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A Framework for the Ex Situ Reintroduction  
of the African Lion (*Panthera leo*)

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**Abstract**

Ex situ reintroduction remains controversial in conservation scientific debate and practice, and is regarded as a last resort method. It has been argued that this conservational strategy should now be considered, alongside existing in situ practices, for the African lion (*Panthera leo*). The rapid decline of this culturally important species is symptomatic of the impact a burgeoning human population and their related activities have upon the lion. Published evaluations of reintroductions for all animal groups show relatively poor survival rates per se, particularly when the released animal is captive-bred. In this paper we consider contributing factors to failed and successful captive-bred reintroductions and revisit previous ex situ efforts to release the African lion into the wild. Whilst past attempts to release captive lions into the wild are largely undocumented in the scientific literature, they have valuable lessons to offer future undertakings. We propose a framework for the ex situ reintroduction of the lion based on scientific guidance and previous endeavours.

**Keywords:** ex situ reintroduction, African lion (*Panthera leo*), conservation, release

## Introduction

The practice of ex situ animal reintroduction as a conservational tool courts controversy and debate within the biological and social sciences. Regarded as a last resort method, the International Union for Conservation of Nature recommend the strategy is used when either one or both of the following Red List criteria are fulfilled: "When the taxa/population is prone to effects of human activities or stochastic events or When the taxa/population is likely to become Critically Endangered, Extinct in the Wild, or Extinct in a very short time. Additional criteria may need to be considered in some cases where taxa or populations of cultural importance, and significant economic or scientific importance, are threatened" (IUCN, 2009, p. 3). With specific reference to lions the IUCN notes "The lion is a flagship species for Africa in terms of research, tourism and trophy-hunting...the lion is a powerful and omnipresent symbol, and its disappearance would represent a great loss for the traditional culture of Africa (it is used in coats of arms, heroic names of former kings, frescos, names of football teams, tales, proverbs, sayings, etc.) -- even if to live with the lion poses serious challenges for many African communities, especially those bordering conservation areas which protect lion populations" (2006, p. 7.). Classified as 'vulnerable' on the IUCN Red List, human activities have contributed to an estimated 30% decline in the African lion (*Panthera leo*) population over the last two decades (Bauer et al., 2008). The main constraint on lion range has been identified by the IUCN as human pressure, including "human density, livestock density, illegal lion killing and insufficient prey" (2006, p. 13).

Riggio (2012) estimates lions have been reduced to a quarter of their historic range. Of the 27 African countries which have wild lions, only 9 of these are believed to have at least 1,000 individuals, and 40% of the total population of free-ranging lions is in Tanzania. It has been argued that ex situ reintroduction should now be considered for the African lion, alongside current strategies (Abell et al., 2013).

Both IUCN and the Association of Zoos and Aquariums (AZA) provide criteria for implementing reintroductions from captive-source populations. These include sufficient availability and evaluation of suitable habitat for release such that the species can thrive in its former historic natural territory, the threats which led to the species' extirpation from the area have been eliminated, appropriate socio-political agreements are in place to ensure legal protection and tolerance for the animal, financial sustainability for the programme is secured, minimal disruption is incurred upon those in close proximity to the reintroduction area, and that there are no adverse consequences for populations of domestic animals such as livestock or resident wild populations. Crucially, ex situ reintroduction requires suitable pre-release training and post-release monitoring of the species in question (AZA, 1997; Cheyne, 2006; IUCN, 1998). Despite recognition that ex situ reintroduction now needs to be executed more habitually in species conservation (Clark & Westrun, 1989; IUCN, 2009; Jule et al., 2008; Mallinson, 1995), an apparent poor track record of failed attempts mean it is resisted and marginalised within conservation (Pritchard et al., 2011). Here we consider reviews of previous ex situ reintroduction attempts. We also revisit previous reintroduction efforts for the African lion. Previous efforts in ex situ reintroduction for the lion have not typically been published in peer-reviewed scientific journals. Consequently it is easy to dismiss the evidence as anecdotal. However, we argue that these efforts provide useful insights for the provision of an ex situ reintroduction

programme as a conservational tool for the African lion. We propose that an ex situ reintroduction programme, that meets IUCN and AZA recommendations and heeds lessons from previous captive-source reintroduction attempts, can achieve the objective of producing self-sustaining wild lion populations in areas where it has been extirpated or where numbers are dwindling. Moreover, we propose that this should now be seriously considered for the African lion.

### **Ex Situ Reintroductions**

Reviews of reintroductions using captive-born founders report unfavourable success rates compared to wild-born. Beck et al. (1994) report a success rate of just 11% in reintroductions from captive-bred animals across all groups. In Fischer and Lindenmayer's (2000) assessment of 116 reintroductions published over a period of 20 years, 31% of wild-born attempts and 13% of captive-born attempts were successful. Success was defined as the establishment of a self-sustaining population, although this is not a uniform definition throughout the literature. For example Kleiman (1989) argues success may not rely on the survival of individuals but upon the habitat receiving greater protection as a result. Cheyne et al (2012) note the death of released individual animals does not inevitably mean failure of the whole programme. What counts is that released animals have the same statistical chance of survival and reproduction as their wild-born counterparts. A review of 45 reintroduction case studies found higher survival rates (53%) in wild-born than in captive-born reintroductions (31%) (Jule et al., 2008), but to what extent this constitutes 'failure' for captive-born reintroductions is unclear. There are problems evident in reintroduction attempts per se. Mortality is high, with many animals dying soon after release (Teixeira et al., 2007). Mortalities in most released animals are caused by human activities such as poisoning and shooting (Jule et al., 2008). Negative human impact also extends to bad management and poor quality reintroduction strategies leading to their failure (Clark & Westrun, 1989). The mortality rate in captive-born reintroductions is further compounded by a higher prevalence of starvation, disease and predation than in wild-born (Jule et al., 2008). Soft-release strategies that entail pre-release training in carnivore reintroductions are therefore important so that instinct and natural behaviours can be developed and expressed (Kleiman, 1989). Unfortunately, hard-releases have sometimes been the reality. Characterised by an absence of pre-release training, hard-releases have meant carnivore reintroductions have become especially prone to failure. Hard-releases can mean dependence upon humans is not curtailed, the animal is ill-equipped to deal with predators, and opportunities to develop hunting skills and dispatch prey have not been given (Griffith et al., 1989; Sharma, 2005). Some researchers have concluded that the requirements so extensive and the captive context so problematic that ex situ reintroduction should not be attempted at all for some species. For example, the impact human imprinting has upon trait selection (McDougall et al., 2006; Sarrazin and Barbault, 1996) and close bonds fostered with humans (Huber, 2010), has led to claims that some animals may better serve their species as ambassadors from within the confines of a zoo.

The conservational merits of ex situ reintroduction have been further questioned on the grounds of their commercial funding (Pritchard et al., 2011). There are of course, purely commercial enterprises involving the African lion where tourists pay to walk lions, cuddle cubs, and where lions

may be part of the canned hunting industry. Conservation organisations have rightly panned such operations as entirely money-oriented with no conservational impetus (Born Free, 2010; LionAid, 2012). In terms of animal welfare canned hunting has been deemed “inhumane, unethical and should not exist” (Ireland, 2002, p. 224). Unfortunately there has been a conflation of these financially-driven business operations with ex situ reintroduction projects that obtain some of their funding through commercial means (such as lion-walking as part of pre-release training). This conflation has meant genuine conservation attempts have been tarred with the same brush as non-conservational captivity practices. Erroneously regarded as ‘cub-cuddling’, the conservational virtues of ex situ reintroduction programmes have been dismissed (Abell & Youldon, 2013; Hunter et al., 2013a; Hunter et al., 2013b). Additionally, ex situ reintroduction has been disregarded as expensive, un-necessary, and detracting funding away from conservation of remaining wild populations and habitat (Cheyne, 2012; Hunter et al., 2012). In the light of declarations such as these, it is hardly surprising that ex situ reintroduction as a conservation tool for the African lion has typically been written off before it has been given the opportunity and time to be fully implemented and fairly assessed.

Evaluations of past attempts have been extremely useful for identifying key factors to successful ex situ reintroduction (based on the establishment of a self-sustaining population). As well as highlighting the importance of pre-release training, crucial components for success include the removal of the original cause of decline and attention to non-ecological factors including socio-political factors and financial viability (Fischer & Lindenmayer, 2000). Success also includes post-release monitoring to evaluate the outcome of the release over an appropriate time-frame. This practice ensures that the development of natural behaviours are checked, socio-political tolerance and financial sustainability scrutinised and ensured, the cause of any mortalities ascertained and documented, and findings published in scientific and popular literature (Chivers, 1991). Furthermore the condition of the habitat should also be assessed frequently post-release (Cheyne, 2006). There are examples of successful ex situ reintroduction attempts documented within the scientific and popular literature, where lessons have been learned from failed attempts, and recommended criteria implemented to achieve a positive outcome.

Oft cited examples of successful ex situ reintroductions include the Arabian oryx (*Oryx leucoryx*) (Stanley Price, 1989), prairie dogs (*Cynomys ludovicianus*) (Shier & Owings, 2006), the American red wolf (*Canis rufus*) (Philips & Parker, 1988), and golden lion tamarins (*Leontopithecus rosalia*) (Beck et al., 1991). However, some of the most documented ex situ reintroduction attempts are for the African lion, although not all of these have been specifically for conservation purposes. Their outcomes have not typically been subject to peer-review and published in academic journals. Consequently it is easy to disregard the significance of these efforts as nothing more than anecdotal. On the contrary, their mixed outcomes offer important insights into ex situ reintroduction for lions in an otherwise scant field of research and practice.

Perhaps the most famous is the reintroduction of large felids, including 17 lions, by Joy and George Adamson. The most renowned of these attempts are the lions Elsa (1956) and Christian (1970). Central to the Adamson’s soft-release strategy was regular exposure of hand-reared cubs to their natural environment and, in later cases, the formation of artificial prides. Adamson reports that

walking cubs through the bush encouraged instinct and fostered the development of natural behaviours resulting in hunting and successful kills (Adamson, 2000). It has been argued that habitat familiarity is more critical in surviving predation than experience with the predators themselves (Wolf et al., 1996). The benefits of a pride structure are well documented in lions. These benefits include coordinated hunting (Packer, 2010; Stander, 1992), communal nurturing of young (Packer & Pusey, 1997; Pusey & Packer, 1994) and defence of a high quality territory (Mosser & Packer, 2009). Consequently ex situ reintroduction should include the provision of a stable cohesive pride structure to improve the survival chances of released lions (Bertram, 1998). Whether the Adamsons were successful depends on how success is defined. What they did achieve was wild release of captive-reared lions that could function as a pride, defend their territory, raise their own cubs and hunt their own food (Adamson 2000, Bourke & Rendell, 2009). In some cases these lions went on to produce wild-born cubs who themselves later reproduced. But there are failings also. For example, Elsa contracted babesiosis believed to be caused by stressful interactions with wild lions (Githaka et al., 2012). She died aged 5 years. Moreover, it seems Elsa was not sufficiently averse to humans and local tolerance for her and her cubs was low (Adamson, 2000). Tony Fitzjohn aided the Adamsons for 18 years at Kora in Kenya and went on to use these techniques at Mkomazi Game Reserve, where he continues to be involved in reintroducing and rehabilitating a range of carnivores including the African wild dog (*Lycaon pictus*) (Fitzjohn, 2011). This project reports 'partial success' (African Wildlife Preservation Trust). Following George Adamson's murder, Gareth Patterson (1989) rehabilitated three of his young lions; Batian, Rafiki and Furaha. In doing so, Patterson not only utilised Adamson's techniques but also extended knowledge about lion behaviour including territory size, range of prey, and the age at which lions could begin to successfully hunt their own food (Patterson, 1994). Patterson estimated an increase in Tuli, where he reintroduced Batian, Rafiki and Furaha, from 25 lions to 43 (Patterson, 1994). Batian established his own territory and pride, siring his own cubs. However, Batian was illegally shot by trophy-hunters aged 3 years. Furaha and two cubs were also later shot. Park warden Norman Carr hand-reared two young cubs, Big Boy and Little Boy, after their mother had been shot in Kafue National Park, Zambia. He frequently exposed both cubs to their natural environment by walking them, leaving them outside as much as possible and feeding them whole carcasses. He reports that the cubs learned to hunt for themselves, resulting in successful kills. It was when they could defend themselves and their kills against wild lions that Carr released them in 1961. Carr never saw them again, but had raised two lions that could feed themselves and defend their territory (Carr, 1962).

We could consign these accounts to history and anecdote. They are not perfect templates of how ex situ reintroduction for the African lion should be achieved. Nor are they written in a standard scientific style subject to rigorous scrutiny. However, they do offer field insights. They were successful if we define success as the reintroduction of self-sufficient lions that could survive in the wild and reproduce. Today, attempts at ex situ reintroduction for conservation of the African lion need to take into account not only behavioural and environmental factors for the survival of released lions, but also the wider socio-political human context in which lion populations have crashed.

## **Implementing Lessons**

Previous ex situ reintroductions including those for the African lion such as those described above, should inform future attempts. They are extremely useful for developing a framework upon which to develop conservational strategies for protection and restoration of the species. The aim of such an initiative should ultimately be to establish socially cohesive and stable self-sustaining wild-born prides from captive-bred founders. Their chance of survival and reproduction in the wild should not differ from that of wild-born lions.

Captivity brings with it advantages as well as concerns. As free-ranging lion populations have got smaller and increasingly geographically fragmented, the threat of inbreeding depressions as well as epidemic and endemic disease has intensified (Riggio, 2011, 2012; Trinkel et al., 2011). A benefit of captivity is that reproduction rates, genetics and disease can be carefully controlled. Lions can be appropriately housed to prevent inbreeding and over-reproduction. Breeding rates can be matched to those in wild prides. Diseases can be vaccinated against (e.g., rabies, feline rhinotracheitis, feline calici and feline panleukopenia), treated, and health-checks regularly undertaken in line with internationally recognized veterinary, animal husbandry, and ethical standards (e.g. African Lion & Environmental Research Trust, 2010).

Past ex situ reintroductions for the lion emphasise the significance of pre-release training of hand-reared lions. These efforts highlighted the importance of familiarising young cubs with their natural environment and developing instinctive behaviours for survival. Consequently any ex situ reintroduction programme for the African lion must involve adequate opportunity for this to occur in captive-born lion cubs. Walking captive-bred cubs in their natural environment builds familiarity and confidence to negotiate a complex terrain, and also enable the development of hunting behaviours as they encounter natural prey species on their daily walks through the African bush. Walking with other cubs and human handlers provides a pride structure. Stalking is an instinctive behaviour in felids, and requires opportunity for expression if it is to be used effectively (Schaller, 1972). Evidence shows that between 12 – 18 months, cubs are able to bring down and kill a range of prey (Adamson, 2000; African Lion & Environmental Research Trust, 2010; Fitzjohn, 2011; Patterson, 1994; Schaller, 1972). Predominantly nocturnal hunters (Packer, 2010; Schaller, 1972) lions also require exposure to their natural environment at night to hone their skills. These initial regular daily walks will provide some of the pre-release training recommended by Kleiman (1989) for successful carnivore reintroduction. A pride structure is put in place hence facilitating social interactions between young lions, and instilling reassurance and confidence to explore a natural habitat. It also exposes young lions to prey, fostering the ability to find and obtain food. Moreover, it offers young cubs a stress-free environment to facilitate play behaviours important for cognitive, neural and social development (Ncube & Ndagurwa, 2010; Schaller, 1972; Smith, 1982)

As cubs reach 18 months of age and become increasingly more proficient in hunting, dependence upon humans needs to be curtailed. Moreover, the opportunity for a pride to work cooperatively in successfully bringing down big prey should be given. Wild lions are capable of killing large game by the age of 2 years (Schaller, 1972; Scheel & Packer, 1991). Large ecologically managed fenced area stocked with game, both large and small, can serve this purpose. Patterson's (1994) use of technology in radio-collaring his reintroduced lions provided helpful information about

their movements. Such technology means lions released into large fenced areas can be tracked and studied from a vehicle to provide valuable information on hunting, territorial behaviours, locomotion within the site, social interactions, condition of the lions, and the release site quality. This provides valuable comparative data with wild prides, such that the 'naturalness' of behaviours and performance of lions as a result of pre-release training can be assessed. Release into a large managed site contributes to addressing the problems of starvation and the non-curtailed human dependency, which have characterised previous carnivore ex situ reintroduction attempts (Jule et al., 2008). Furthermore, this allows for the establishment of a stable and cohesive pride structure in captive-bred lions.

Although carnivores may become proficient hunters, the inability to deal with competitive species effectively has resulted in failure for many ex situ reintroduction attempts (Beck et al., 1994; Kleiman, 1989). Consequently, once a pride is stable and hunting successfully, exposure is needed to competitive species. Playback experiments have offered some interesting insights into responses of cheetahs (*Acinonyx jubatus*) to competitors such as spotted hyena (*Crocuta crocuta*) and lions (Durant, 2000), and lion responses to wild dogs (*Lycaon pictus*) and spotted hyena (Webster et al., 2010). They can also offer vicarious experience of competitors to a naïve lion population and an opportunity to monitor responses. Lions also require experience with those competitive species they would encounter in the wild. In an ideal habitat lions require fenced areas of at least 40km<sup>2</sup> in size, consistent with home ranges found in the wild (Bertram, 1998; Schaller, 1972). This allows for the introduction of some competitive species as well as game. With the sustained removal of human contact, this now stable pride can continue to develop hunting skills as well as anti-predator defence to protect territory, food and cubs born to the pride.

Previous ex situ reintroduction attempts for the African lion have released the captive-bred animal itself, following a period of training. However, the endurance of human imprinting have arguably compromised these efforts. Therefore, we argue it is the cubs born to the captive-bred pride that should be candidates for reintroduction. Sarrazin and Barbault (1996) note that traits which result as a consequence of human imprinting may disappear in the 1<sup>st</sup> wild-born generation. Consequently, it is this semi-wild-born generation with which reintroduction attempts should be made. Raised by a self-sufficient pride, they will have been taught the necessary skills to hunt, defend, and live as a self-sustaining pride member, without human intervention. At sexual maturity it is these 'cubs' that can be released as a stable social unit into reserves and transfrontier parks in Africa where there are no resident lions or where existing populations have become depleted. Lions can be released as whole prides, or as male coalitions to bring natural gene flow into existing populations population. Alternatively, released lions can augment existing prides and coalitions through the established practice of boma-bonding (van Dyk, 1997).

Prior to any reintroduction the targeted environment will need to be evaluated biologically, ecologically and socio-politically, to establish likely success. This includes suitability of habitat, confirmation of sound ecological management practices, and ensuring local tolerance for lions. Operating a wildlife reintroduction and rehabilitation program for a carnivore in a developing country brings with it particular challenges (Karesh, 1995). These can be practical such as implementing a

complex initiative with limited technological resources. They can also include local community perceptions and attitudes towards the species, its reintroduction, the funding invested, and health risks. On a broader scale, a programme must be sensitive to the political priorities of the country involved (Karesh, 1995). Without local and national community and government support, and sound in situ conservation practices in place, ex situ reintroduction is likely to fail. Consequently such a programme needs to take a holistic approach to lion conservation that tackles the educational, economic, health and socio-political issues that impact upon local communities in close proximity to reintroduction areas. This necessarily involves stakeholders working together to safeguard the reintroduction programme. There has to be a common will and benefit to releasing lions back into the wild in Africa. Current in situ lion conservation practices, such as the Lion Guardians, are valuable in protecting communities and lions through education, employment, and wildlife training (Hazzah & Dolreny, 2007). Fostering political and economic drivers for lion conservation, which are culturally and socially appropriate, is proving successful in areas where such initiatives are implemented. However, the long-term financial sustainability and scalability is a concern where funding relies upon donors (Abell et al., 2013). Reintroductions are also hampered by the cost of implementing them (Teixeira et al., 2007). However, an ex situ reintroduction programme with income streams from commercial sources, can offer long-term financial longevity as well as genetically viable and disease-free lions that can survive in the wild. The development of ex situ reintroduction programmes does not undermine in situ practices but would supplement the gene pool of geographically fragmented and closed populations. Moreover, through commercial activities these practices can heighten awareness for the species' plight (Cheyne et al., 2012). Post-release monitoring of reintroduced lions must be undertaken to not only evaluate the released lions, but also their impact upon the environment and their human neighbours.

## **Conclusions**

We contend that the African lion is now a candidate for ex situ reintroduction. Previous attempts to reintroduce captive-reared lions should not be resigned to history or anecdote but should critically inform future attempts to conserve a rapidly disappearing species in the wild. These attempts offer crucial practical insights into how ex situ reintroduction might work today. Unfortunately its perceived failings, apparent poor comparison with wild-source reintroductions, lack of published scientific evidence, and conflation with non-conservation commercial practices, mean that this strategy is not granted any conservational merit in academia. In this paper we have suggested that the future of lion conservation needs to develop ex situ programmes which would meet requirements proposed by AZA and ICUN, and address previous failings for carnivore ex situ reintroductions (including those for the African lion). Unfortunately, for this to be granted an opportunity for further development and discussion by academics and practitioners, negative attitudes towards this 'last resort' conservational tool will need to subside.

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