impact thereof will not be managed. The risk of inappropriate predator translocations may only manifest themselves long after the event and possibly when further interventions are no longer possible. |
|  | The removal of predators will at a certain scale disrupt predation as a natural process in the broader landscape/environment thereby affecting ecosystem functioning and non-target species | The disruption of natural predation interactions, through the exclusion of apex-predators from the agricultural landscape and the resultant increase of smaller to medium-sized predators. This in turn may lead to a disproportionate impact upon smaller prey species, also potentially increasing human-wildlife conflict. The removal of predators from a system may also impact upon the prey’s inherent fear of predation over time. This may result in the species ability to avoid predators becoming diminished over time.The removal of key species may disrupt certain ecological processes which assist in maintaining equilibrium in the system. This in turn leads to an increased management intervention thereby placing further strain on the system. These increased interventions then in turn impact upon non-target species. Ecological processes take place within a broader landscape context and thus affect more than the cadastral boundary of any one breeding operation. Thus the management interventions increase throughout the landscape as a result of the disruption in one particular area.Historically areas in which large livestock production was maintained contributed to predator conservation objectives, yet the increase of intensive and selective breeding operations is taking place within these same areas, thereby reducing the ability of such to contribute to predator conservation as a result of changing management actions. | The evidence is well established to support this impact, yet the extent to which the removal of predators has on ecosystem functioning within the South African context does require further investigation, but is highly likely that removals will impact biodiversity in general. The removal of predators from the system is virtually certain to occur as has been highlighted by Pitman *et al.* ([2016](#_ENREF_297)). The removal of individual predators is unlikely to have an impact but it is reasonable to suggest that the impact on the species will be present as long as the intolerance of predators within the landscape is present and that a holistic approach to predator management is not employed. Predator populations will always be under pressure as a result of removals which will result in further conservation interventions being required – the moratorium of leopard hunting in 2016 and 2017 being an example of such. This in turn has the potential to further increase the intolerance of landowners to the remaining predator populations. The ability of predators to assist in the removal of weak and or injured animals from a system is beneficial to landowners who operate within extensive systems, which is often not promoted and may also be an indirect consequence of intensive management of predators within smaller ranching systems. The impact of predator removal, either apex or meso-predator, and trophic release is a key research question that should be undertaken as a matter of urgency. It is most probable that such is occurring within game ranching areas but the extent is not quantifiable. The potential risk for ecosystem health and functioning is high with possible long term consequences for not only conservation but the economic viability of agriculture as well.  |
| Improper use of stock remedies (animal health products) and veterinary medicines resulting in the development of parasite resistance to these products and to the loss of disease and parasite resistance in host populations | The development of microbial, helminth and ectoparasite resistance to stock remedies and veterinary medicines resulting in microbes, helminths and ectoparasites that may start infesting free-roaming game and livestock on a large scale with conservation and economic consequences  | Game animals in small areas may suffer from higher than normal rates of parasite infection. Game animals in intensive breeding facilities are exposed to anthelmintic and ectoparasiticide treatments, and sometimes antimicrobials, that are seldom necessary and rarely administered according to prescribed dosage rates. Resistance to stock remedies, such as anthelmintics, ectoparasiticides and anti-microbials is of global concern. In South Africa the liberal and improper use of these commodities (by game breeders and veterinarians) is potentially causing a rapid genetic shift to resistance in worm, ectoparasite and microbe populations. Should these resistant populations spill over to livestock the economic consequences for the livestock industry will be significant. There could be a regulatory backlash from Agriculture on both the intensive and extensive wildlife farming/ranching industry, which may have negative impacts on the conservation contribution of this industry. It has been stated by the industry that one of the objectives of intensive and selective breeding is to produce animals for the hunting industry, which would necessitate releasing intensively-bred animals, with high probability of containing resistant parasites, into wild conditions with other wild indigenous species. It is likely that the resistant strains would be transferred to wild animal populations and it is conceivable that these animals may be more impacted by resistant worm, ectoparasite and/or microbes as they have not evolved with such organisms. These wild populations may also transfer resistant parasites to livestock. | The evidence of development of resistance to stock remedies and veterinary medicines is well established in the agricultural and biological literature, but limited studies have been undertaken in the context of intensive breeding, although at least one study in South Africa has demonstrated the development of resistance under treatment regimens commonly used and various experts and industry role players have expressed concern about the development of parasite resistance. It is virtually certain that the risk factors for the development of parasite and disease resistance occur as a result of management practices adopted within a large proportion of the industry based on a broad understanding of current practices. Whilst there has been no assessment nor current evidence of the role of intensive breeding on the spread of resistant parasites to the broader agricultural and natural systems it appears likely that this could happen. It is unknown whether resistant parasites would be more damaging to natural populations of wildlife than non-resistant strains, but it is likely to have direct negative production and economic consequences for livestock agriculture and other intensive breeding operations, and (in the absence of interventions) likely to have indirect negative consequences for the broader wildlife economy and biodiversity conservation through increased agricultural regulatory oversight and restrictions placed on the movement of game. It is possible (about as likely as not) that game species, where a large proportion of the population is contained in intensive breeding facilities, could be affected through the development and spread of resistant parasites, but unlikely to be an issue for species where a significant wild population undergoing natural selection still exists (unless resistant parasites and diseases have a more negative effect than non-resistant strains). It is very likely that individual properties where parasite resistance has established will be more difficult or costly to continue intensive breeding or to get back into agricultural production should the need arise. |
|  | Disruption of the process of natural selection in terms of host-parasite evolution with resulting loss of disease and parasite resistance within the game population | In nature, parasites and host animals are in a continual ‘arms race’, and parasites and disease are very important components of natural selection. Host animals in the wild and in agricultural production systems will always be exposed to parasites and diseases. In many cases early exposure to parasites and diseases results in the development of individual and herd immunity. In nature, differential mortality (natural selection) results in perpetuation of genetic lineages of species more resistant to such diseases and parasites. The nature of intensive breeding (confined areas, desire to minimise mortality and produce bigger and faster growing animals) necessitates and incentivises intensive and ongoing control of helminths and ectoparasites.The control of helminths and ectoparasites in intensive breeding operations compromises the ability of game animals in both the short and long term to cope with parasitic organisms, leaving the individuals and populations vulnerable to a continuous shift towards lack of resistance to parasites. The process of inbreeding, used to maximise the expression of human-desired traits, may reduce the genetic diversity and hence disease and parasite resistance of animals. In intensive breeding operations natural selection for disease and parasite resistance will almost certainly cease to operate. Such game animals are likely to suffer high levels of mortality when/if released into the wild, and will have to be farmed like livestock with continuous disease and parasite management, further entrenching the domestication process. | The evidence for loss of disease and parasite resistance within the game population is established but incomplete. There is a strong theoretical basis for expecting the loss of resistance over time based on the removal of natural selective processes. It is virtually certain that the risk factors for the development of loss of resistance at an individual and herd level to parasites and diseases occur as a result of management practices adopted within a large proportion of the industry based on a broad understanding of current practices. It is unlikely that loss of resistance in populations kept under intensive conditions will have broader biodiversity or species impacts as any animals that escape or are released into wild conditions under natural selection are likely to suffer higher rates of mortality. However, translocation of intensively-bred animals onto other properties is very likely to result in receiving properties implementing the same parasite and disease controls that initially lead to both parasite resistance to stock remedies and veterinary medicines and loss of disease and parasite resistance in game populations (see Chapter 9), thereby further exacerbating and accelerating both of these impacts. It is highly likely that species where a large proportion of the population is contained in intensive breeding facilities will lose resistance and be at risk, but unlikely to be an issue for species where a significant wild population undergoing natural selection still exists, unless selected phenotypic traits are positively linked to fitness in the wild, while having linked to genes resulting in reduced resistance (unknown but unlikely). However, natural selective processes are increasingly being removed or moderated on properties outside of intensive breeding properties, in which case it is more likely that non-resistant individuals will pass on their genes to wild populations making the broader population more susceptible to periodic disease or parasite outbreaks. |
| Improper use of stock remedies (animal health products) and veterinary medicines resulting in risks to consumers | Venison from intensively bred game may be contaminated by antimicrobials, ectoparasiticides, anthelmintics and/or anti-inflammatory agents, thereby posing a health risk to humans; intensively produced venison may not be as healthy as wild venison, potentially damaging the brand image and value of extensively produced venison | Game animals in intensive game breeding operations are exposed to anthelmintic and ectoparasiticide treatments, and sometimes antimicrobials that are very seldom necessary and rarely administered according to prescribed dosage rates. In addition, the desire for animals with larger bodies and horns (current) and faster growth rates (linked to plans for maximising meat production) may promote the use of growth enhancing supplements in game feed.This may result in undesired (qualitative and quantitative) residues of such chemicals in venison that is marketed locally and internationally. Should undesired residues be identified in foreign markets it could severely jeopardise South Africa’s position as an exporter of venison, placing further risk on the extensive wildlife ranching industry.The stated intention of the industry is to move towards intensive venison production. The high stocking rates and high levels of physiological stress associated with such intensification will result in the ongoing need for use of stock remedies; growth supplements such as beta-agonists are already being used to increase body and horn size. These may pose a risk to human health unless appropriately managed and monitored.An indirect risk to extensive game farmers is that they may be subject to increased regulatory oversight (and hence costs) as a result of the need to manage intensively bred game meat entering the market; the value of their brand as ‘‘untainted by modern farming practises’’ will almost certainly be at risk in the medium to long term. | The evidence for health risks to humans or damage to the brand image of venison is established but incomplete. It is virtually certain that current management practices adopted within a proportion of the industry could contribute to this risk, however at present it is presumed that little venison is entering the formal market from intensive breeding sources, although increasing volumes of meat from intensively-bred animals offered for put-and-take hunts may be increasing the health risk for hunters and staff. In future there are plans to produce significant volumes of venison under intensive conditions for the national and international markets; if issues of meat safety are not properly managed it is likely that the damage to the brand of South African venison will have a negative effect on the profitability of extensive game ranches (largely compatible with biodiversity objectives) thereby indirectly likely to have negative biodiversity impact. There are unlikely to be any species or population level impacts, other than through the broader indirect biodiversity impact already discussed. |
| Increased use and misuse of pesticides including herbicides, insecticides and acaricides as defined by the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, Act No. 36 of 1947 and hazardous substances (toxins) as defined by the Hazardous Substances Act, Act No. 15 of 1973 and excluded from Act No. 36 of 1947 | Off-label use of pesticides and unlawful use of hazardous substances cause mortality of indigenous species resulting in changes in ecosystem functioning and increased threats to the conservation of threatened species | The misuse of pesticides and hazardous substances to control damage causing animals including predators, birds of prey, primates and warthogs is common practice within a certain sector of the game breeding industry. Carbamate and organophosphate insecticides are generally misused, while sodium monofluoroacetate is increasingly being used unlawfully. This not only threatens mammalian predators and scavengers but also avian predators and scavengers. Chemicals implicated are aldicarb, carbofuran, methomyl, cadusafos, fenamiphos and sodium monofluoroacetate; at this stage there are no records of cyanide use, but it is not unlikely that is may feature in the future.Red-billed oxpeckers (*Buphagus erythrorhynchus*) are on occasion targeted with direct attempts to poison them when they impact on game in small enclosures. Organophosphate acaricides are implicated in these unlawful actions.The secondary effect of pesticide and hazardous substance misuse in connection with poisoning of animals is that of poisoning non-target animals: scavenging raptors, other birds that scavenge such as Marabou storks (*Leptoptilos crumeniferus*), southern ground hornbills (*Bucorvus leadbeateri*) and white storks (*Ciconia ciconia*), and scavenging mammals such as hyenas, aardwolf (*Proteles cristatus*) (that scavenge maggots), small predators and even rock monitors (*Varanus albigularis*). Vultures of all species, Bateleur eagles (*Terathopius ecaudatus*), tawny eagles (*Aquila rapax*), Verraux’s eagles (*Aquilla verreauxii*) and to a lesser extent martial eagles (*Polemaetus bellicosus*) are species that are either poisoned directly or indirectly as a result of pesticide and hazardous substance misuse. As the trend to breed small antelope increases it can be expected that direct persecution of large raptors will increase. Avermectin type anthelmintics that are ingested pass through rapidly and are deposited in the dung, posing a severe risk to dung beetles. The increased use of herbicides to eradicate trees and shrubs in overgrazed areas, along fence lines and in woodlands/bushveld where landowners endeavour to change the plant ecology to more open savanna-type vegetation, is an increasing trend. Soil sterilant herbicides with a very long half-life and significant potential to leach laterally, such as bromacil and tebuthiuron, are used by individuals often without any knowledge of the potential impacts. Eradication of vegetation is also done with non-selective systemic herbicides such as glyphosate in sensitive areas like riparian zones and steep slopes. | The evidence for negative biodiversity impacts resulting from the off-label use of pesticides and unlawful use of hazardous substances is well-established. Owing to the illegal nature of the activity it is however difficult to assess the probability and extent of occurrence of this issue within the intensive and selective breeding sector of the wildlife industry, but instances of this are have been documented, reported or strongly suspected. The frequency of occurrence is likely to be proportional to the growth of the industry, but the likelihood of it taking place at an individual property level is unknown. It is also known that off-label use of pesticides and unlawful use of hazardous substances takes place in extensive wildlife and agricultural contexts, and it is unknown whether the extent of occurrence is any higher in intensive and selective breeding operations, although there is good reason and some evidence to suspect that intolerance of predators is higher due to the higher values of the game (see Chapter 7), and hence it is anticipated that the use of poisons (as well as other methods of controlling predators) will be higher, but there are competing explanations. It is known from other work that only a very small proportion of carcasses in the landscape (0.4 – 0.7%) need to contain poisons in order to result in massive population declines and even extinction of vultures ([Green et al. 2004](#_ENREF_164)). It is therefore very likely that any off-label use of pesticides and unlawful use of hazardous substances in the sector will have severe negative impacts on biodiversity and species, particularly on rare or threatened species and on the predator and scavenger guilds e.g. leopards, vultures.The clearing of vegetation, through chemical and/or mechanical means, to enhance production could be having significant impacts on biodiversity especially where this takes place in threatened or under-protected ecosystems. In many cases the extent of modification could actually constitute indigenous vegetation ‘clearance’ in terms of the NEMA Listing Notice 3. It is essential that it is clear at what point vegetation modification triggers the regulations and where environmental authorisation is required, especially where it is motivated as managing ‘bush encroachment’. |
| The practice of intensive and selective breeding of indigenous game animals may have negative impacts on South Africa as a hunting destination and on the role of hunting in social and economic development and the conservation of wildlife | Shooting of intensively and selectively bred game may contribute to reputational risks for the hunting sector that can lead to negative economic and conservation outcomes for the broader wildlife industry | Shooting of intensive and selectively bred game is perceived negatively by important stakeholders and poses a reputational risk to hunting and other sectors of the wildlife industry.Reputational damage resulting from shooting of intensive and selectively bred game have economic consequences.Responsible hunting has conservation benefits and these benefits are threatened by reputational damage to hunting. Absence of mechanisms to communicate credible market information on the conservation contribution of game populations and hunting activities can compound reputational risks to responsible hunting and game ranching. | This assessment confirmed that, with increasing pressures on natural resources, there is mounting pressure from the public at large that enterprises should better demonstrate that their practices are in line with international principles of sustainability and that they are socially responsible in utilising the natural resource base. This assessment however demonstrates that the various sectors within the wildlife industry have different levels of understanding and acceptance of these realities and principles in evaluating their own activities for future growth. It has been demonstrated that hunting is under increased public scrutiny, with animal rights groups using any possible opportunity to bring hunting in disrepute, with substantive risks associated with perceived irresponsible hunting practices for the individuals involved, enterprises and the sector as a whole. All role players agree that this reputational damage to hunting can have significant negative implications for its sustained contribution to conservation, livelihoods and socio-economic development. Policy makers should be mindful that ignoring this risk, can exacerbate the reputational damage that the industry already experiences with concomitant negative economic impacts for individuals, the various sectors and the wildlife industry as a whole.The majority of prominent, relevant local and international role players in the hunting and conservation fraternities have negative attitudes towards breeding game intensive and selectively for shooting, raising hunting ethics, reputational risk and lack of conservation contribution as the major concerns. This is in line with internationally accepted guidelines for hunting to be seen as sustainable and socially responsible, as captured in several internationally accepted codes of good practice, including guidelines developed by the IUCN. In all of these hunting codes, the management of source population and their habitat forms an integral part of responsible hunting. The intensive and selective game breeders however do not support the notion that their practices contribute to reputational damage of hunting especially if done according to internally developed standards. Illegal hunting and animal right activism are seen as the major causes for reputational damage.There is general agreement that the lack of a generally accepted mechanism that communicate credible market information on the practices of role players in the value chain can reduce reputational risk. Theory on reputation management and this assessment suggests that such a mechanisms should address both the conservation contribution and sustainability of management practices of source populations and hunting activities to reduce reputational risks to like-minded role-players in the same value chain. |
|  | Unregulated change in landuse from conservation compatible extensive wildlife areas to intensive game breeding operations reduce the effectiveness of conservation initiatives with an increase conservation costs to government and society | There is a lack of legal and policy instruments that quantify the nature and extend of intensive and selective breeding operations and their location in sensitive landscapes. The above-mentioned shortcomings impedes the ability of conservation agencies and government to factor in the impacts of the practice in conservation and landuse planning processes. The result is uninformed decision-making with potential conservation and economic implications. | The impacts of intensive and selective breeding on the resource base and biodiversity have been discussed extensively in this assessment. It has been demonstrated that the ecological footprint of these game breeding operations are very different from traditional extensive wildlife areas, even if the landcover may still be near natural in some cases. Associated impacts such as habitat fragmentation, animals killed in fences and reduced tolerance by intensive game breeders towards free ranging threatened predators, are expectedly, of greater concern in near natural and sensitive environments such as areas adjacent to protected areas and wildlife corridors, than in areas already modified or zoned for intensive agricultural practices. The existing shortfalls in policy frameworks that govern landuse planning and environmental impact assessments, results in a gap between the information used to inform policy processes and what is happening on the ground. This limits the ability of government to address the impacts of intensive and selective breeding operations on biodiversity associated with natural landscapes and extensive wildlife areas that:* forms the basis of wildlife-based tourism and hunting, the biggest contributors to the wildlife economy;
* forms the basis of wildlife corridors, private sector contribution to national conservation targets and the national protected area strategy, wherein protected areas can function as drivers in the rural economy; and
* generates ecosystem goods and services, which in South Africa, amounts to R73 billion per annum, or equivalent to 3% of the country’s GDP (SANBI, 2010) and that fuels the economy.

In the absence of a policy framework to prevent or at the least mitigate these impacts, the direct and indirect costs to government may be significant. |