

Can Captive Breeding and Release be a Viable Compliment to In-Situ
Conservation in Preventing the Extinction of the African Lion (*Panthera leo*)?

Jennifer L. Majors

University of Denver University College

Capstone Project

For

Master of Applied Science

May 2011

John A. Hill, Ph.D.
Capstone Advisor and Academic Director

Upon the Recommendation of the Department

James R. Davis, Ph.D.
Dean

ABSTRACT

While the conservation of threatened and endangered species continues to be a priority for captive animals, breeding and release programs like the African Lion Rehabilitation and Release into the Wild Program is attempting to increase sustainable populations of African lions in the wild using captive-bred animals. This project focused on the feasibility of these programs as a viable management technique by determining if the young lions in the ALERT program could learn necessary hunting methods, which then could be taught to offspring. This project also examined past release attempts and what factors made them a success or failure. Ultimately, this project determined that breeding and release programs can be a successful compliment to in-situ conservation if strict release criteria are followed.

Table of Contents

Introduction	1
Statement of Problem	1
Goals and Objectives	5
Literature Review.....	6
Habitat and Distribution	6
Reasons for Decline	8
Reintroduction Criteria	11
Reintroduction Attempts	19
George and Joy Adamson’s release of Elsa.....	23
George Adamson’s release of Christian	25
Gareth Patterson’s release of Batian, Rafiki and Furaha	28
Norman Carr’s release of Big Boy and Little Boy	31
African Lion Rehabilitation and Release into the Wild Program	34
Stage One	35
Stage Two	43
Stage Three.....	46
Stage Four.....	47
Community Involvement	48
Results	50
Analysis	50
Evaluations.....	56

Findings 57

Conclusion 59

Appendixes 63

References..... 113

"From the most iconic of its species, the African lion, to the humble grasses of its great plains, wildlife across the continent is facing an ever-increasing fight for survival." – Andrew Conolly, Chairman and Founder of ALERT

Terms

- *Ex-situ conservation*: captive breeding, gene and seed banks, zoos and aquaria and all other forms of maintaining species artificially and off-site.
- *Hard release*: no pre- or post-release training is included before release.
- *Inherent behavior*: part of the very nature of something and therefore permanently characteristic of it or necessarily involved in it.
- *In-situ conservation*: the process of protecting an endangered plant or animal species in its natural habitat, either by protecting or conserving the habitat itself, or by defending the species from predators.
- *Instinctual behavior*: the inherent inclination of a living organism toward a particular behavior; actions that are inherited rather than learned.
- *Introductions*: releasing animals (captive or wild born) where they never existed; usually because old habitat is gone, degraded or not available, but the new habitat is considered suitable.
- *Learned behavior*: behavior or knowledge that is acquired through training or experience rather than being instinctual.
- *Re-establishment*: Re-establishment is synonymous to reintroduction, but implies that the reintroduction has been successful.

- *Reintroductions*: releasing captive-born animals where they once existed. Only successful after the original cause(s) of population decline has been corrected.
- *Re-stocking*: reintroduction of species still existing in the wild.
- *Soft release*: includes pre-and/or post-release conditioning before release.
- *Translocations*: moving wild-born animals from one place to another. Translocation is done when the wild population is in imminent danger of extinction due to habitat alteration.

Introduction

Statement of Problem

The African continent is home to many species of wildlife, but perhaps no other animal is as iconic and a true symbol of Africa as the lion (*Panthera leo*). The lion's image has been presented in advertising and embroidered on family crests and national flags to represent majesty, courage and nobility. The lion is also one of Africa's best known carnivores and a key predator, helping to control the numerous populations of hoof stock species. Millions of visitors travel to the African continent annually to view the "King of Beasts" along with the leopard, elephant, rhino and buffalo, which make up the "Big Five" (SafariNow 2010).

The African lion is the second largest of the thirty-five species of cats, only slightly smaller than the tiger (Bertram 1998, 7). Lions are unique among the big cat species for two reasons: 1) unlike other big cats, adult males and females are very different in appearance, with the males having a large, dark mane around his head, and 2) they are highly social cats, living together in prides, unlike other large cats, which are more solitary (Bertram 1998, 8).

Historically, lions roamed throughout large parts of the African continent (figure 1) and were estimated to number as many as 200,000 in 1975 (Kenya 2004). However, gathering an accurate count of lions has always been a challenging task for researchers because of the lions' low

density, but vast distribution, and because they are primarily nocturnal animals (Bauer et al. 2005).

Some of the best estimates of current lion populations range from 23,000 to 39,000 (Bauer et al. 2005), with the majority of animals living in Botswana, Central African Republic, Ethiopia, Kenya, Tanzania, Zaire, and Zambia (Nowell and Jackson 1996). African

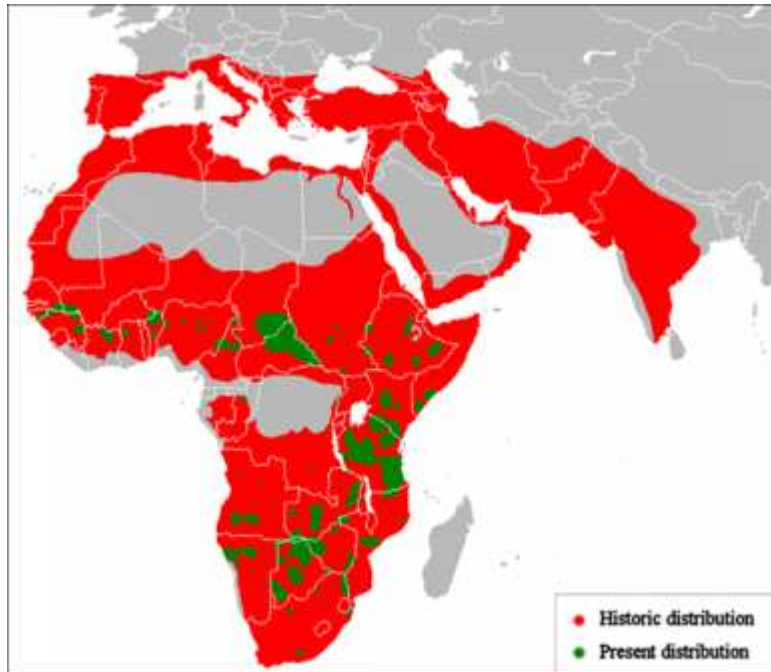


Figure 1. Historic and present distribution of African lions (Pictures of Cats 2010).

lions are considered to be extinct in the northern and southern parts of Africa, having been extirpated from Tunisia and Algeria in about 1891; from Morocco in 1920; and in Southern Africa, they disappeared from most of the Cape Province during the 1860s, as well as from the greater part of Natal (Smithers 1983). They may have survived in the High Atlas Mountains until the 1940s, but they are believed to be extinct, or practically so, in Djibouti, Gabon, Togo, Mauritania and Lesotho (Nowell and Jackson 1996).

Even though completely accurate counts are difficult to gather, experts do agree that numbers are steadily declining and are at an all-time low (Frank et al. n.d.).

This decline has other far-reaching ecological effects as well. Large carnivores such as the African lion are important to the ecology of an area for many reasons. Large predators remove the sick and injured animals from a herd, leaving only the strongest animals to reproduce, which improves the overall health of the herd. Large predators also keep the herds and other prey species alert and moving from one area to another. This is not only important because when the herds move away from an area, the vegetation of the area is able to replenish and produce at a higher rate, which allows for a higher holding capacity, but it also allows a herd to come into contact with other herds of the same species, which reduces the rate of inbreeding (Carr 1962, 39). Without large carnivores, prey species such as impala and water buffalo would increase in numbers, causing detriment to the species and to the area they inhabit.

In an attempt to stop this rapid decline, conservation efforts are underway to protect the African lion. Efforts include habitat restoration projects; efforts to reduce lion poaching and retribution killing; educating local communities about the importance of conservation; and showing those same communities how the presence of lions can be an economic benefit.

These are just a few ways wildlife managers and conservation organizations are working to save lion populations.

Additionally, some organizations are attempting a more ambitious endeavor by reintroducing captive-bred lions into the wild. These projects are becoming more common, but they remain controversial for many reasons. The technical considerations associated with captive breeding and reintroduction include problems with properly preparing and training captive-bred animals for life in the wild, as well as the lack of available and suitable habitat for reintroductions (Chivers 1991). However, faced with rapidly declining lion populations and the need to use more land to sustain growing human populations, these programs, while controversial, are considered by some to be at least an effort. When Dr. Pieter Kat, a consultant ecologist who was invited by the government of Botswana to study lion populations for 10 years, was asked to make recommendations on the conservation and viability of lion populations, he said,

I therefore believe the future for lions is in African hands. If the international community does not offer considered support, I suggest we come up with our own solutions. If governments continue to seek income from trophy hunting at the expense of wildlife resources it is up to us to prevent such greed. If numbers are going to be disputed by different groups, let the governments step in and ask dispassionate experts to determine how many lions remain in their countries, and

then justify off-take on a sustainable basis. Let these same governments decide where they want lions, and, once that decision is taken, vigorously protect these populations. As I said, the future of African lions is in African hands. Let us salute those who have been steadfast to ensure this future, and recognize that any action is better than the currently looming extinction of an African icon if we do nothing. (ALERT n.d. b, 7)

With the improvement of scientific information and data available and a greater understanding of the most effective management techniques, it is evident that captive breeding and release programs can be a viable compliment to in-situ conservation in preventing the extinction of the African lion.

Goals and Objectives

The goals and objectives of this capstone project are to establish that while most in-situ conservation efforts are important and beneficial, species threatened with extinction are merely being bred and maintained in captivity are not necessarily increasing the sustainable populations of these species in their natural environment. However, efforts currently underway to increase the populations of vulnerable, threatened and endangered species can also benefit from ex-situ conservation work such as breeding and release programs, as long as these animals are given sufficient pre- and post-release training and monitoring. In the case of African lions, pre-release

training must include exposing the lions to as many natural hunting experiences as possible so they can acquire the necessary skills to go along with their instinctive hunting behaviors; curbing the lions' dependence on humans to avoid future conflicts; and allowing the lions to establish a natural social pride structure before being released provides the pre-release training necessary. The cooperation of governments and communities in areas selected for release is also essential, as well as performing post-release checks on the animals to ensure the animals' welfare after release.

Since these programs are considered controversial, this capstone project will examine and evaluate past and present release efforts and evaluate methods used in each case, if reported. This project will also examine and evaluate preliminary results from the African Lion Rehabilitation and Release into the Wild Program's breeding and release program, which is currently in Stage two of its four-stage rehabilitation and release program.

The program is based in Zimbabwe, Africa, and uses a four-stage method to release African lions bred within the program into national parks and wildlife reserves. Preliminary hunting data gathered by the African Lion and Environmental Research Trust (ALERT) will be analyzed and compared to wild lion hunting rates, as well as examination of the four stages of the program to determine if the program has a workable plan for long-term success.

Literature Review

Habitat and Distribution

Once widely found throughout the continent, the African lion's recent conservation status is giving cause for serious concern. The most recent population surveys were conducted in 2002 and 2004. The first survey was conducted by H. Bauer and S. Van Der Merwe in 2002 (not published until 2004) in conjunction with the African Lion Working Group (ALWG), a network of lion specialists affiliated with the International Union of Conservation of Nature (IUCN)/Species Survival Commission (SSC) Cat Specialist Group. The second survey was conducted by Philippe Chardonnet and was sponsored by the International Foundation for the Conservation of Wildlife and Conservation Force (ALERT n.d. b).

As seen in table 1, Bauer and Van Der Merwe's population estimate is 23,000 individuals with a range of 16,500 to 30,000. Chardonnet's total

Table 1. Population estimates of African lions

Area	Minimum		Maximum		Estimate	
	Bauer & Van Der Merwe, 2004	Chardonnet, 2002	Bauer & Van Der Merwe, 2004	Chardonnet, 2002	Bauer & Van Der Merwe, 2004	Chardonnet, 2002
West Africa	450	968	1,250	1,358	850	1,163
Central Africa	500	2,092	1,550	3,538	950	2,815
East Africa	8,000	11,268	15,000	18,811	11,000	15,744
Southern Africa	7,500	14,526	12,500	23,425	10,000	19,651
Total	16,500	28,854	30,000	47,132	23,000	39,373

Source: ALERT n.d. b

figure is slightly larger, estimating just over 39,000 individuals with a range of 28,854 to just over 47,000.

Even with the slight discrepancies between the two surveys, most experts agree that these numbers are down from the estimated 200,000-250,000 lions that once roamed from the Atlas Mountains in Morocco to the Cape of South Africa and from the coastal regions of the Gambia to the vast savannahs of Tanzania (ALERT n.d. b). In West Africa, lions number fewer than 1,500 and meet the criteria for Regionally Endangered (IUCN 2005).

Due to indiscriminate killing (primarily as a result of retaliatory or pre-emptive killing to protect life and livestock), over-hunting, and prey-base depletion, coupled with habitat loss as lands are converted for agriculture and livestock use, the population continues to decline. The IUCN agrees with these current estimates of 23,000 to 39,000 and lists *Panthera leo* as “vulnerable” on the IUCN Red List of Threatened Species (Bauer et al. 2008).

According to R. H. N. Smithers, author of *The Mammals of the Southern African Subregion*, “There is probably no other species whose distributional range has shrunk during historical times to the same extent” (Smithers 1983, 392).

Reasons for Decline

Habitat loss, retaliatory and sport killing are some of the leading threats to the existing African lion population. With the expansion of the human population and the correlating expansion of livestock comes habitat losses from overgrazing; the installation of fencing, which prevents migration of native wildlife; and the conversion of wild lands into agricultural

use (USAID 2009). Realistically though, the livestock industry is socially and politically important in developing countries because it provides food and income for one billion of the world's poor, especially in dry areas like Africa and Asia, where livestock are often the only source of livelihoods (Food and Agriculture Organization 2006). In fact, more than 200 million Africans rely on livestock for their income and mechanical power (Cutler 2007). It is not hard to imagine, then, that lions and other large predators are looked at – and in some countries legally classified – as vermin (Frank et al. n.d.).

Because the amount of land needed for livestock is growing, the main sources of the lions' prey – zebra, antelope and other large grazers – are also being squeezed out, causing a decline in the lions' food source (Myers 1975). This, in turn, is causing more human-lion conflicts as lions move into human-populated areas in search of food. Farmers are, understandably, intolerant of lions that consider their livestock an easy food source (Caporella 2010). And, unfortunately, lions do not limit their supplemental food options to livestock. Between 1990 and 2004, lions killed approximately 563 people and injured more than 308 (Packer et al. 2006). Around the world, though, the number of big cat attacks on humans is still considered low when compared with other natural perils (McCarthy 2004).

Human-wildlife conflicts revolving around livestock and game species are two of the most well-known predator control problems worldwide (Graham et al. 2003), and retaliation or pre-emptive killing of lions by rural

people – particularly livestock owners – is considered to be the single greatest threat to lions (Frank et al. n.d.). Any evidence of a lion attack on livestock will prompt pastoral communities to lace livestock carcasses with poison that can kill entire prides of lions, as well as many other predators and scavengers (King 2009). The Maasai culture also contributes to the vulnerability of lions through the practice of *Ala-mayo*, during which a young warrior proves his courage by killing a lion. And, while lions do have some protection afforded them, if people or livestock are killed by lions, it is legal to engage in a lion hunt (Packer 2010). In addition to pastoral people's practice of using poisoned carcasses and spearing, they will even ambush lions at watering holes with various automatic and semi-automatic weapons (The African Lion Database 2002).

Sport hunting is also taking a toll on lion populations; hunters will pay as much as \$80,000 USD to kill a lion (figure 2) (McCarthy 2004).

Trophy hunting in South Africa alone can

contribute as much as \$91.2 million USD annually to the country's economy



Figure 2. Sport hunting in Africa (Hunting Legends 2010).

(CNBC 2010). In Tanzania, the government allows the harvest of approximately 240 wild lions a year from game preserves and other unprotected areas, the highest take in Africa (Tucker 2010).

In economically depressed areas, this large amount of money is more often the deciding factor for wildlife managers rather than conservation of a species. For example, in 2002 on a 21,000-square-mile reserve in Southeast Tanzania, 226 trophy lions were allowed to be hunted to help pay for the upkeep of the reserve (McCarthy 2004). This is especially troubling in light of a University of Minnesota study that suggests African countries with the highest intensity of sport hunting have shown the steepest population declines in African lions over the last 25 years (Packer et al. 2009). The steep population declines are attributed to the hunters' desire to kill the large male lions, often the most dominant member of his pride. Less dominant males are able to take over the pride once the pride leader is killed, and because lions are an infanticidal species, these newly dominant males will kill the young lions so the females will come into estrus sooner and be available for breeding (Packer et al. 2009).

Before reintroduction and release of captive-bred lions can be a viable compliment to the conservation efforts currently working to combat the issues causing the decline of the lion population, it is necessary for program managers to have a good understanding of the available release and reintroduction criteria.

Reintroduction Criteria

With the reintroduction and release of captive-bred animals comes a host of problems and concerns; therefore, there is no shortage of release guidelines and opinions available for reintroduction methods and procedures. Release and reintroduction guidelines adopted by the Association of Zoos and Aquariums (AZA) and the IUCN are two of the most recognized and cited resources.

The IUCN addresses its release criteria in a 1998 report prepared by the IUCN and the Species Survival Commission (SSC). These guidelines state that when choosing a release site and type, consideration should be given to the historic range of the species to be released. For a reintroduction, no wild individuals should remain in the proposed area so as to prevent the spread of disease, social disruptions and the introduction of alien genes. In some circumstances, reintroductions may be required into a fenced or otherwise restricted area, but should still be located within the species' former natural habitat (IUCN 1998).

The AZA writes in its reintroduction guidelines,

Reintroduction should be used primarily to establish or reinforce a self-sustaining native wild population and reintroduction should proceed in habitats where the original causes of threat, e.g. habitat destruction, habitat fragmentation, and/or over-hunting have been eliminated or ameliorated, and where there is minimal probability of serious

pollution, manmade disaster, or exposure to exotic introduced predators, competitors or diseases. (AZA Guidelines 1997)

Regardless of the agency, however, most organizations agree that many factors must be considered before a release or reintroduction attempt can be made, including safe transportation of the animal(s) during pre-release training and to the eventual release site; site suitability, selection, preparation and costs; post-release monitoring; acquiring appropriate expertise; and gaining political and community support (Chivers 1991).

Additionally, M.R. Brambell writes,

Many prerequisites must be met before reintroduction should be contemplated: Does the wild habitat have the capacity to absorb the introduced animals? Does the surplus stock have the right characteristics for release into the available habitat? Can the individual animals involved survive the transition from the support and protection of captive management to the harsh realities of the wild? (Brambell 1977, 113)

In the case of specifically releasing captive-bred lions, critics cite many complications, most notably the previously mentioned conflicts with humans and their livestock, which could develop following release. This could be especially likely of captive-bred lions that might not have learned human avoidance characteristics in their pre-release training (ALERT n.d.a). The IUCN addresses this possibility in its Guidelines for Reintroduction:

Care should be taken to ensure that potentially dangerous captive bred animals (such as large carnivores or primates) are not so confident in the presence of humans that they might be a danger to local inhabitants and/or their livestock. (IUCN 1998, 9)

To avoid these conflicts, pre-release training is a vital component to be met before release. Since most species of mammals and birds learn from the individual experiences they have as juveniles and rely heavily on these experiences for survival, captive-bred animals must be given the opportunity to acquire the necessary information to enable their survival in the wild (IUCN 1998). For instance, the urge to hunt is considered an instinctual behavior for cats; the instinct to stalk and chase is present at birth. This is seen between litter and pride mates in how they play and interact with each other when they are younger (Lion Research Center 2010). However, the skills necessary to actually bring down prey are behaviors that must be learned from actual experience.

Many reintroduction programs have not implemented any pre- or post-release training of the animals. The types and amounts of pre-release training depend on the type of animal being released; however, six main areas of behavior should be evaluated in pre-release training. Candidates for release 1) should be able to avoid predators, 2) should be able to locate and acquire food, 3) should interact properly with others of the same species, 4) should be able to find or construct nests or shelters, 5) should be able to

move around efficiently on different types of terrain, and 6) should be able to orient themselves and navigate in the complex environment that will become their home range (Kleiman 1989).

The overall success of carnivore reintroductions, specifically, requires that released animals be able to find and take down acceptable and appropriate prey; be able to escape from predators; and successfully reproduce viable offspring (Reading and Clark 1996). Of these tasks, teaching an animal the proper response to predators is one of the more difficult. It is often more costly as well because predator response training has to be traded off with other activities, such as feeding, resting or looking for mates (Lima and Dill 1990).

While recent studies have been encouraging, they are still viewed skeptically by wildlife managers who believe that antipredator behavior must be expressed properly the first time it is required, so such responses are thought to be inherent, rather than learned behaviors. Carnivore reintroductions are considered fundamentally more difficult than those of herbivores or omnivores for these reasons (Griffith et al. 1989). Additionally, mortality due to predation is a leading cause of reintroduction failure (Griffin et al. 2000).

When actually releasing or reintroducing animals, it is recommended that only a few animals be released at a time so that problems and difficulties can be recognized and dealt with immediately. Because so much

learned behavior is necessary for survival, it is very difficult to think about training large numbers of animals all at once (Brambell 1977). Once all issues have been dealt with and ultimately overcome, the rest of the animals can be released with fewer unknowns to consider.

In past failed release attempts, animals were not exposed to pre-release training, therefore their dependence on humans was not curtailed and they had no experience with actually hunting and killing prey (e.g. ambushing and intercepting prey) (Sharma n.d.). In addition, some lions were released as individuals rather than in groups. It has typically been reported that prides of lions work together during hunts, giving them an advantage over individual hunters. However, some experts disagree about the true nature of cooperative hunting abilities among prides. In an article written by Craig Packer and Anne Pusey, professors of Evolution, Ecology and Behavior at the University of Minnesota, the authors contend that prides of lions do not necessarily work together to bring down prey. In fact, in a pride situation there are more mouths to feed, and the less dominant the lion the less there is to eat. Since lone hunters are capable of taking down prey such as wildebeest and warthogs by themselves, they are able to reap all of the benefits if there are no other lions to share with (Packer and Pusey 1997). However, Packer and Pusey do agree that other benefits are gained from pride living. Lions are the only social species of big cats, so they depend on other members of the pride for protection, companionship and

mating (Bertram 1998, 29). This communal living also makes lionesses better mothers; pridemates share the nursing responsibilities; and groups of lions can protect their young from invading or trespassing lions. As a result, more cubs survive into adulthood (Packer and Pusey 1997). Brian Bertram, author of *Lions*, agrees that lions have a higher rate of survival within a pride situation and states that prides are generally made up of related females and their cubs, as well as some unrelated males. Since strangers would not typically be permitted to join an established pride, individually-released lions would have a much harder life and lower survival rate (Bertram 1998, 29).

If a program chooses to release individual lions, however, it is important to consider this information. An individual lion may be able to feed itself, but it would face a much higher risk of injury or death when encountering wild lions because prides of lions have been reported killing individual lions that come into their territory (Packer and Pusey 1997), and individual lions would have a much harder time finding a mate and raising young.

Even with all the release criteria available, one of the most important factors to be considered before release and reintroduction of any species is the political and community support for the project. Since lions are considered a nuisance species in many areas, community support must be gained or any animals released will face the same issues that originally led

to the decrease in their population. The AZA addresses the need for community involvement and support in its guidelines:

There should be extensive and early contact between people living in the reintroduction area and the reintroduction planners. Planners should try to understand (perhaps aided by scientific surveys) the needs and attitudes of local residents, should inform them of the rationale and techniques of the reintroduction, and try to gain their support for the program. (AZA Guidelines 1997)

Especially in some of the more politically unstable African countries where potential release sites may be acquired, extensive contact with the local and national regulatory agencies (AZA Guidelines 1997) must be made to ensure adequate land acquisition, government authorization to transport and release animals into national parks and reserves, and to gain some sort of legal protection for the released animals. In fact, a 1982 sociology study performed after the reintroduction of wolves in the western United States emphasizes the need for a community education program. The study showed in political terms, an 85 to 90 percent majority of support for a program would be overwhelming and would seem to signal a high success rate; however, opposition from just 10 to 15 percent could be all that is needed to ensure failure of a reintroduction program (Hook and Robinson 1982). This is due in large part to an anti-predator attitude among citizens who may take

extreme and illegal actions to rid the area of the undesired species (Hook and Robinson 1982).

Finally, conducting several years of post-release monitoring on at least a sample of the released population must also be factored in when considering releases and reintroductions. Without proper post-release monitoring of the animals' behavior and productivity of their environment, the success or failure of the project cannot be determined (Chivers 1991).

Post-release monitoring includes monitoring and recording information regarding animal behavior; adaptation to the area and other wildlife; ecological and demographic studies; collection and investigation of any released animal mortalities; humane interventions to supplement food supplies and/or provide veterinary aid if necessary; decisions for revisions or discontinuation of the program; habitat restoration or protection; continuing with public relations and education programs in the affected communities; evaluation of cost-effectiveness and overall success of the program; and regular publications in scientific and popular literature (IUCN 1998).

To determine the overall success of a program, a combination of the following four criteria are now generally agreed upon as indicating overall program success: 1) successful reproduction by the first wild-born generation, 2) a three year breeding population exceeding adult death rate, 3) an unsupported wild population of at least 500 individuals, and 4) the establishment of a self-sustaining wild population (Jule et al 2008).

Reintroduction Attempts

It is difficult to know exactly when the first true case of a species reintroduction occurred, but in 1907, 15 American bison (*Bison bison*) were released into a newly-established reserve in Oklahoma (Kleiman 1989). Project managers anticipated the need for careful planning to include pre-release health assessments of the animals, strong local community support, and they garnered corporate and media backing (Seddon et al. 2007).

Many other reintroductions have been attempted throughout the years, yet little information has been published. However, Fischer and Lindenmayer assessed a large number of case studies that had been published, as well as theoretical papers on animal relocations (reintroductions were defined by the authors as a type of relocation and it is specifically that data that is dealt with here) that have been published in major journals throughout the world over the past 20 years. Most of the case studies they examined dealt with reintroductions for conservation reasons. This illustrates the popularity and potential value of reintroductions as a management tool (Fischer and Lindenmayer 2000). For the purpose of Fischer and Lindenmayer's review, a reintroduction was considered successful if it resulted in a self-sustaining population (Griffith et al. 1989).

The authors published the following results:

- Reintroductions were the most common type of relocation (116/180) and three-quarters of these were conducted for conservation purposes.
- Reintroduction success was not found to have changed over the past two decades, but reintroductions appeared to be more successful when the source population was wild, a large number of animals were released ($n > 100$), and the cause of original population decline was removed.
- Mammals alone accounted for more than 50 percent of all relocation studies. This may indicate that reintroductions are a particularly suitable conservation strategy for mammals.
- Of the 116 reintroductions, 52 had a captive source population, while 45 had a wild source population. The status of 19 source populations was unknown. The success rate for reintroductions with a wild source population was higher (31 percent) than for reintroductions that originated from a captive population (13 percent).

Overall, of the 116 reintroduction studies examined, 30 (26 percent) were classified as successful, 31 (27 percent) were classified as failures, while the outcome of 55 (47 percent) reintroductions were classified as unknown at the time of publication. They also reported that these trends did not appear to change when only examining reintroductions for conservation

purposes (n=87) with 20 (23 percent) successes, 23 (26 percent) failures and 44 (51 percent) studies with an uncertain outcome (Fischer and Lindenmayer 2000).

The authors point out that it is likely their results could over-estimate reintroduction success. This is because project managers may be more likely to publish their results if they are able to report a "success" (Fischer and Lindenmayer 2000).

Luke Hunter, executive vice president of Panthera, a conservation program working to save big cats, agrees that reintroduction success is low; however, he points out that post-release monitoring has also been low. Therefore, he says, the reasons for failed reintroduction attempts are not well understood (Hunter 1998; Mathews et al. 2005).

Possible reasons for these failed attempts include moving animals into protected areas where there is already an abundance of the same species, causing a saturation of that species. If animals are not able to find sufficient food and other habitat requirements, they tend to leave the area in search of a more a productive space (Hunter 1998). Also, African lions are very territorial and could attempt to return to previous locations after they have been released. Hunter does state that most previous release or relocation attempts have been "hard releases," whereby the animals receive no pre-release training. Hunter explains, however, that research and experience has

suggested that programs incorporating a captivity period at the release site may improve project success (Hunter 1998).

Research studies exist, however, that indicate program successes. For example, the tiger and leopard were considered to be endangered in India in the early 1970s, but since the reintroduction program, Project Tiger, was implemented, populations of both species have increased over a large proportion of their former range (Panwar and Rodgers 1986).

The following reintroduction cases also indicate successful releases of African lions when animals were given proper pre-release training and time in a natural environment.

George and Joy Adamson's Release of Elsa

One of the most well-known and successful releases of a human-raised lion back into a wild environment occurred more than 50 years ago when George Adamson, a senior game warden in Kenya in the 1950s, and his wife, Joy, hand raised Elsa, a lion cub whose mother had been killed (figure 3).

Joy Adamson chronicled the story of Elsa in her book *Born Free: A Lioness of Two Worlds*.

Our plan was this: we would spend the first week taking Elsa, perched on the



Figure 3. George Adamson with Elsa (Father of Lions 2010).

roof of the Land Rover, around the new country, thus getting her used to it and the animals, many of which belonged to species which do not live in the Northern Frontier and she had therefore never seen," Adamson wrote, "During the second week we intended to leave her overnight, while she was active in the bush, and to visit and feed her in the mornings when she was sleepy. Afterward we would reduce her meals, in the hope that this would encourage her to kill on her own or to join a wild lion. (Adamson 2000, 127)

Elsa's first experience with killing an animal of about her own weight was a waterbuck that had been shot, but not killed, by George Adamson. Before the animal fell, Elsa jumped on it and instinctively clamped her mouth around the waterbuck's throat until it suffocated. Joy Adamson commented on this common technique used by lions to kill their prey: "We now saw that she knew the vital spot by instinct and also the way of effecting (sic) a quick death; in fact, she had made use of a lion's normal method of killing prey" (Adamson 2000, 152-53).

Other instinctual behaviors became evident during the Adamsons' walks through the bush with Elsa. "Many times on our walks through the bush we watched her, sniffing the air and then stalking determinedly in one direction until we heard the crashing of big bodies breaking through the woods" (Adamson 2000, 164). Eventually, the Adamsons' were able to leave

Elsa in the bush for longer periods of time, confident that she would be able to find and take down prey on her own.

After spending more than three years with the Adamsons, where Elsa was, initially, completely dependent on them for food and companionship, she proved she could fend for herself by hunting, finding a mate and, after giving birth to her first set of cubs on December 20, 1959, reproducing successfully (Adamson 2000, 219). Elsa later died from tick fever (Bourke and Rendell 2009, 160), but this release attempt is considered to be successful because Elsa was able to locate and acquire appropriate prey, and she was able to mate with wild lions and bear successful young.

George Adamson's Release of Christian

While Elsa's story is the first record of a hand-reared lion being successfully released, George Adamson went on to introduce seventeen lions into the wild, including Christian, a lion raised by Anthony Bourke and John Rendall in a London furniture shop in 1969.

Bourke and Rendall (figure 4) wrote about their experience with Christian and their eventual meeting with George Adamson when they decided Christian should be released back into the wilds of Africa in *A Lion Called Christian*. "George [Adamson] was extremely interested in the experiment of bringing a lion from England for rehabilitation in Africa, and was confident that it would be successful" (Bourke and Rendell 2009, 81).

After negotiations with the Kenyan government, Bourke and Rendall travelled with the eight-month-old Christian to Kora, the camp established by George Adamson and where

he planned to live for at least two years to release Christian and two other lions. Christian's pre-release training began with introductions to his soon-to-be pride mates, Boy and Katania, a seven-year-old lion and four-



Figure 4. Bourke and Rendall with Christian (ImpactLab 2010).

month-old lioness, respectively (Bourke and Rendell 2009, 135): "George intended to create a man-made pride of lions, incorporating Christian." In the same way he had lived with Elsa, George would also live with this newly developed pride, offering supplemental feedings until the lions established their territory and could effectively function together (Bourke and Rendell 2009, 82).

While stopped for a break during the drive to Kora, Christian had his first encounter with prey. Adamson was impressed with Christian's stalking of a gombi (a large domestic African cow). Purely on instinct, as Christian had had no previous hunting experience, he fanned out into a wide semi-circle, using the bushes for cover. He had positioned himself upwind of the animal so it would not detect his scent (Bourke and Rendell 2009, 137-8).

Adamson was so impressed, in fact, that he stated there would be no trouble adapting Christian to a life in the wild (Bourke and Rendell 2009, 138).

After a few weeks, Bourke and Rendell left Kora but received regular updates from Adamson. In one letter Adamson wrote about two additional lionesses that were given to him to rehabilitate and release. Because females are vital to pride unity, the addition of the two females was especially important after Katania, only pride female, had been killed a few months earlier by a crocodile while swimming across the Tana River (Bourke and Rendell 2009, 179). Later, Adamson was given two more lionesses, both eighteen-months-old, and a young male named Supercub (Bourke and Rendell 2009, 188).

Adamson's work suffered another setback and changed the dynamic of the pride when Boy attacked Adamson's assistant. Adamson was forced to shoot and kill Boy in an attempt to save the assistant's life (Bourke and Rendell 2009, 189).

This new pride was made up of lions of various ages and personalities, and through Adamson's knowledge and patience



Figure 5. Adamson with Christian (Father of Lions 2010).

he was able to create a coherent man-made "pyramid" of lions with Christian as the now dominant male (figure 5) (Bourke and Rendell 2009, 216).

Christian and the rest of his pride went on to not only hunt for themselves, but breed with wild lions in the area; their cubs also had their own cubs during Adamson's nineteen years at Kora (Bourke and Rendell 2009, 217). Using the same techniques previously used to rehabilitate Elsa, Adamson had been successful in returning Christian to a self-sufficient life in Africa.

Gareth Patterson's Release of Batian, Rafiki and Furaha

In 1989, while Adamson was working to rehabilitate and release three new cubs, he was attacked and murdered by poachers (Bourke and Rendell



Figure 6. Patterson with Rafiki (Gareth Patterson 2010).

2009, 217). Gareth Patterson, who had spent a limited amount of time working with George Adamson, adopted the cubs Batian, Rafiki and Furaha (figure 6) and

documented his rehabilitation efforts in his book *Last of the Free*.

How does one rehabilitate lions? I had never undertaken such work over an extended period before, with my practical experience being limited to what I had learned from George with the cubs at Kora. The

procedures of the rehabilitation of large carnivores have not been written up formally, primarily because few people have embarked upon such work. It is a great pity that zoologists did not formulate George's findings and understanding of the process of lion rehabilitation into a single journal or paper. I had very few rehabilitation guidelines to go by, apart from the very general information I had gleaned from George and Joy's books. I therefore set myself three main rehabilitation guidelines:

1. To familiarise the lions with their new surroundings, thus giving them security and the opportunity of becoming territorial.
2. To give the lions every opportunity to hunt prey, presenting situations to them so that they could begin to polish their inherent knowledge of hunting.
3. To nurture a mutual and deep trust between the lions and myself but, at the same time, ensuring that the lions became increasingly less familiar with people. I hoped that in time they would view man in the same manner as wild lions do. (Patterson 1994, 13-14)

Since the urge to hunt is an instinctual behavior, Patterson did not need to teach the lions how to stalk, etc. He did, however, lead the cubs in the direction of suitable prey until the cubs were able to spot prey on their own (Patterson 1994, 14). By the age of twenty months, the lions were

killing prey at regular intervals and were no longer confined to their enclosures during the night (Patterson 1994, 71).

During this time, cattle farmers were allowing their cattle to illegally graze in the area where Patterson was rehabilitating the three cubs. To ensure proper identification of his lions from others that may have been preying on the cattle, Patterson fitted the three lions with radio collars. The tracking collars increased the amount of information known about the lions' territory and feeding habits. For instance, Patterson learned that the lions' range extended to an area of one hundred and fifty square kilometers, which was considered an average size range for other lions in the area (Patterson 1994, 107; Tucker 2010). Patterson also discovered that the lions were killing a diversity of prey and more prey than what was necessary for survival. In a five-day period, Patterson recorded the lions preying on one adult female kudu, one adult female eland, one warthog, one adult bull eland, and one large Zimbabwean ox (Patterson 1994, 107).

While conducting a survey of the area, a guard suddenly came across Batian in the bush, surprising them both. To be sure it was truly Batian, Patterson searched the area, calling his name.

I saw Batian's head protruding quizzically from some bushes. I called him, and he very nervously came out, peering everywhere but at me. He was looking for humans. Afterwards, he leapt effortlessly up onto a tall termite mound to scan for what he clearly feared – man. Although

he had clearly been frightened on seeing the guard, I was immensely pleased with the way he had reacted – exactly as any wild lion would under similar circumstances. (Patterson 1994, 113)

By May of 1991, Patterson was pleased with the results of his anti-poaching efforts as he wrote, “Eighteen months previously, only twenty-five lions existed in the Tuli, but by May I estimated that the population, including the cubs, had risen to forty-three” (Patterson 1994, 129). Patterson was also very pleased that the cubs were completely self-sufficient at this time as well. “Rafiki and Furaha were fully rehabilitated, pregnant and happy. Batian, now a beautiful, golden young prince, was regularly disappearing north into the Zimbabwean portion of the Tuli bushlands. He had finally found a lioness of his own” (Patterson 1994, 129).

While Batian was illegally killed by poachers when he was three years old (Patterson 1995), the release of these three lions is considered to be a successful release effort. All three lions were able to hunt effectively, had been able to integrate themselves into different prides, and were able to reproduce successfully.

Norman Carr’s Release of Big Boy and Little Boy

Norman Carr served as a warden in the Kafue National Park in Zambia during the 1960s. Two males, Big Boy and Little Boy, were just a few days old when their mother was killed and Carr took over their care (figure 7) (Norman Carr Safaris 2010). While the cubs were still in the nursing stage,

they were kept in Carr's home. After that, they lived outside in as natural conditions as possible and nothing was done to modify their natural behaviors; they were not taught any commands except for a few commands necessary for the safety of the lions and the people they were with (Carr 1962, 9).

Like the other release attempts examined, Carr gave the two lions as much time actually hunting as possible. Although Carr had no set way of teaching the cubs to hunt, he wrote in his book *Return to the Wild*, "I wanted to teach my foster children to

live a free and independent life and they could only do this if they could secure their own food; and that they would never be able to do without practice" (Carr 1962, 39). Until the lions were able to provide for themselves, Carr would provide whole carcasses for them, hoping they would later associate the carcass he gave them with the actual animal. When the lions grew older and learned to hunt for themselves, Carr wrote, "the association was obvious to them" (Carr 1962, 68).



Figure 7. Carr with Big Boy and Little Boy (Norman Carr Safaris 2010).

After making their first official kill together in November, 1960, Big Boy and Little Boy gorged themselves and remained with the carcass, protecting it from scavengers, a practice regularly seen with wild lions (Carr 1962, 117).

The two lions regularly encountered wild lions in various locations during their time with Carr. On most occasions they were usually very intimidated and would retreat. Only later, after another encounter with the wild lions, did they defend themselves and their territory. Carr then considered the lions ready for life completely on their own (Carr 1962, 126). In 1961, Carr took the lions to a game preserve on the Luangwa River, where they were released.

There was no indication of any post-release monitoring as Carr wrote that he did not see the lions again. The lions were ultimately able to successfully hunt for themselves; however, there is no mention as to whether they were able to integrate into an established pride or find mates.

More recently, a variety of organizations have started work to reintroduce lions back into their natural environments. For instance, the Global White Lion Protection Trust is a South African-based non-profit conservation and community development organization established in 2002 by author and conservationist Linda Tucker (Administrator 2010).

In 2002, when the White Lion Trust was established, no known White lion individuals remained in the wild in the Greater Timbavati region.

Because this had been the status for the past decade, the White Lion Trust launched its White Lion Reintroduction Program. As of 2009, the reintroduction program is considered successful as the founding pride is able to hunt self-sufficiently and is reproducing without human intervention (Administrator 2010).

The African Lion Rehabilitation and Release into the Wild Program

When Andrew and Wendy Conolly purchased Antelope Park (figure 8)

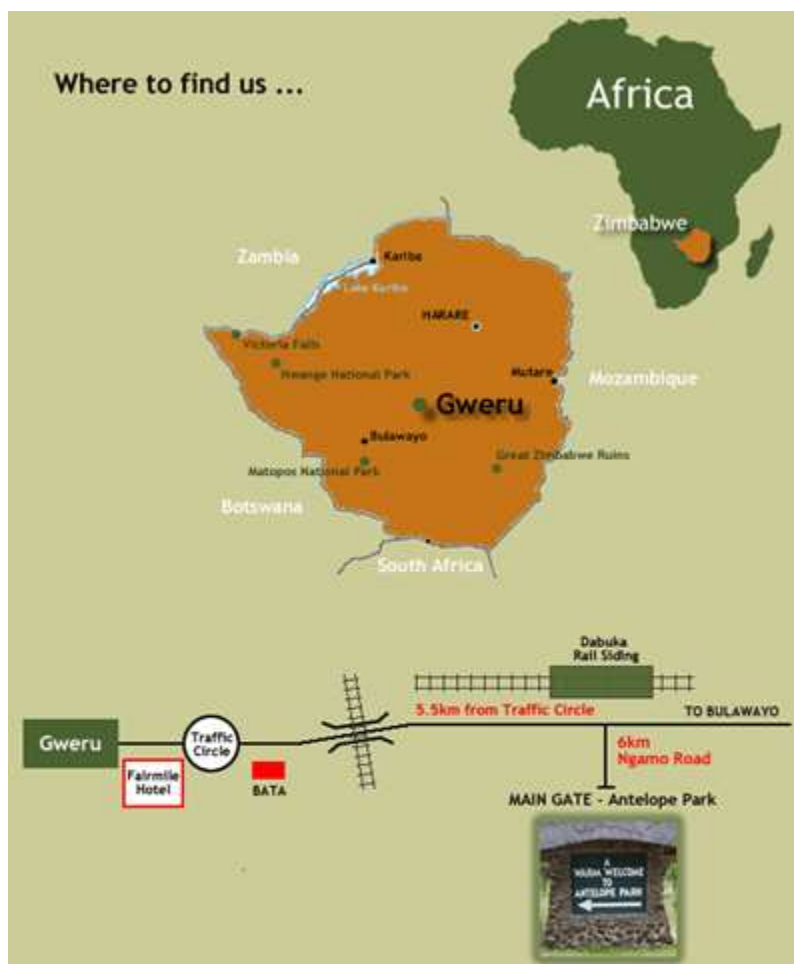


Figure 8. Antelope Park in Gweru, Zimbabwe (Antelope Park 2010).

in 1987, there were already six captive lions (a few with cubs) living on the property. In order to exercise the cubs, the Conollys took them out for walks in the bush. It was during these walks that Andrew Conolly noticed the cubs would display similar behaviors to those of wild lions, and the more they were out in the bush, the more they

would display these wild behaviors (ALERT n.d. b). It was from these

observations that Conolly began to think it might be possible for these cubs to survive in the wild. After realizing the wider implications of releasing captive-bred lions and the many issues that would need to be dealt with, Conolly founded ALERT in 2005. ALERT began developing long-range release plans, as well as habitat protection, conservation and community involvement programs (ALERT n.d. b).

Using a four-stage process, the intention of ALERT is to rehabilitate captive-bred lions into a limited number of fenced wild environments, free of any human contact. These lions will give birth to cubs that will be raised within the established pride and in a natural environment where they can develop their instinctive and acquired skills. These skills will be comparable to any wild-born lion, therefore, these lions will be able to be reintroduced into appropriate national parks and reserves identified for their protection (ALERT 2010a).

During one month spent volunteering at the Antelope Park location in 2009, this capstone project author participated in lion behavior studies and assisted with the collection of hunting data during daily walks with cubs and during Night Encounters with older lions, which will be discussed later in the text. The author was able to gain a first-hand account of the program and has included information gained from personal experiences while volunteering at Antelope Park, as well as information from published ALERT information.

Stage One/Night Encounters

While ALERT was not officially founded until 2005, Stage one (Rehabilitation/Breeding Phase One) of the program has been operating at Antelope Park in Gweru, Zimbabwe, since 1999; at the Victoria Falls, Zimbabwe, location since 2005, and at the Livingstone, Zambia, location since 2008 (ALERT 2010a).

Most lions are born into the program from existing lion populations maintained at the park. ALERT documents all lion parentage in a stud book with the intention of meeting international standards in order to maintain accurate reporting of the animals held within the program (ALERT 2010a). Females and males are also kept in separate enclosures once they reach sexual maturity to ensure there is no uncontrolled breeding. Females are bred at breeding intervals similar to those of wild lions raising a litter to maturity, which is an average of 20 months; a range of 11 to 25 months (Roach 2001).

To replicate wild lion behavior, a pregnant female is removed from her pride and placed in a separate enclosure, with a den, about a week before she is ready to give birth. Cubs remain with their mother in the birthing den for three weeks. During these first three weeks, they gain the necessary anti-bodies from their mother while nursing (ALERT 2010a). After three weeks, however, the mother is returned to her pride and the cubs are cared

for by an assigned lion handler who takes over the care of the litter and takes on the role of dominant pride member.

The cubs receive only enough training so that it is safe to walk with them in the bush. Beginning at six weeks of age, groups of cubs are taken by their handler out for short walks in the bush. After a short time, other handlers will be introduced on these walks to simulate a mother introducing her cubs to the rest of her pride (ALERT 2010a).

These twice daily walks are an important component of the reintroduction program. Much like the examples of reintroductions previously examined, spending as much time as possible in the bush provides the cubs the necessary exposure to their natural environment. These walks allow the cubs to build their confidence to their surroundings, and especially to the many types of game species found within the park – typical game species they would encounter as wild lions (ALERT n.d. a). As the lions become more confident, they are many opportunities to practice, and eventually, perfect their hunting skills.

By eighteen months of age, the lions are able to bring down smaller prey species, such as duiker or juvenile impala. Also by eighteen months, the lions are usually retired from daily walks and begin Night Encounters (ALERT 2010a). Night Encounters, the second phase of stage one, were added to the program in July, 2005, to offer the lions in groups of two to four a chance to hunt at night (ALERT 2010a). During Night Encounters, lion

handlers, volunteers and park guests ride in vehicles while following along with the lions as they hunt. Red filtered spotlights are used so as not to disrupt the hunting process (ALERT 2010a).

Since the lions' ability to hunt and bring down appropriate prey is an essential part of the release program, data to include hunting style, vegetative cover and direction of approach is collected for each hunt to determine the progress of the lions throughout the program.

For example, in figure 9, data taken from 218 Night Encounter hunts –

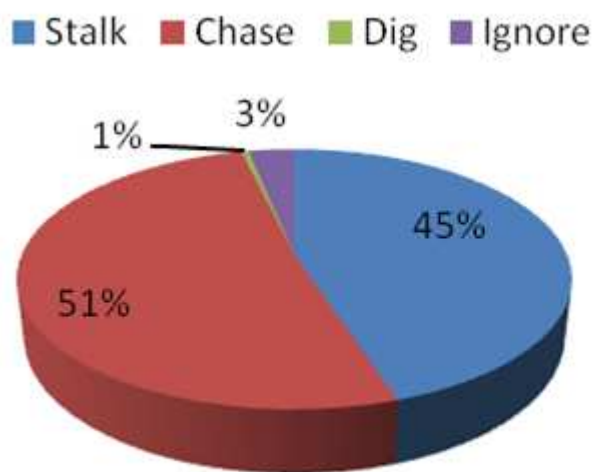


Figure 9. Initial response by lions on Night Encounters at Antelope Park (ALERT 2010c).

successful or unsuccessful – between May 26, 2008, and April 29, 2010, show that the lions were more successful if they initially chased the prey rather than stalking it. Figure 9 also shows that chasing prey is the preferred

reaction after seeing the prey (ALERT 2010c).

Figure 10 shows that the optimum prey size and hunting technique for Night Encounter hunts is chasing medium-sized prey, which resulted in a 35 percent kill rate (ALERT 2010c).

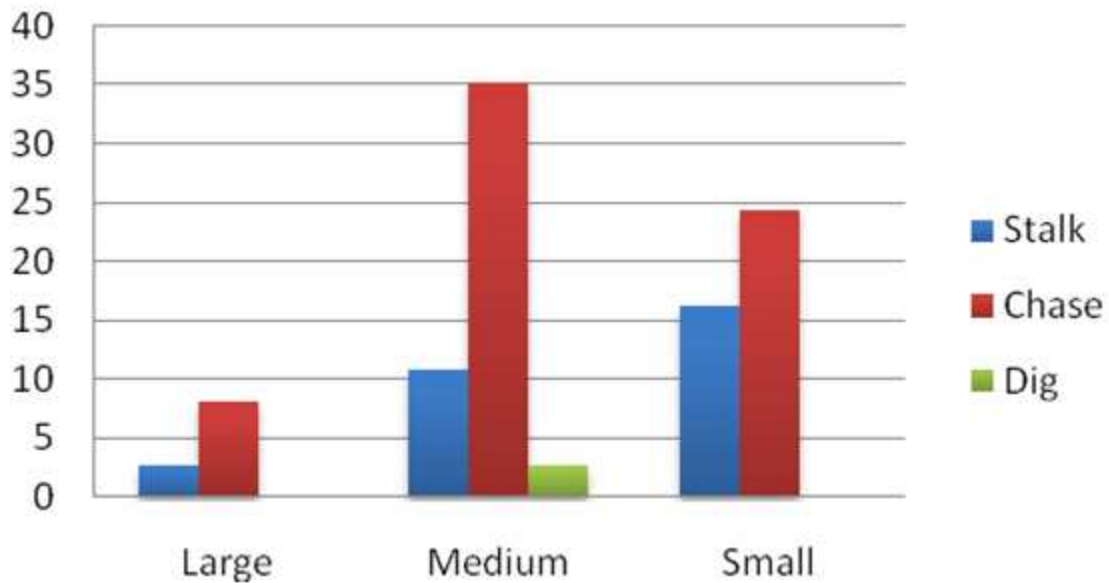


Figure 10. Successful hunting styles relative to prey size (ALERT 2010c).

While figure 10 shows that medium-sized species are the most commonly predated category of prey, figure 11 represents the 218 night

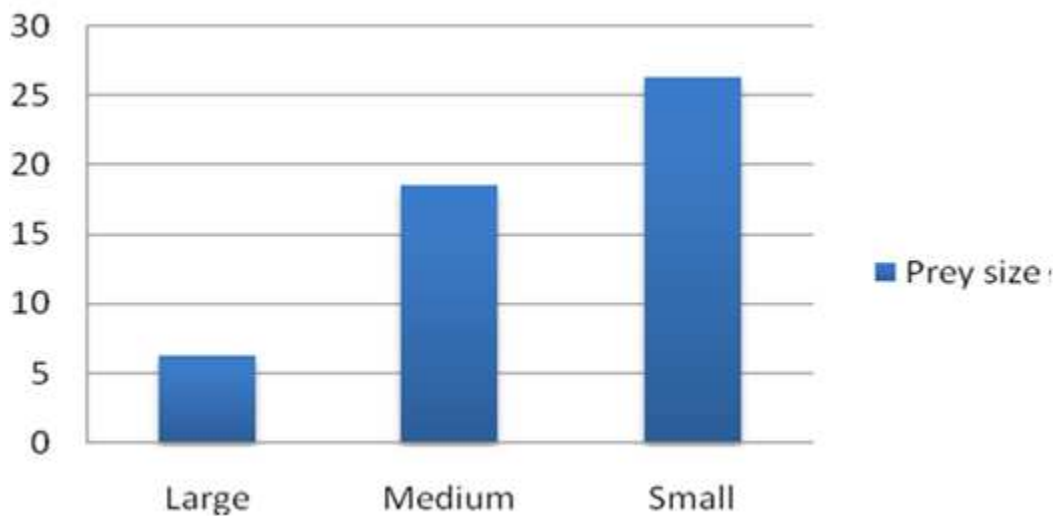


Figure 11. Successful hunts relative to prey size (ALERT 2010c).

encounter hunts categorized into large, medium and small prey. It shows that relative to the number of hunts in each category the lions actually have

a higher success rate with smaller prey (15 kills in 57 attempts, or 26.31 percent) (ALERT 2010c).

One of the most successful hunting groups in the ALERT program has been the 3S group made up of three females – Saraha, Soriah and Swahili, referred to as the

3S group. As seen in table 2, the 3S group encountered impala, wildebeest and zebra more than expected during their hunts, but preferred to hunt smaller prey groups (using

Table 2. 3S hunts for February 2010

Species	Jacobs' Index	Herd Size	Distance (m)	Kills %
Kudu	1	6	100	0
Impala	0.11	30	63	50
Mongoose	0	1	20	0
Zebra	-0.18	6	35	16.67
Duiker	0	1	15	0
Rabbit	-0.12	1	50	16.67
Wildebeest	0	50	50	0
Tortoise	-0.12	1	5	16.67

Source: ALERT 2009a

Note: 3S group consists of three female lions – Sahara, Soriah and Swahili

Jacobs' index: the closer the value to (+) 1, the more it is preferred) (ALERT 2010b). This suggests that the 3S group has a maximum preference for kudu (Jacob's index of 1) and maximum avoidance for zebra (Jacob's index of -0.18). The lions encountered zebra more often, but only pursued them some of the time, and made successful kills 16.66 percent of the time. The group's preference levels do not seem to be influenced by the habitat as they have developed good hunting strategies in which they utilize a low crouching

stalk. This gives them time to flank the herd and single out the weaker members (ALERT 2010b).

The 3S group retired from Night Encounters in May of 2010 with a 50 percent kill rate making them the second most successful stage one hunting group. But with 13 kills attributed just to her, Saraha is the program's most successful hunter overall (ALERT 2010b).

Pride Development

As mentioned, cubs are kept in groups to enable them to bond as a pride in the earliest stages of their development. However, some lions have been accepted into the program from other facilities. Since these lions are of different ages and at different developmental stages, prides sometimes must be created. In an email sent to the author on September 8, 2010, Jacqui Kirk, research technician based at Lion Encounter in Zambia, explains how lions are selected for inclusion into a pride:

Lions are selected to be bonded into a pride together on the basis of their associations with other lions. Obviously, in a wild situation, females would grow up together and more often than not remain in their mother's pride; rarely will outsiders join. So we try and keep those lions in release prides that have associations – whether they are siblings or former non-related walking group members. For instance, in Livingstone, while we have smaller walking groups, we raise several groups together to emulate a natural situation. If lions are to be

bonded that have no previous association, this process is begun around the age of Night Encounters (18-30 months).

Time wise, it is desirable to have them together from day one, but if bonded at a later date (like Night Encounter age) this process usually starts with lions being housed next door to one another. No two processes are the same, and you have to monitor for signs of when the two groups can be introduced (such as greeting through the fence line). From then, it is likely that they will need to spend several months together to ensure no sociality problems arise before release can even be considered.

In addition to this, we also have an ongoing study in association with the University of Exeter [in Devon, UK]; Behavioural Sequencing and Personality Development, which aims to work out which traits in young cubs are indicative of personality types (for instance, does low or high play levels mean a good/poor hunter etc...). What we hope will be the end result of this is that suitable pride members can be identified at a very young age and bonded from that time.

These personality character studies took place beginning in September and continued through December of 2009 and have been conducted every three months in order to gain a better understanding of the traits within the cubs, which can be used to accurately predict the role they will fill in a stage two pride (ALERT 2009). In figure 12 the results of a character study for

three young lions (TMs) – Tsavo, Thulani and Meggie – shows the most dominant character traits for each of the cubs during a twelve month period

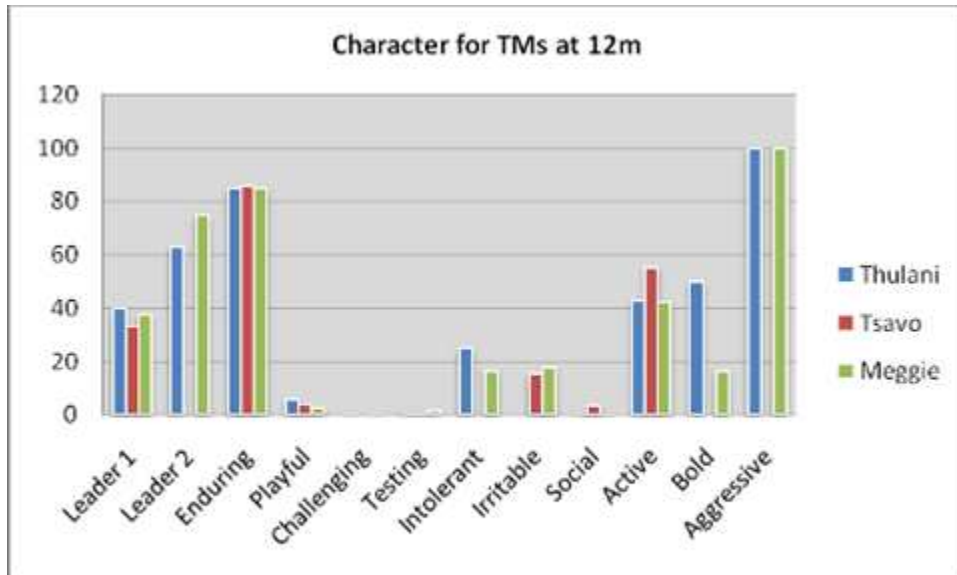


Figure 12. Behavioral sequencing and personality study for ALERT lions (ALERT 2009b).

(12 m). For instance, if Thulani displays dominant behaviors over the female, Meggie, but Tsavo is more

dominant over both Thulani and Meggie. If this trend continues, Tsavo could be a good candidate to fill the role of dominant pride member in a stage two release.

Stage Two

In stage two (Rehabilitation Phase Two) prides of lions are released into a large enclosure, which is stocked with common game species. The lions are radio collared before being released and their progress is monitored closely, although all human contact is removed in this stage (ALERT 2010a).

Disease is a large problem in wild lion populations and captive-bred lions often have little to no immunity to these diseases, therefore, the lions are vaccinated at a young age for e.g. rabies, feline rhinotracheitis, feline

calici and feline panleukopenia (ALERT n.d. a). Additionally, before being released into the stage two enclosure areas, the lions are screened for overall health, including a check of red and white blood cells and organ function. They also receive a feline viral screening, i.e. feline immunodeficiency virus (FIV), feline leukemia (FeLV), corona, calici, herpes and distemper, as well as being tested for Bovine tuberculosis. Stool samples are tested, and if necessary, the lions are treated for internal parasites, such as worms and toxoplasma as well as external parasites, such as ticks, fleas, mange, etc. All of these tests and examinations are carried out under the supervision of consultant veterinarians (ALERT n.d. a).

On August 29, 2007, a pride of two males and five female lions were released into the program's first stage two site, Dollar Block Reserve, located in Central Zimbabwe. On the fourth day of release, the pride successfully brought down an adult eland and continued making kills on species such as impala, warthog and wildebeest every three to four days and achieved an average daily meat intake comparable to wild lion populations (ALERT 2010a).

Unfortunately, on the morning of October 23, 2007, the research team monitoring Dollar Block found one of the lionesses had been killed. The two male lions were in close proximity to the dead lioness and it could only be presumed that the lioness died after a possible aggressive encounter with the two males (ALERT 2007). Only a few days later on October 28, 2007 the

two male lions were witnessed attacking another of the female lions. It was originally thought that she had only minor injuries, but she later died, presumably from internal injuries (ALERT 2007). It was decided that the two males would be removed from the enclosure allowing the remaining three females to continue to support themselves. They hunted successfully, even bringing down an adult giraffe (ALERT 2007).

The team planned to add three additional lionesses, but the upcoming rainy season caused them to delay the additions. However, once the three lionesses were added on April 13, 2008, the pride continued to be completely self-sufficient during their remaining time in Dollar Block (ALERT 2010a). Plans were made to introduce a different male into the group, but deteriorating economic conditions within Zimbabwe made it very difficult to properly monitor the site. Therefore, in September, 2008, all of the lions were removed from Dollar Block and returned to Antelope Park (ALERT 2010a). Milo, the male who was slated to be introduced into the Dollar Block site with the females, was placed in an enclosure next to the females so bonding could continue until another stage two site could be acquired (ALERT 2007).

ALERT was able to acquire 6200 acres of land adjacent to Antelope Park. This was enough land for several release sites, and three sites were planned. One of these three sites became the second stage two location, and in September, 2010, the Ngamo site was operational.

After the deaths of the two females at the Dollar Block site, ALERT changed its protocols in regards to when males would be released into the site. It was decided that the females should be given time to bond with each other and become comfortable in the release area before a male would be introduced (ALERT 2010a). With this new protocol in place only the six original female members of the Dollar Block pride, plus one additional female were released into the new Ngamo site in September, 2010 (ALERT 2010a). Within the first twenty-four hours of release, the lionesses made two kills on a juvenile wildebeest and juvenile zebra. By day three the females had also taken down a sub-adult wildebeest (ALERT 2010a). After two weeks, the male lion, Milo, was released into the Ngamo site with the females. All of the females greeted him and showed proper submissive displays upon seeing Milo in the enclosure. This indicated to the researchers monitoring the lions that a proper social pride system was complete (ALERT 2010a).

Throughout the following weeks, the pride continued hunting successfully with each lion consuming an average of 7.44 kilograms of meat per day, which slightly exceeds the average of 7.4 kilograms per day consumed by the lions while at the Dollar Block location (ALERT 2010a). This number also falls within the expected range of average daily meat intake of wild lions (Lehmann et al. 2008; Schaller 1972; van Orsdol 1982).

Since the pride's release into the Ngamo site, three of the females came into estrus and mated with Milo. As an example of the how the next

stages of the program will work, if these females were to conceive, and should their offspring survive (it will be the first litter for each female, which do not have a high rate of survival) their cubs, when they are old enough, would be the first lions to be eligible for release into the wild having been raised by the pride, rather than by their human handlers (ALERT 2010e).

While ALERT is still in the early stages of the Ngamo release, the lions have managed 20 total kills (ALERT 2010a). This is only one kill short of the average monthly kill rate recorded from a wild pride of similar size, which was observed in Karongwe reserve in South Africa (Lehmann et al. 2008).

Stage Three

In stage three of the program, which has not yet begun, the pride of lions that have been living in stage two release sites will be moved into a larger enclosed area where more diverse prey species, as well as competitive species such as hyena, will be introduced. The lions will continue to give birth to cubs that will be raised in a natural pride social system and will have the necessary hunting and human-avoidance skills to later be completely released into stage four (ALERT 2010a).

While contraceptive devices can be used to control breeding as well as regularly replacing pride males with unrelated males from other release areas to maintain gene flow (ALERT 2010a), ALERT believes this program can make a real difference in the long term survival of the species.

Land for the first 10,000-acre stage three release area has been secured through a lease agreement and a Forestry Concession Agreement in the Dambwa Forest and is located just outside the town of Livingstone, Zambia (ALERT 2010a).

Stage Four

When lions born in stage three are old enough for release, appropriate social groups will be released into areas where there are no wild lions or where existing populations have been depleted leaving available territories. Additionally, mixed pride groups can be released into areas where existing prides still occur. For example, male-only coalition groups can be released to naturally take over prides from existing pride males (Tucker 2010), which will bring natural gene flow into otherwise genetically closed populations; and female-only groups that can be released to augment the wild existing prides (ALERT 2010a).

ALERT anticipates its first stage four release will take place in 2012 or 2013 and has already received inquiries from private reserves and trans-frontier parks in such countries as Mozambique and Ghana (ALERT 2010a).

Prior to release into stage four sites, each potential release environment will be evaluated to establish likely success and confirm elements such as the most appropriate form of release, likely home range establishment following release and the prey base within the release area (ALERT 2010a).

Community Involvement

As previously stated, without community support for reintroduction programs, released lions will face the same issues that have brought about such a significant decline in their population. To involve local communities in the reintroduction process, ALERT developed the ALERT Communities Trust (ACT) to ensure the sustainability of those reintroduced populations by educating local residents. Through these education programs, it is hoped that the area's human residents will develop a better understanding of the lions' environment and ecology, and thus, support the need to protect them (ALERT 2010a).

ACT offers many types of programs to support and assist the community. These programs include urban agriculture and conservation education; health-based programs; child and adult education programs, and; social and empowerment programs (ALERT 2010a).

Before any stage four releases, ALERT will examine the proximity of the release areas to local communities so appropriate ACT community programs can be implemented to mitigate possible livestock-lion conflicts, establish education programs, and garner support for the wild area in question through various community development projects, which will be mutually agreed upon as priorities with the local community (ALERT 2010a).

Finally, post-release monitoring programs will be implemented to judge the performance of the released prides and any effects on the area of release and its local communities (ALERT 2010a).

Results

Analysis

Comparing wild lion data with data from ALERT is a difficult task, and direct comparisons are virtually impossible. ALERT's hunting data tracks young and sub-adult lions up to 30 months of age. These lions are merely gaining necessary hunting experiences; they are not yet old enough to be self-sufficient. Wild lion data examined for this project comes primarily from older, more experienced lions that have learned from their pridemates. However, because one of ALERT's goals is to allow younger lions to develop hunting instincts and become proficient hunters, ALERT's current data can be examined in a side-by-side comparison to determine how ALERT's animals are developing compared to their wild-born counterparts (ALERT 2010c).

The results of two wild lion studies were examined to compare the development of ALERT's lions – P.E. Stander's observations of lions in Etosha National Park and a study conducted by Lehmann et al. in Karongwe Game Reserve in South Africa. These particular studies were examined because the conditions of both are very similar to the situations in the ALERT program. These authors observed smaller pride sizes which inhabited smaller, controlled areas as is the case with ALERT prides and release areas.

In the first study, Stander studied 5 different prides of 9-15 lions each (very similar to Lehman and ALERT) groups of lions were examined to determine foraging

Table 3. Wild lion hunting success rates in Etosha National Park

Number of hunts	Number of successes	Number of Misses	% of Successful kills	% of Misses
920	137	783	14.9%	85.1%

Source: Stander 1992

dynamics. Based on 920 attempts with 137 successful hunts, Stander observed a 14.9 percent success rate (table 3). Stander determined that coordinated cooperative hunting was essential in the dry season, when prey was scarcer, and females mostly formed groups of two (Stander 1992). This number is comparable to the hunting groups formed in the ALERT program.

In Lehmann's study a single pride of lions, made up of 4-11 lions (mean=8), was observed in a controlled area of the Karongwe Game Reserve in South Africa from 1999 to 2005. Lehmann et al. writes,

As the population experienced no intraspecific competition it was an ideal situation in which to study the food requirements of a small population, and as many such reserves exist in which lion reintroductions have, or will occur, these results should be applicable to those populations (Lehman, et al. 2007).

During this study, an estimated 1,539 kills occurred over the six-year period, but only 43 percent (662 kills) of the kills were located. As seen in table 4, Lehmann observed similar hunting groups to those in Stander's

Table 4. Wild Lion hunting success in Karongwe Game Reserve

Years	Average Number of Lions	Estimated Encounters (based on Stander's 15% Success Rate)	Estimated kills per year	Estimated Kills per Month	Number of Kills per Lion per year	Number of Kills per Lion per month
2000	4.5	1426.7	214	17.8	54	4.5
2001	7.5	1506.7	226	18.8	57	4.7
2002	7.3	1926.7	289	24.1	77	6.4
2003	8.8	1786.7	268	22.3	89	7.4
2004	8.8	1993.3	299	24.9	99	8.3
2005	8	1620.0	243	20.3	81	6.7

Source: Lehmann et al. 2007

study although the average number of lions fluctuated throughout the study as males moved in and out of the pride (Lehmann et al. 2007). In Lehmann's study, no data was included for the estimated number of encounters with prey as was documented in Stander's study, so Stander's 15 percent rate was applied (column three) to Lehmann et al. in order to make direct comparisons between Stander's data and ALERT data. Without an estimated number of encounters, an overall hunting success rate could not be determined; and, because similar conditions exist between Stander and Lehmann, logic infers that similar conditions would result in similar hunting rates. After applying the 15 percent success rate to Lehmann's data, the results were used to compare hunting encounters versus successful hunts (when prey was killed), which Lehmann's documented to determine

successful hunts versus unsuccessful hunts. Using the resulting data in a similar fashion, we are able to examine and analyze ALERT's hunting rates in tables 5 and 6.

As these tables indicate, ALERT's young lions stalk, chase and make

Table 5. ALERT hunting success rates for 10 lions in a one year period

Alert Lion	Number of Encounters with Prey	Number of Stalks	% of Stalks to encounters	Number of Chases	% of Chases to encounters	Number of Kills	% of Kills to encounters
Kela	87	61	70%	65	75%	0	0.0%
Kwandi	100	71	71%	72	72%	3	3.0%
Toka	58	33	57%	36	62%	0	0.0%
Leya	65	40	62%	38	58%	3	4.6%
Loma	64	22	34%	24	38%	0	0.0%
Zulu	52	20	38%	13	25%	3	5.8%
Rundi	70	46	66%	38	54%	0	0.0%
Rusha	61	35	57%	20	33%	3	4.9%
Temi	71	51	72%	34	48%	1	1.4%
Tswana	76	58	76%	35	46%	2	2.6%
Totals	704	437	62%	375	53%	15	2.1%

Note: Numbers used here are from raw hunting data supplied by ALERT. See Appendix 1 and 2.

contact with prey, even if this contact is at yet unsuccessful at bringing

Table 6. ALERT hunting success rates for five animals in a four month period

Alert Lion	Number of Encounters with Prey	Number of Stalks	% of Stalks to encounters	Number of Chases	% of Chases to encounters	Number of Kills	% of Kills to encounters
Bisa	27	27	100%	21	78%	1	3.7%
Bemba	33	12	36%	6	18%	0	0.0%
Rwanda	17	8	47%	7	41%	0	0.0%
Rufiji	15	8	53%	8	53%	0	0.0%
Ruma	16	11	69%	9	56%	0	0.0%
Totals	108	66	61%	51	47%	1	0.9%

Note: Numbers used here are from raw hunting data supplied by ALERT. See Appendix 1 and 2.

down prey when compared to older wild lions.

Lions are successful hunters both during the day and at night, however, lion activity levels tend to peak during the cooler parts of the night

(ALERT 2010c). Nighttime hunting adds the extra benefit of allowing the lions to hunt under cover of darkness. In table 7, data from ALERT night encounters are examined alongside data collected by Stander in Etosha National Park during night hunts. While ALERT lion hunting success is

Table 7. Night encounter hunting rates for Etosha Nat'l Park and ALERT

	Encounters	Successes	Rate
Alert	232	42	18.1%
Wild	145	95	65.5%

Source: ALERT 2010c; Stander 1992

still lower than the wild lions, ALERT lions exhibit a distinct improvement in hunting rates when of the ALERT lions compared to hunting rates observed during day walks.

As previously discussed, hunting is an instinctual behavior; however, lions must learn to actually bring down prey to be self-sufficient hunters. Therefore, prey capture methods for wild and ALERT lions were compared to determine if ALERT lions are able to learn different techniques on their own. In the following tables ALERT lion hunting methods are compared to wild lion hunting methods to determine similarities. Table 8 illustrates the success

Table 8. Reaction to prey by ALERT lions during Night Encounters

Hunt Style	Number of successful hunts (percent of successful stalking/chasing or digging hunts)	Number of unsuccessful hunts (percent of unsuccessful stalking/chasing or digging hunts)	Success rate to all kills (percent $n = 37$)
Stalk	11 (11%)	87 (89%)	29.7
Chase	25 (22%)	87 (78%)	67.6
Dig	1 (100%)	0 (0%)	2.7
Ignore	0	7	0

Source: ALERT 2010c.

rate for ALERT lions during night encounters in relation to the methods used to capture prey. Table 8 also shows that of the night encounter hunts sampled, the lions were more successful if they initially chased their prey rather than stalking it (22.3 percent of all chasing hunts resulted in a kill while stalking lead to 11.2 percent success). Digging is shown to have a 100 percent success rate; however, this method was only observed once. Of the 212 hunts, 37 resulted in a kill (giving an overall success rate of 17 percent). The final column of table 8 shows that of the 37 kills, the one digging response represents 2.702 percent of all kills, stalking resulted in 29.8 percent of kills and chases resulted in 67.567 percent of all successful kills (ALERT 2010c).

Wild lions observed by Stander in Etosha National Park are examined

Table 9. Method of prey capture for wild lions in Etosha National Park

Prey Size	Number of Encounters	Jump On	Collide Over	Grab with Claws	Grab in Midair	Grab with Mouth	Slap Down
Large Prey >50 kg	110	17	8	23	33	4	25
Large Prey Percentage		15.5%	7.3%	20.9%	30.0%	3.6%	22.7%
Small Prey <50 kg	25	0	3	3	2	1	16
Small Prey Percentage		0.0%	12.0%	12.0%	8.0%	4.0%	64.0%
Combined %		15.50%	9.6%	16.5%	19.0%	3.8%	43.4%

Source: Stander 1992

in table 9 for the types of hunting methods they employ to bring down large and small prey. As indicated here, the wild lions used a variety of methods to bring down prey during 110 encounters with large prey. Grabbing the

animal in midair was observed to be the most common method used to bring down prey for this group of wild lions. For the 25 encounters observed with small prey, the wild lions overwhelmingly used their paws to slap down the prey. ALERT does not record information for the same methods as in Stander's study; however, table 10 reveals similarities between the wild lions and ALERT lions in the variety of methods used to bring down prey. Table 10 indicates a much lower overall success rate than the rates shown in

Table 10. Types of Kill/Attempt Responses by ALERT lions

Alert Lion	First to Walk To-ward Prey	First to Stalk	First to Chase	First to make Contact	Makes Contact	Ankle Taps	Jumps On	Brings to Ground	Kills
Bisa	26	24	21	1	1	0	1	1	1 _a
Bemba	8	8	6	0	0	0	0	0	0
Rwanda	4	4	4	0	0	0	0	0	0
Rufiji	4	4	4	0	0	0	0	0	0
Ruma	8	7	7	1	1	0	0	0	0
Kela	37	39	38	2	5	2	5	1	0
Kwandi	43	44	48	6	7	2	5	4	3 _b
Toka	29	27	25	0	1	0	1	0	0
Leya	29	29	32	7	7	0	5	3	3 _c
Loma	7	4	7	1	1	0	1	0	0
Zulu	7	4	6	5	5	0	2	1	3 _d
Rundi	40	37	29	1	2	0	0	0	0
Rusha	27	19	13	3	3	0	1	2	3 _e
Temi	26	34	24	3	5	1	3	5	1 _f
Tswana	38	39	28	3	5	1	4	3	2 _g
Total Encounters	333						28	20	
Percentage							8.4%	6.0%	

Note: Numbers used here are from raw hunting data supplied by ALERT. See Appendix 1 and 2.

- a. Bisa's kill: an impala (large prey)
- b. Kwandi's kills: two waterbucks (large prey) and a duiker (small prey)
- c. Leya's kills: an impala (large prey) and two giraffe (large prey)
- d. Zulu's kills: a monitor lizard, a tortoise and three vervet monkeys (all small prey)
- e. Rusha's kills: two baboons (small prey) and a monitor lizard (small prey)
- f. Temi's kill: an impala (large prey)
- g. Tswana's kills: two duiker (small prey)

table 9; however, the data does demonstrate that the ALERT lions will move

towards their prey by stalking or chasing, and they are able to make contact using different methods, including ankle taps to trip prey and jumping on prey to bring it down. Similarities are also observed in the hunting methods used for large and small prey. For instance, as seen in table 10, Bisa jumped on larger prey such as impala to bring it down; Kwandi used ankle taps to bring down smaller prey, but jumped on the back of waterbucks, which are considered to be larger prey; Leya also jumped on larger prey; and Temi and Tswana used ankle taps to bring smaller prey to the ground and then jumped on the prey to make the kill.

Evaluations

ALERT provides pre-release training to younger lions in its program. As the lions progress through the day walks and night encounters of stage one, their hunting skills show improvement. Data indicates the lions are more successful at bringing down smaller prey animals, but as they get older, they are able to bring down larger prey animals such as waterbuck and giraffe which is similar to the hunting ability and progression of wild lions.

As the lions' hunting skills improve and they learn different methods to bring down prey, these lions advance into stage two of the program. Here they will become completely self-sufficient as the human contact they are accustomed to is reduced. Still very early in stage two, the newly released pride is killing prey at an average rate comparable to wild lions and consuming comparable amounts of food as wild lions. Based on the

improvement of lions throughout stage one of the program, the lions in stage two should continue to develop hunting skills and pride socialization in a natural environment. It is these hunting skills and pride socialization that will be taught to their offspring born in stage two and stage three of the program.

The offspring of these lions will learn natural behaviors from their pridemates and will not have the same human contact as their parents. When these lions are old enough, they will be released into national parks and protected reserves ultimately as wild lions.

Findings

Based on the criteria for release and reintroduction programs of captive-bred lions, the ALERT program has a good chance of long-term success. The program has already seen success in its first release into stage two. Cubs born to lions in the next stages of the program will be wild lions learning the necessary behaviors from their parents and pridemates.

However, financial support for ALERT could become a concern. The program operates an ecotourism aspect of its program where visitors pay to participate in different lion-related activities, but the costs of acquiring new land, building enclosures, feeding and caring for animals, etc. are high. Donations are accepted, but in depressed economic times, financial support could dwindle. This is a real concern which could affect the long-term success of the program.

Other concerns include the ability to acquire enough land for stage four release sites. Since the human population in Africa is increasing dramatically, it will be more difficult to give lions the space they require without them coming into contact with human residents and their livestock. Even though the lions which will be released by ALERT in stage four will have had no human interaction, as discussed, wild lions have many negative interactions with humans and livestock in their natural environments. Efforts need to be made to find more effective ways of minimizing these conflicts especially since retaliatory and pre-emptive killing of lions by pastoralists is still a real concern and a reason for the decline in the population.

Conclusion

There is an abundance of literature that discusses reintroduction of captive-bred animals. Releasing captive-bred animals is becoming a more accepted management technique to increase the population of at-risk species. And, the available literature that supports captive-bred releases and reintroductions is growing, but more information needs to be published to gain a better understanding of release and reintroduction programs, regardless of the outcome of the project.

Most of the studies researched for this project did not meet the proposed release criteria in one way or another and were, therefore, not considered successful release attempts. Those reintroductions that were examined and considered to be successful release attempts followed most of

the established criteria and were able to release self-sufficient lions into the wild. This proves the importance of pre-release training when any reintroduction project is planned.

Pre-release training is also the key to avoiding human-wildlife conflicts that lead to the criticism that surrounds captive-breeding and release programs. Ending an animals' dependence on humans by teaching them to locate appropriate prey; developing the natural hunting abilities of lions and allowing the lions ample time in their natural environment to practice effectively bringing down prey; and developing predator avoidance behaviors will ensure the animal can fend for itself and become self-sufficient. Recognizing and recreating a stable social structure based on known behaviors of lions while in the pre-release training period will also give lions the best chance of survival and increase the success rates of these programs. Locating proper release sites and gaining political and community support is another key factor that must be fully considered before attempting a reintroduction and release program. Without this support, a program will only release lions that will be doomed to face the same problems that caused the population to decline so dramatically.

In the case of ALERT, pre-release training is performed during each of the steps towards the ultimate release into reserves and wildlife management areas: lions are exposed to a natural environment; exposed to natural prey; allowed to hunt and bring down prey on their own thereby

learning necessary hunting skills; limiting human exposure in later stages of release; and, releasing the lions into progressively larger, controlled areas to become completely self-sufficient are all training techniques used by ALERT to ensure the lions will be able to pass on the appropriate hunting and survival behaviors to their offspring.

The ALERT, ACT and CCWA organizations bridge the gap between preconceived ideas about lions and the communities where lions could potentially be released. Education programs provide a much needed understanding about lions and the important economic potential of ecotourism in the communities.

The vulnerable status of the African lion is a real concern that needs to be addressed before the population is diminished beyond repair. Estimates show declines so steep that lions could disappear altogether unless more effective conservation measures are taken. Because the African lion population is decreasing at such an alarming rate, these types of programs are even more important if there is any hope of saving one of Africa's most iconic animals. ALERT, as well as other organizations, is providing a viable reintroduction method which compliments current conservation measures aimed at increasing a sustainable population of African lions.

Appendix 1. Hunting data for ALERT lions

Response	Date	Species	Lion	Walks towards prey	Catches & brings prey to ground	Kills prey	Notes
1	21-Apr-10 21-Apr-10 21-Apr-10	Giraffe Giraffe Giraffe	Ruma Rufiji Rwanda	Yes Yes Yes			
2	28-Apr-10 28-Apr-10 28-Apr-10	Giraffe Giraffe Giraffe	Ruma Rufiji Rwanda	Yes Yes Yes			
3	29-Apr-10 29-Apr-10	Impala Impala	Bisa Bemba	Yes Yes			Heard the animal before seeing it Heard the animal before seeing it
4	10-May-10 10-May-10 10-May-10	Impala Impala Impala	Ruma Rufiji Rwanda	Yes			
5	20-May-10 20-May-10	Guinea Fowl Guinea Fowl	Bisa Bemba	Yes			
6	21-May-10 21-May-10 21-May-10	Vervet Monkey Vervet Monkey Vervet Monkey	Ruma Rufiji Rwanda				
7	23-May-10 23-May-10 23-May-10	Giraffe Giraffe Giraffe	Ruma Rufiji Rwanda	Yes			
8	25-May-10 25-May-10	Ducks Ducks	Bisa Bemba	Yes			
9	12-Jun-10 12-Jun-10	Vervet Monkey Vervet Monkey	Bisa Bemba	Yes			Was moved on by handler after she stalked to closest tree and sat down and watched
10	12-Jun-10 12-Jun-10 12-Jun-10	Vervet Monkey Vervet Monkey Vervet Monkey	Ruma Rufiji Rwanda	Yes			Monkey climbed into tree

11	13-Jun-10	Giraffe	Bemba				Bemba joined in once the giraffe had been chased she stalked in from the right
	13-Jun-10	Giraffe	Bisa	Yes			
12	15-Jun-10	Vervet Monkey	Ruma	Yes			Monkeys ran up tree
	15-Jun-10	Vervet Monkey	Rufiji				
	15-Jun-10	Vervet Monkey	Rwanda				
13	22-Jun-10	Baboon	Ruma				Morning long walk
	22-Jun-10	Baboon	Rufiji				
	22-Jun-10	Baboon	Rwanda				
14	27-Jun-10	Giraffe	Ruma				
	27-Jun-10	Giraffe	Rufiji	Yes			Chased for around 600m
	27-Jun-10	Giraffe	Rwanda	Yes			
15	4-Jul-10	Warthog	Ruma	Yes			
	4-Jul-10	Warthog	Rufiji				
	4-Jul-10	Warthog	Rwanda				
16	7-Jul-10	Warthog	Bemba				
	7-Jul-10	Warthog	Bisa	Yes			Stopped chasing because distracted by presence of scouts
17	9-Jul-10	Vervet Monkey	Bemba				
	9-Jul-10	Vervet Monkey	Bisa				
18	10-Jul-10	Giraffe	Bemba				Bemba stalked Bisa, but didn't show any signs of seeing prey
	10-Jul-10	Giraffe	Bisa	Yes			Clients scared off the giraffe
19	17-Jul-10	Impala	Bemba	Yes			
	17-Jul-10	Impala	Bisa	Yes			
20	17-Jul-10	Impala	Bemba	Yes			
	17-Jul-10	Impala	Bisa	Yes			

21	17-Jul-10 17-Jul-10	Duiker Duiker	Bemba Bisa				Baby duiker, hiding in bushes - broke cover. Chase lasted c.15m
22	24-Jul-10 24-Jul-10	Impala Impala	Bemba Bisa	Yes			
23	24-Jul-10 24-Jul-10	Buffalo Buffalo	Bemba Bisa	Yes			Buffalo began chasing Bisa when she got to approx. 5m
24	24-Jul-10 24-Jul-10	Duiker Duiker	Bemba Bisa	Yes			
25	25-Jul-10 25-Jul-10 25-Jul-10	Giraffe Giraffe Giraffe	Ruma Rufiji Rwanda	Yes Yes Yes			
26	26-Jul-10 26-Jul-10	Elephant Elephant	Bemba Bisa	Yes Yes			Elephant chased cubs Elephant chased cubs
27	27-Jul-10 27-Jul-10 27-Jul-10	Buffalo Buffalo Buffalo	Ruma Rufiji Rwanda				
28	27-Jul-10 27-Jul-10 27-Jul-10	Impala Impala Impala	Ruma Rufiji Rwanda	Yes			
29	28-Jul-10 28-Jul-10	Impala Impala	Bemba Bisa	Yes Yes	Yes Yes		Came over once Bisa had caught it but didn't see or take part in hunt Strangled and suffocated; played with it for a long time after it was dead
30	29-Jul-10 29-Jul-10	Giraffe Giraffe	Bemba Bisa	Yes Yes			

31	30-Jul-10 30-Jul-10	Vervet Monkey Vervet Monkey	Bemba Bisa	Yes			
32	1-Aug-10 1-Aug-10	Impala Impala	Bemba Bisa	Yes			
33	1-Aug-10 1-Aug-10	Impala Impala	Bemba Bisa	Yes			
34	1-Aug-10 1-Aug-10	Duiker Duiker	Bemba Bisa	Yes			
35	1-Aug-10 1-Aug-10	Bushbuck Bushbuck	Bemba Bisa	Yes			
36	1-Aug-10 1-Aug-10	Bushbuck Bushbuck	Bemba Bisa	Yes			
37	1-Aug-10 1-Aug-10	Impala Impala	Bemba Bisa	Yes Yes			Just following Bisa
38	1-Aug-10 1-Aug-10	Giraffe Giraffe	Bemba Bisa	Yes Yes			
39	5-Aug-10 5-Aug-10	Impala Impala	Bemba Bisa	Yes Yes			
40	5-Aug-10 5-Aug-10	Impala Impala	Bemba Bisa	Yes Yes			

41	5-Aug-10	Impala	Bernba	Yes				
	5-Aug-10	Impala	Bisa					
42	6-Aug-10	Impala	Bernba					
	6-Aug-10	Impala	Bisa	Yes				
43	7-Aug-10	Impala	Bernba					
	7-Aug-10	Impala	Bisa	Yes				
44	7-Aug-10	Impala	Bernba					
	7-Aug-10	Impala	Bisa	Yes				
45	12-Aug-10	Giraffe	Bernba					
	12-Aug-10	Giraffe	Bisa	Yes				
46	15-Aug-10	Impala	Bernba	Yes				
	15-Aug-10	Impala	Bisa	Yes				
47	15-Aug-10	Duiker	Bernba					
	15-Aug-10	Duiker	Bisa	Yes				
48	15-Aug-10	Buifalo	Ruma	Yes				
	15-Aug-10	Buifalo	Rufiji					
	15-Aug-10	Buifalo	Rwanda	Yes				
49	15-Aug-10	Buifalo	Ruma	Yes				
	15-Aug-10	Buifalo	Rufiji	Yes				
	15-Aug-10	Buifalo	Rwanda	Yes				
50	17-Aug-10	Bushbuck	Bernba					
	17-Aug-10	Bushbuck	Bisa					

51	18-Aug-10	Bushbuck	Ruma Rufiji Rwanda	Yes				
52	18-Aug-10	Bushbuck	Ruma Rufiji Rwanda	Yes				
	20-Aug-10	Buffalo	Ruma Rufiji Rwanda	Yes				
	20-Aug-10	Buffalo	Ruma Rufiji Rwanda	Yes				
53	21-Aug-10	Giraffe	Bemba Bisa	Yes				
	21-Aug-10	Giraffe	Bemba Bisa	Yes				
54	23-Aug-10	Impala	Bemba Bisa	Yes				
	23-Aug-10	Impala	Bemba Bisa	Yes				
55	26-Aug-10	Duiker	Ruma Rufiji Rwanda					
	26-Aug-10	Duiker	Ruma Rufiji Rwanda					
	26-Aug-10	Duiker	Ruma Rufiji Rwanda					
56	26-Aug-10	Kudu	Ruma Rufiji Rwanda	Yes				Chase lasted for some 200m
	26-Aug-10	Kudu	Ruma Rufiji Rwanda	Yes				
	26-Aug-10	Kudu	Ruma Rufiji Rwanda	Yes				
57	26-Aug-10	Impala	Ruma Rufiji Rwanda	Yes				Impala ran off
	26-Aug-10	Impala	Ruma Rufiji Rwanda	Yes				
	26-Aug-10	Impala	Ruma Rufiji Rwanda	Yes				

Appendix 2. Hunting data for ALERT lions

Date	Species	Number of prey	Lion	Walks towards prey	Catches & brings prey to ground	Kills prey	Notes
25-Apr-09	Giraffe	3	Toka	Yes			
25-Apr-09	Giraffe	3	Rundi	Yes			
25-Apr-09	Giraffe	3	Rusha	Yes			
26-Apr-09	Monitor Lizard	1	Kela	Yes			
26-Apr-09	Monitor Lizard	1	Kwandi				Kwandi and Loma did not see lizard
26-Apr-09	Monitor Lizard	1	Loma				Kwandi and Loma did not see lizard
26-Apr-09	Giraffe	3	Kela				
26-Apr-09	Giraffe	3	Kwandi				Kwandi saw prey but did not approach
26-Apr-09	Giraffe	3	Loma				
27-Apr-09	Snake	1	Temi	Yes			
27-Apr-09	Snake	1	Tswana				
27-Apr-09	Giraffe	3	Kela				
27-Apr-09	Giraffe	3	Kwandi	Yes			
27-Apr-09	Giraffe	3	Loma				
27-Apr-09	Giraffe	8	Kela	Yes			
27-Apr-09	Giraffe	8	Kwandi	Yes			Kwandi only spotted giraffe long after Kela had already begun the hunt
27-Apr-09	Giraffe	8	Loma				
28-Apr-09	Giraffe	1	Rundi				
28-Apr-09	Giraffe	1	Rusha				Saw the giraffe, watched, then sat down

28-Apr-09	Impala	2	Kela				Client walk. Saw the prey, went into a stalking position but did not move towards
28-Apr-09	Impala	2	Kwandi				
28-Apr-09	Impala	2	Loma				
30-Apr-09	Waterbuck	2	Kela	Yes			
30-Apr-09	Waterbuck	2	Kwandi	Yes			Kwandi and Loma saw the prey, moved 10 metres or so towards then stopped
30-Apr-09	Waterbuck	2	Loma	Yes			Kwandi and Loma saw the prey, moved 10 metres or so towards then stopped
30-Apr-09	Warthog	2	Kela				Kela never saw the first warthog although should have, 2nd she saw within 30s
30-Apr-09	Warthog	2	Kwandi				
30-Apr-09	Warthog	2	Loma				Loma never actually saw the game, however was following Kwandi so did advance
30-Apr-09	Impala	10	Kela	U/K	U/K		Kela and Loma were out of sight, unknown how close they got
30-Apr-09	Impala	10	Kwandi				
30-Apr-09	Impala	10	Loma	U/K	U/K		Kela and Loma were out of sight, unknown how close they got
1-May-09	Warthog	1	Temi				Temi was looking the other way as it ran past, otherwise would have seen it
1-May-09	Warthog	1	Tswana	Yes			
2-May-09	Monkey	8	Leya				Leya was looking in the other direction
2-May-09	Monkey	8	Toka	Yes			Monkeys were in the tree
2-May-09	Monkey	8	Zulu	Yes			Monkeys were in the tree
3-May-09	Elephant	1	Leya				
3-May-09	Elephant	1	Toka	Yes			Prevented from going any further due to wild elephant herd
3-May-09	Elephant	1	Zulu				

4-May-09	Baboon	15	Rundi	Yes			
4-May-09	Baboon	15	Rusha	Yes			
6-May-09	Bushbuck	1	Kela				
6-May-09	Bushbuck	1	Kwandi				
6-May-09	Bushbuck	1	Loma				
8-May-09	Guinea Fowl	20	Kela				Bird flew off as soon as lions started chasing
8-May-09	Guinea Fowl	20	Kwandi				
8-May-09	Guinea Fowl	20	Loma				Bird flew off as soon as lions started chasing
12-May-09	Duiker	1	Leja				
12-May-09	Duiker	1	Toke				Leja heard the duiker as it ran, and took a few steps towards the direction of the noise, but never saw it
12-May-09	Duiker	1	Zulu				
12-May-09	Warthog	10	Rundi				
12-May-09	Warthog	10	Rusha				
13-May-09	Impala	1	Kela				
13-May-09	Impala	1	Kwandi	Yes			
13-May-09	Impala	1	Loma				Loma was looking at clients in other direction
13-May-09	Monitor Lizard	1	Rundi				
13-May-09	Monitor Lizard	1	Rusha				Lizard escaped by jumping in the river
13-May-09	Waterbuck	6	Leja	Yes			
13-May-09	Waterbuck	6	Toke	Yes			

14-May-09	Bushbuck	1	Leya				
14-May-09	Bushbuck	1	Toka				
14-May-09	Bushbuck	1	Zulu				
17-May-09	Buffalo	1	Kela	Yes			
17-May-09	Buffalo	1	Kwandi	Yes			
17-May-09	Buffalo	1	Loma				
18-May-09	Giraffe	12	Leya	Yes			
18-May-09	Giraffe	12	Toka				
18-May-09	Giraffe	12	Zulu				
19-May-09	Bushbuck	1	Kela	Yes			
19-May-09	Bushbuck	1	Kwandi				
19-May-09	Bushbuck	1	Loma				
20-May-09	Zebra	15	Rundi	Yes			
20-May-09	Zebra	15	Rusha	Yes			
23-May-09	Zebra	8	Kela	Yes			
23-May-09	Zebra	8	Kwandi	Yes			
23-May-09	Zebra	8	Loma	Yes			
24-May-09	Impala	1	Kela				
24-May-09	Impala	1	Kwandi				
24-May-09	Impala	1	Loma				

24-May-09	Giraffe	3	Kela	Yes				
24-May-09	Giraffe	3	Kwandi					
24-May-09	Giraffe	3	Loma					
25-May-09	Guinea Fowl	1	Kela					Kela ran into the bush after exiting enclosure
25-May-09	Guinea Fowl	1	Kwandi					
25-May-09	Guinea Fowl	1	Loma					
27-May-09	Impala	8	Rundi	Yes				
27-May-09	Impala	8	Rusha	Yes				
31-May-09	Impala	2	Kela					
31-May-09	Impala	2	Kwandi	Yes				
31-May-09	Impala	2	Loma					
1-Jun-09	Guinea Fowl	12	Rundi	Yes				
1-Jun-09	Guinea Fowl	12	Rusha	Yes				
3-Jun-09	Impala	4	Kela	Yes				
3-Jun-09	Impala	4	Kwandi	Yes				
3-Jun-09	Impala	4	Loma	Yes				
3-Jun-09	Waterbuck	1	Kela	Yes				
3-Jun-09	Waterbuck	1	Kwandi	Yes				
3-Jun-09	Waterbuck	1	Loma	Yes				

3-Jun-09	Giraffe	4	Kela	Yes			
3-Jun-09	Giraffe	4	Kwandi	Yes			
3-Jun-09	Giraffe	4	Loma	Yes			
3-Jun-09	Waterbuck	2	Kela				
3-Jun-09	Waterbuck	2	Kwandi				
3-Jun-09	Waterbuck	2	Loma				
3-Jun-09	Bushbuck	2	Kela				
3-Jun-09	Bushbuck	2	Kwandi				
3-Jun-09	Bushbuck	2	Loma				
3-Jun-09	Giraffe	7	Rundi	Yes			
3-Jun-09	Giraffe	7	Rusha	Yes			
4-Jun-09	Waterbuck	5	Kela	Yes			
4-Jun-09	Waterbuck	5	Kwandi	Yes			
4-Jun-09	Waterbuck	5	Loma	Yes			
4-Jun-09	Impala	25	Terni	Yes			
4-Jun-09	Impala	25	Tswana	Yes			
5-Jun-09	Impala	15	Leya				
5-Jun-09	Impala	15	Toka				
5-Jun-09	Impala	15	Zulu				

5-Jun-09	Impala	25	Kela	Yes			
5-Jun-09	Impala	25	Kwandi	Yes			
5-Jun-09	Impala	25	Loma				
5-Jun-09	Impala	25	Kela	Yes			
5-Jun-09	Impala	25	Kwandi	Yes			
5-Jun-09	Impala	25	Loma				
5-Jun-09	Impala	10	Leya	Yes			
5-Jun-09	Impala	10	Toka				
5-Jun-09	Impala	10	Zulu				
6-Jun-09	Waterbuck	1	Kela				
6-Jun-09	Waterbuck	1	Kwandi	Yes			Kwandi initially went into a standing stalk, but also went into crouching stalk
6-Jun-09	Waterbuck	1	Loma				
8-Jun-09	Waterbuck	3	Kela				
8-Jun-09	Waterbuck	3	Kwandi	Yes			
8-Jun-09	Waterbuck	3	Loma				
11-Jun-09	Giraffe	1	Kela				
11-Jun-09	Giraffe	1	Kwandi	Yes			
11-Jun-09	Giraffe	1	Loma				
13-Jun-09	Giraffe	3	Leya	Yes			
13-Jun-09	Giraffe	3	Toka	Yes			
13-Jun-09	Giraffe	3	Zulu	Yes			

14-Jun-09	Bushbuck	1	Kela	Yes			
14-Jun-09	Bushbuck	1	Kwandi				
14-Jun-09	Bushbuck	1	Loma				
15-Jun-09	Buffalo	20	Kela				Loma was first to chase while the Ks stalked. Buffalo turned and chased Loma and Ks chased buffalo
15-Jun-09	Buffalo	20	Kwandi				
15-Jun-09	Buffalo	20	Loma				
15-Jun-09	Buffalo	1	Kela	Yes			Kela & Kwandi followed a bull from the original herd from Beach 2 to Sussi & Chuma - walking behind the entire way before jumping on it
15-Jun-09	Buffalo	1	Kwandi	Yes			Kela & Kwandi followed a bull from the original herd from Beach 2 to Sussi & Chuma - walking behind the entire way before jumping on it
15-Jun-09	Buffalo	1	Loma				Loma has been chased off by the herd at this point and was missing
15-Jun-09	Giraffe	1	Kela				Loma was still absent from earlier buffalo encounter
15-Jun-09	Giraffe	1	Kwandi				Loma was still absent from earlier buffalo encounter
16-Jun-09	Impala	7	Kela	Yes			
16-Jun-09	Impala	7	Kwandi	Yes			
16-Jun-09	Impala	7	Loma	Yes			Loma did see the game and walk towards it but was walking with the group rather than with the Ks
17-Jun-09	Waterbuck	9	Kela				
17-Jun-09	Waterbuck	9	Kwandi	Yes			
17-Jun-09	Waterbuck	9	Loma				
17-Jun-09	Bushbuck	1	Leja	Yes			
17-Jun-09	Bushbuck	1	Toka				Toka was lying down in the grass initially and didn't see until the others started to chase
17-Jun-09	Bushbuck	1	Zulu	Yes			

18-Jun-09	Baboon	5	Kela	Yes			
18-Jun-09	Baboon	5	Kwandi	Yes			
18-Jun-09	Baboon	5	Loma	Yes			
18-Jun-09	Vervet monkey	1	Teri				
18-Jun-09	Vervet monkey	1	Tswana	Yes			
18-Jun-09	Waterbuck	6	Rundi	Yes			
18-Jun-09	Waterbuck	6	Rusha	Yes			
18-Jun-09	Buffalo	1	Kela				
18-Jun-09	Buffalo	1	Kwandi	Yes			
18-Jun-09	Buffalo	1	Loma				
18-Jun-09	Impala	7	Teri				
18-Jun-09	Impala	7	Tswana				
18-Jun-09	Impala	1	Teri	Yes			
18-Jun-09	Impala	1	Tswana	Yes			
19-Jun-09	Duiker	1	Kela	Yes			
19-Jun-09	Duiker	1	Kwandi				
19-Jun-09	Duiker	1	Loma				
23-Jun-09	Impala	10	Teri				
23-Jun-09	Impala	10	Tswana				
23-Jun-09	Impala	10	Kela				
23-Jun-09	Impala	10	Kwandi	Yes			
23-Jun-09	Impala	10	Loma				

24-Jun-09	Bushbuck	1	Kela	Yes			
24-Jun-09	Bushbuck	1	Kwandi	Yes			
24-Jun-09	Bushbuck	1	Loma				
24-Jun-09	Giraffe	6	Rundi	Yes			
24-Jun-09	Giraffe	6	Rusha	Yes			
24-Jun-09	Impala	15	Leya	Yes	Yes		
24-Jun-09	Impala	15	Toka				Toka followed Leya once she had run off and already brought the impala down, was not involved in chase
24-Jun-09	Impala	15	Zulu				Zulu saw the prey but did not move initially. Did not follow and was returned to enclosure
26-Jun-09	Duiker	1	Leya				
26-Jun-09	Duiker	1	Toka	Yes			
26-Jun-09	Duiker	1	Zulu	Yes			
27-Jun-09	Buffalo	35	Kela				
27-Jun-09	Buffalo	35	Kwandi				
27-Jun-09	Buffalo	35	Loma				
27-Jun-09	Giraffe	6	Leya				
27-Jun-09	Giraffe	6	Toka				
27-Jun-09	Giraffe	6	Zulu				
27-Jun-09	Impala	12	Kela				
27-Jun-09	Impala	12	Kwandi	Yes			
27-Jun-09	Impala	12	Loma				

27-Jun-09	Giraffe	3	Kela	Yes		
27-Jun-09	Giraffe	3	Kwandi			
27-Jun-09	Giraffe	3	Loma	Yes		
28-Jun-09	Waterbuck	11	Leya	Yes		
28-Jun-09	Waterbuck	11	Toka			
28-Jun-09	Waterbuck	11	Zulu	Yes		
29-Jun-09	Impala	4	Temi			
29-Jun-09	Impala	4	Tswana			
29-Jun-09	Impala	10	Temi	Yes		
29-Jun-09	Impala	10	Tswana	Yes		
30-Jun-09	Impala	20	Temi	Yes		
30-Jun-09	Impala	20	Tswana	Yes		
1-Jul-09	Baboon	20	Leya	Yes		
1-Jul-09	Baboon	20	Toka	Yes		
1-Jul-09	Baboon	20	Zulu	Yes		
2-Jul-09	Impala	20	Temi	Yes		
2-Jul-09	Impala	20	Tswana			
2-Jul-09	Duilker	1	Leya			
2-Jul-09	Duilker	1	Toka	Yes		
2-Jul-09	Duilker	1	Zulu			

2-Jul-09	Impala	3	Leya	Yes			
2-Jul-09	Impala	3	Toke				
2-Jul-09	Impala	3	Zulu	Yes			
2-Jul-09	Giraffe	1	Temu				
2-Jul-09	Giraffe	1	Tswana				
2-Jul-09	Impala	7	Temu	Yes			
2-Jul-09	Impala	7	Tswana	Yes			
3-Jul-09	Waterbuck	11	Kela	Yes			
3-Jul-09	Waterbuck	11	Kwandi				
3-Jul-09	Waterbuck	11	Loma	Yes			
3-Jul-09	Giraffe	8	Kela	Yes			
3-Jul-09	Giraffe	8	Kwandi	Yes			
3-Jul-09	Giraffe	8	Loma				
3-Jul-09	Impala	60	Rundi				
3-Jul-09	Impala	60	Rusha				
3-Jul-09	Impala	7	Rundi				
3-Jul-09	Impala	7	Rusha	Yes			
5-Jul-09	Giraffe	2	Temu	Yes			
5-Jul-09	Giraffe	2	Tswana	Yes			
5-Jul-09	Giraffe	2	Temu				
5-Jul-09	Giraffe	2	Tswana	Yes			
6-Jul-09	Duiker	1	Leya	Yes			
6-Jul-09	Duiker	1	Toke				
6-Jul-09	Duiker	1	Zulu				

6-Jul-09	Waterbuck	1	Leya	Yes			
6-Jul-09	Waterbuck	1	Toka				
6-Jul-09	Waterbuck	1	Zulu				
7-Jul-09	Giraffe	3	Tenni	Yes			
7-Jul-09	Giraffe	3	Tswana	Yes			
8-Jul-09	Buffalo	35	Leya	Yes			
8-Jul-09	Buffalo	35	Toka	Yes			
8-Jul-09	Buffalo	35	Zulu	Yes			
8-Jul-09	Impala	20	Kela	Yes			
8-Jul-09	Impala	20	Kwandi	Yes			
8-Jul-09	Impala	20	Loma	Yes			
9-Jul-09	Impala	3	Kela				
9-Jul-09	Impala	3	Kwandi				
9-Jul-09	Impala	3	Loma				
9-Jul-09	Waterbuck	8	Kela	Yes			
9-Jul-09	Waterbuck	8	Kwandi	Yes			
9-Jul-09	Waterbuck	8	Loma	Yes			
9-Jul-09	Buffalo	2	Kela	Yes			
9-Jul-09	Buffalo	2	Kwandi	Yes			
9-Jul-09	Buffalo	2	Loma				
9-Jul-09	Impala	40	Kela				
9-Jul-09	Impala	40	Kwandi	Yes			
9-Jul-09	Impala	40	Loma	Yes			

9-Jul-09	Impala	40	Kela	Yes			
9-Jul-09	Impala	40	Kwandi	Yes			
9-Jul-09	Impala	40	Loma				
9-Jul-09	Impala	10	Rundi	Yes			
9-Jul-09	Impala	10	Rusha				
9-Jul-09	Monitor Lizard	1	Leja	Yes			
9-Jul-09	Monitor Lizard	1	Toka				
9-Jul-09	Monitor Lizard	1	Zulu				
10-Jul-09	Impala	50	Kela	Yes			
10-Jul-09	Impala	50	Kwandi	Yes			
10-Jul-09	Impala	50	Loma	Yes			
11-Jul-09	Waterbuck	7	Kela	Yes			
11-Jul-09	Waterbuck	7	Kwandi	Yes			
11-Jul-09	Waterbuck	7	Loma				
11-Jul-09	Impala	9	Teri	Yes			
11-Jul-09	Impala	9	Tswana	Yes			
11-Jul-09	Waterbuck	6	Kela	Yes			
11-Jul-09	Waterbuck	6	Kwandi	Yes			
11-Jul-09	Waterbuck	6	Loma				
12-Jul-09	Giraffe	3	Leja				
12-Jul-09	Giraffe	3	Toka	Yes			
12-Jul-09	Giraffe	3	Zulu				

12-Jul-09	Giraffe	8	Leja		Yes	Yes	
12-Jul-09	Giraffe	8	Toka				
12-Jul-09	Giraffe	8	Zulu	Yes			
13-Jul-09	Buffalo	1	Leja	Yes			
13-Jul-09	Buffalo	1	Toka	Yes			
13-Jul-09	Buffalo	1	Zulu				
14-Jul-09	Waterbuck	5	Kela	Yes			
14-Jul-09	Waterbuck	5	Kwandi	Yes			
14-Jul-09	Waterbuck	5	Loma	Yes			
14-Jul-09	Impala	5	Rundi				
14-Jul-09	Impala	5	Rusha				
14-Jul-09	Buffalo	50	Leja	Yes			
14-Jul-09	Buffalo	50	Toka	Yes			
14-Jul-09	Buffalo	50	Zulu				
14-Jul-09	Giraffe	6	Kela	Yes			
14-Jul-09	Giraffe	6	Kwandi	Yes			
14-Jul-09	Giraffe	6	Loma				
15-Jul-09	Guinea Fowl	5	Temi				
15-Jul-09	Guinea Fowl	5	Tswana	Yes			
15-Jul-09	Impala	30	Kela	Yes			
15-Jul-09	Impala	30	Kwandi	Yes			
15-Jul-09	Impala	30	Loma	Yes			

15-Jul-09	Impala	1	Kela	Yes			
15-Jul-09	Impala	1	Kwandi				
15-Jul-09	Impala	1	Loma				
16-Jul-09	Buffalo	1	Kela				
16-Jul-09	Buffalo	1	Kwandi				
16-Jul-09	Buffalo	1	Loma				
16-Jul-09	Impala	3	Leya	Yes			
16-Jul-09	Impala	3	Toka				
16-Jul-09	Impala	3	Zulu	Yes			
17-Jul-09	Impala	25	Leya	Yes			
17-Jul-09	Impala	25	Toka	Yes			
17-Jul-09	Impala	25	Zulu	Yes			
17-Jul-09	Impala	6	Temi	Yes			
17-Jul-09	Impala	6	Tswana				
18-Jul-09	Buffalo	1	Leya	Yes			
18-Jul-09	Buffalo	1	Toka	Yes			
18-Jul-09	Buffalo	1	Zulu	Yes			
18-Jul-09	Impala	1	Leya	Yes			
18-Jul-09	Impala	1	Toka	Yes			
18-Jul-09	Impala	1	Zulu	Yes			
18-Jul-09	Impala	4	Leya				
18-Jul-09	Impala	4	Toka				
18-Jul-09	Impala	4	Zulu	Yes			
19-Jul-09	Waterbuck	20	Kela		Yes		
19-Jul-09	Waterbuck	20	Kwandi		Yes		
19-Jul-09	Waterbuck	20	Loma				
19-Jul-09	Duiker	1	Kela				
19-Jul-09	Duiker	1	Kwandi				
19-Jul-09	Duiker	1	Loma				

26-Jul-09	Impala	7	Rundi	Yes			Handlers stopped the chase
26-Jul-09	Impala	7	Rusha				
28-Jul-09	Waterbuck	6	Kela		Yes		
28-Jul-09	Waterbuck	6	Kwandi	Yes			
28-Jul-09	Waterbuck	6	Loma				
29-Jul-09	Impala	4	Rundi	Yes			
29-Jul-09	Impala	4	Rusha	Yes			
29-Jul-09	Waterbuck	3	Leya	Yes			Prevented from going further by handlers
29-Jul-09	Waterbuck	3	Toka				
29-Jul-09	Waterbuck	3	Zulu				Prevented from going further by handlers
30-Jul-09	Impala	2	Temi	Yes			
30-Jul-09	Impala	2	Tswana				
30-Jul-09	Impala	25	Leya				Cubs had been fed earlier that day and were very fat
30-Jul-09	Impala	25	Toka				Cubs had been fed earlier that day and were very fat
30-Jul-09	Impala	25	Zulu				Cubs had been fed earlier that day and were very fat
2-Aug-09	Impala	10	Temi				
2-Aug-09	Impala	10	Tswana	Yes			
3-Aug-09	Bushbuck	1	Rundi				
3-Aug-09	Bushbuck	1	Rusha	Yes			
3-Aug-09	Bushbuck	1	Rundi				
3-Aug-09	Bushbuck	1	Rusha	Yes			

3-Aug-09	Bushbuck	2	Leya	Yes			Cubs were fed yesterday
3-Aug-09	Bushbuck	2	Toke				Cubs were fed yesterday
3-Aug-09	Bushbuck	2	Zulu	Yes			Cubs were fed yesterday
3-Aug-09	Impala	10	Rundi	Yes			
3-Aug-09	Impala	10	Rusha				
4-Aug-09	Duiker	1	Kela		Yes		
4-Aug-09	Duiker	1	Kwandi		Yes		
4-Aug-09	Duiker	1	Loma				
5-Aug-09	Impala	15	Leya	Yes			
5-Aug-09	Impala	15	Toke	Yes			
5-Aug-09	Impala	15	Zulu				
5-Aug-09	Impala	60	Rundi	Yes			Were moved on due to client walk coming
5-Aug-09	Impala	60	Rusha				Were moved on due to client walk coming
6-Aug-09	Impala	30	Terri				Terri was sleeping under a tree, didn't see until Tswana was already approaching
6-Aug-09	Impala	30	Tswana	Yes			
6-Aug-09	Guinea Fowl	20	Terri	Yes			
6-Aug-09	Guinea Fowl	20	Tswana	Yes			
6-Aug-09	Bushbuck	1	Rundi				
6-Aug-09	Bushbuck	1	Rusha				

7-Aug-09	Buffalo	35	Kela	Yes	Yes	
7-Aug-09	Buffalo	35	Kwandi	Yes	Yes	
7-Aug-09	Buffalo	35	Loma			
7-Aug-09	Impala	20	Leya	Yes		
7-Aug-09	Impala	20	Toka			
7-Aug-09	Impala	20	Zulu			
7-Aug-09	Hippo	1	Leya	Yes		Hippo had already sustained injuries
7-Aug-09	Hippo	1	Toka			
7-Aug-09	Hippo	1	Zulu			
7-Aug-09	Impala	1	Rundi			
7-Aug-09	Impala	1	Rusha	Yes		
10-Aug-09	Impala	25	Temi	Yes		
10-Aug-09	Impala	25	Tswana	Yes		
10-Aug-09	Giraffe	2	Rundi	Yes		
10-Aug-09	Giraffe	2	Rusha			
11-Aug-09	Bushbuck	2	Kela			
11-Aug-09	Bushbuck	2	Kwandi			
11-Aug-09	Bushbuck	2	Loma			
11-Aug-09	Baboon	15	Kela			
11-Aug-09	Baboon	15	Kwandi	Yes		
11-Aug-09	Baboon	15	Loma			
12-Aug-09	Impala	1	Kela			
12-Aug-09	Impala	1	Kwandi	Yes		
12-Aug-09	Impala	1	Loma			

Bushbucks ran towards Kwandi - hence 50-10ms without moving

12-Aug-09	Impala	3	Kela				
12-Aug-09	Impala	3	Kwandi	Yes			
12-Aug-09	Impala	3	Loma				
15-Aug-09	Impala	5	Rundi	Yes			
15-Aug-09	Impala	5	Rusha	Yes			
18-Aug-09	Rabbit	1	Leya				Rabbit was running towards Leya - didn't see her lying in the grass, hence 30 - 15ms
18-Aug-09	Rabbit	1	Toka				
18-Aug-09	Rabbit	1	Zulu				
19-Aug-09	Duiker	1	Terni				
19-Aug-09	Duiker	1	Tswana	Yes			
19-Aug-09	Duiker	1	Rundi	Yes			
19-Aug-09	Duiker	1	Rusha	Yes			Rusha was limping
20-Aug-09	Plover	1	Leya				
20-Aug-09	Plover	1	Toka	Yes			
20-Aug-09	Plover	1	Zulu				
22-Aug-09	Grysbok	1	Terni	Yes			Lions were stopped because of elephant riders nearby
22-Aug-09	Grysbok	1	Tswana				Lions were stopped because of elephant riders nearby
23-Aug-09	Guinea Fowl	3	Rundi	Yes			
23-Aug-09	Guinea Fowl	3	Rusha				
23-Aug	Duiker	1	Leya				
23-Aug	Duiker	1	Toka				
23-Aug	Duiker	1	Zulu				

29-Aug-09	Impala	2	Temu				
29-Aug-09	Impala	2	Tswana				
29-Aug-09	Bushbuck	3	Temu				
29-Aug-09	Bushbuck	3	Tswana				
29-Aug-09	Giraffe	2	Rundi	Yes			
29-Aug-09	Giraffe	2	Rusha	Yes			
29-Aug-09	Duiker	1	Rundi				
29-Aug-09	Duiker	1	Rusha				
29-Aug-09	Buffalo	10	Rundi	Yes			
29-Aug-09	Buffalo	10	Rusha				
29-Aug-09	Giraffe	7	Kela				
29-Aug-09	Giraffe	7	Kwandi	Yes			
29-Aug-09	Giraffe	7	Loma				
29-Aug-09	Impala	15	Temu				
29-Aug-09	Impala	15	Tswana	Yes			
30-Aug-09	Duiker	3	Leja	Yes			
30-Aug-09	Duiker	3	Toka				
30-Aug-09	Duiker	3	Zulu				
30-Aug-09	Impala	2	Leja				
30-Aug-09	Impala	2	Toka				
30-Aug-09	Impala	2	Zulu				
30-Aug-09	Duiker	1	Kela	Yes			
30-Aug-09	Duiker	1	Kwandi				
30-Aug-09	Duiker	1	Loma				

31-Aug-09	Impala	6	Rundi	Yes			
31-Aug-09	Impala	6	Rusha				
31-Aug-09	Impala	4	Leya	Yes			
31-Aug-09	Impala	4	Toka	Yes			
31-Aug-09	Impala	4	Zulu	Yes			
31-Aug-09	Impala	15	Temi				
31-Aug-09	Impala	15	Tswana				
2-Sep-09	Buffalo	2	Kela	Yes			
2-Sep-09	Buffalo	2	Kwandi	Yes			
2-Sep-09	Buffalo	2	Loma	Yes			
3-Sep-09	Waterbuck	5	Leya	Yes			
3-Sep-09	Waterbuck	5	Toka				
3-Sep-09	Waterbuck	5	Zulu				
4-Sep-09	Waterbuck	1	Kela	Yes			
4-Sep-09	Waterbuck	1	Kwandi	Yes			
4-Sep-09	Waterbuck	1	Loma				
4-Sep-09	Buffalo	30	Kela	Yes			
4-Sep-09	Buffalo	30	Kwandi	Yes			
4-Sep-09	Buffalo	30	Loma	Yes			
4-Sep-09	Giraffe	2	Kela	Yes			
4-Sep-09	Giraffe	2	Kwandi				
4-Sep-09	Giraffe	2	Loma				
4-Sep-09	Buffalo	10	Kela	Yes			
4-Sep-09	Buffalo	10	Kwandi				
4-Sep-09	Buffalo	10	Loma				

6-Sep-09	Waterbuck	1	Tenni		Yes	2Kls were brought out to kill Waterbuck. Waterbuck had previous wound to its stomach
6-Sep-09	Waterbuck	1	Tswana			2Kls were brought out to kill Waterbuck. Waterbuck had previous wound to its stomach
7-Sep-09	Waterbuck	5	Tenni			
7-Sep-09	Waterbuck	5	Tswana	Yes		
7-Sep-09	Duiker	3	Tenni			
7-Sep-09	Duiker	3	Tswana			
9-Sep-09	Giraffe	1	Rundi			
9-Sep-09	Giraffe	1	Rusha			
9-Sep-09	Impala	20	Kela			
9-Sep-09	Impala	20	Kwandi	Yes		
9-Sep-09	Impala	20	Loma			
11-Sep-09	Impala	8	Tenni	Yes		
11-Sep-09	Impala	8	Tswana	Yes		
11-Sep-09	Impala	10	Tenni	Yes		
11-Sep-09	Impala	10	Tswana	Yes		
11-Sep-09	Buffalo	10	Tenni	Yes		
11-Sep-09	Buffalo	10	Tswana	Yes		
11-Sep-09	Buffalo	25	Kela	Yes		
11-Sep-09	Buffalo	25	Kwandi	Yes		
11-Sep-09	Buffalo	25	Loma	Yes		Loma didn't move for a long time after the /s

12-Sep-09	Impala	6	Leja	Yes			
12-Sep-09	Impala	6	Toka				
12-Sep-09	Impala	6	Zulu				
12-Sep-09	Waterbuck	10	Rundi	Yes			
12-Sep-09	Waterbuck	10	Rusha				
12-Sep-09	Impala	10	Rundi	Yes			
12-Sep-09	Impala	10	Rusha				
13-Sep-09	Buffalo	35	Kela	Yes			
13-Sep-09	Buffalo	35	Kwandi	Yes			
13-Sep-09	Buffalo	35	Loma				
14-Sep-09	Waterbuck	20	Kela	Yes			
14-Sep-09	Waterbuck	20	Kwandi	Yes			
14-Sep-09	Waterbuck	20	Loma	Yes			
14-Sep-09	Waterbuck	1	Kela	Yes			
14-Sep-09	Waterbuck	1	Kwandi	Yes			
14-Sep-09	Waterbuck	1	Loma	Yes			Loma tried to play with Kwandi as they were stalking - alerted the waterbuck
14-Sep-09	Bushbuck	2	Temi				
14-Sep-09	Bushbuck	2	Tswana				
15-Sep-09	Impala	12	Leja				
15-Sep-09	Impala	12	Toka	Yes			
15-Sep-09	Impala	12	Zulu	Yes			
15-Sep-09	Impala	12	Leja	Yes			
15-Sep-09	Impala	12	Toka				
15-Sep-09	Impala	12	Zulu	Yes			

15-Sep-09	Baboon	2	Leya				
15-Sep-09	Baboon	2	Toka				
15-Sep-09	Baboon	2	Zulu				
15-Sep-09	Bushbuck	2	Leya				
15-Sep-09	Bushbuck	2	Toka				
15-Sep-09	Bushbuck	2	Zulu				
15-Sep-09	Waterbuck	8	Tenni	Yes			
15-Sep-09	Waterbuck	8	Tswana				
15-Sep-09	Impala	10	Tenni	Yes			
15-Sep-09	Impala	10	Tswana				
15-Sep-09	Impala	10	Tenni	Yes			
15-Sep-09	Impala	10	Tswana	Yes			
17-Sep-09	Baboon	3	Leya	Yes			
17-Sep-09	Baboon	3	Toka	Yes			
17-Sep-09	Baboon	3	Zulu	Yes			
17-Sep-09	Buffalo	1	Rundi				
17-Sep-09	Buffalo	1	Rustia	Yes			
17-Sep-09	Impala	10	Leya				
17-Sep-09	Impala	10	Toka				
17-Sep-09	Impala	10	Zulu				

17-Sep-09	Impala	4	Kela				Were moved on towards MT3, but made no attempt to move towards herd
17-Sep-09	Impala	4	Kwandi				Were moved on towards MT3, but made no attempt to move towards herd
17-Sep-09	Impala	4	Loma				Were moved on towards MT3, but made no attempt to move towards herd
18-Sep-09	Bushbuck	5	Leya	Yes			
18-Sep-09	Bushbuck	5	Toka	Yes			
18-Sep-09	Bushbuck	5	Zulu	Yes			
19-Sep-09	Impala	10	Temu		Yes		Client walk - impala ran into a hedge and fell to the ground. Temu jumped on as it fell
19-Sep-09	Impala	10	Tswana		Yes		Tswana came into assist once Temu had already jumped on the impala
19-Sep-09	Buffalo	4	Kela	Yes			
19-Sep-09	Buffalo	4	Kwandi	Yes			
19-Sep-09	Buffalo	4	Loma	Yes			
21-Sep-09	Impala	8	Temu	Yes			
21-Sep-09	Impala	8	Tswana	Yes			Tswana doubled back on herself to go around prey while it was distracted by Temu
21-Sep-09	Bushbuck	1	Temu	Yes			
21-Sep-09	Bushbuck	1	Tswana	Yes			
21-Sep-09	Duiker	1	Temu	Yes			
21-Sep-09	Duiker	1	Tswana	Yes			
25-Sep-09	Buffalo	30	Leya	Yes			All three were chased by the buffalo
25-Sep-09	Buffalo	30	Toka	Yes			All three were chased by the buffalo
25-Sep-09	Buffalo	30	Zulu	Yes			All three were chased by the buffalo

26-Sep-09	Guinea Fowl	30	Rundi	Yes			
26-Sep-09	Guinea Fowl	30	Rusha	Yes			
26-Sep-09	Waterbuck	6	Rundi	Yes			
26-Sep-09	Waterbuck	6	Rusha				
26-Sep-09	Impala	6	Rundi	Yes			
26-Sep-09	Impala	6	Rusha				
26-Sep-09	Waterbuck	14	Leya				
26-Sep-09	Waterbuck	14	Toka	Yes			
26-Sep-09	Waterbuck	14	Zulu				
26-Sep-09	Giraffe	1	Leya	Yes	Sub-adult giraffe		
26-Sep-09	Giraffe	1	Toka		Toka laid down in grass to rest		
26-Sep-09	Giraffe	1	Zulu		Zulu laid down in grass to rest		
26-Sep-09	Giraffe	1	Leya		Leya's chase drove the giraffe towards Zulu		
26-Sep-09	Giraffe	1	Toka	Yes			
26-Sep-09	Giraffe	1	Zulu		Jumped at hind left leg		
27-Sep-09	Baboon	3	Rundi		Lost interest when baboons went up tree		
27-Sep-09	Baboon	3	Rusha	Yes	Lost interest when baboons went up tree		
27-Sep-09	Buffalo	4	Kela				
27-Sep-09	Buffalo	4	Kwandi				
27-Sep-09	Buffalo	4	Loma				
27-Sep-09	Guinea Fowl	20	Kela				
27-Sep-09	Guinea Fowl	20	Kwandi	Yes			
27-Sep-09	Guinea Fowl	20	Loma				
27-Sep-09	Impala	15	Leya				
27-Sep-09	Impala	15	Toka				
27-Sep-09	Impala	15	Zulu				

27-Sep-09	Bushbuck	4	Leja	Yes			
27-Sep-09	Bushbuck	4	Toka				
27-Sep-09	Bushbuck	4	Zulu				
28-Sep-09	Buffalo	30	Kela	Yes			All three held calf down for 15 minutes. Bleating brought the herd back.
28-Sep-09	Buffalo	30	Kwandi				All three held calf down for 15 minutes. Bleating brought the herd back.
28-Sep-09	Buffalo	30	Loma				All three held calf down for 15 minutes. Bleating brought the herd back.
28-Sep-09	Giraffe	5	Temi	Yes			
28-Sep-09	Giraffe	5	Tswana	Yes			
28-Sep-09	Bushbuck	3	Temi	Yes			
28-Sep-09	Bushbuck	3	Tswana	Yes			
29-Sep-09	Warthog	1	Leja	Yes			
29-Sep-09	Warthog	1	Toka				
29-Sep-09	Warthog	1	Zulu				
29-Sep-09	Duiker	1	Leja	Yes			
29-Sep-09	Duiker	1	Toka				
29-Sep-09	Duiker	1	Zulu				
29-Sep-09	Monkey	5	Rundi	Yes			
29-Sep-09	Monkey	5	Rusha	Yes			
1-Oct-09	Waterbuck	3	Rundi				
1-Oct-09	Waterbuck	3	Rusha	Yes			
1-Oct-09	Waterbuck	8	Leja	Yes			
1-Oct-09	Waterbuck	8	Toka	Yes			
1-Oct-09	Waterbuck	8	Zulu	Yes			

2-Oct-09	Waterbuck	1	Leya	Yes				Zulu jumped on Toka's back to play, mid-hunt scaring WB away.
2-Oct-09	Waterbuck	1	Toka					Zulu should have seen the prey but was too interested in Toka and ruined the hunt
2-Oct-09	Waterbuck	1	Zulu					
5-Oct-09	Bushbuck	5	Leya					
5-Oct-09	Bushbuck	5	Toka	Yes				
5-Oct-09	Bushbuck	5	Zulu					
6-Oct-09	Bushbuck	2	Temi	Yes				
6-Oct-09	Bushbuck	2	Tswana	Yes				
7-Oct-09	Giraffe	1	Kela					Kela didn't see the game until Kwandi had already started chasing
7-Oct-09	Giraffe	1	Kwandi	Yes				
7-Oct-09	Giraffe	1	Loma					
7-Oct-09	Duiker	2	Rundi					
7-Oct-09	Duiker	2	Rusha					
8-Oct-09	Impala	30	Temi	Yes				
8-Oct-09	Impala	30	Tswana	Yes				
8-Oct-09	Baboon	15	Temi	Yes				Bushbuck crossed path as hunting baboon; see entry below
8-Oct-09	Baboon	15	Tswana					
8-Oct-09	Bushbuck	1	Temi					
8-Oct-09	Bushbuck	1	Tswana					
9-Oct-09	Buffalo	1	Leya					
9-Oct-09	Buffalo	1	Toka					
9-Oct-09	Buffalo	1	Zulu	Yes				
9-Oct-09	Giraffe	7	Kela	Yes				
9-Oct-09	Giraffe	7	Kwandi	Yes				
9-Oct-09	Giraffe	7	Loma	Yes				

9-Oct-09	Buffalo	20	Kela	Yes				Bulls turned to defend herd from lions
9-Oct-09	Buffalo	20	Kwandi	Yes				Bulls turned to defend herd from lions
9-Oct-09	Buffalo	20	Loma	Yes				Loma encountered Waterbuck while chasing, see entry below
9-Oct-09	Waterbuck	8	Kela					Kela still hunting buffalo
9-Oct-09	Waterbuck	8	Kwandi					Kwandi still hunting buffalo
9-Oct-09	Waterbuck	8	Loma					Loma encountered mid-chase with buffalo
9-Oct-09	Buffalo	1	Kela					Lone bull, not part of herd
9-Oct-09	Buffalo	1	Kwandi					Lone bull, not part of herd
9-Oct-09	Buffalo	1	Loma	Yes				Lone bull, not part of herd
12-Oct-09	Bushbuck	4	Leya					
12-Oct-09	Bushbuck	4	Toka					
12-Oct-09	Bushbuck	4	Zulu					
12-Oct-09	Waterbuck	1	Leya					
12-Oct-09	Waterbuck	1	Toka					
12-Oct-09	Waterbuck	1	Zulu					
13-Oct-09	Impala	40	Terni					
13-Oct-09	Impala	40	Tswana					
13-Oct-09	Bushbuck	1	Terni					
13-Oct-09	Bushbuck	1	Tswana					
13-Oct-09	Impala	5	Rundi					
13-Oct-09	Impala	5	Rusha	Yes				
15-Oct-09	Bushbuck	1	Rundi					
15-Oct-09	Bushbuck	1	Rusha	Yes				
15-Oct-09	Duiker	1	Rundi	Yes				
15-Oct-09	Duiker	1	Rusha					

16-Oct-09	Impala	1	Leya	Yes			
16-Oct-09	Impala	1	Toka	Yes			
16-Oct-09	Impala	1	Zulu	Yes			
16-Oct-09	Bushbuck	1	Leya	Yes			
16-Oct-09	Bushbuck	1	Toka	Yes			
16-Oct-09	Bushbuck	1	Zulu	Yes			
16-Oct-09	Impala	20	Rundi	Yes			
16-Oct-09	Impala	20	Rusha	Yes			
16-Oct-09	Impala	10	Rundi	Yes			
16-Oct-09	Impala	10	Rusha	Yes			
17-Oct-09	Bushbuck	2	Leya	Yes			
17-Oct-09	Bushbuck	2	Toka	Yes			
17-Oct-09	Bushbuck	2	Zulu	Yes			
17-Oct-09	Giraffe	7	Rundi	Yes			
17-Oct-09	Giraffe	7	Rusha	Yes			
17-Oct-09	Giraffe	1	Kela				
17-Oct-09	Giraffe	1	Kwandi				
17-Oct-09	Giraffe	1	Loma				
17-Oct-09	Waterbuck	1	Kela				
17-Oct-09	Waterbuck	1	Kwandi				
17-Oct-09	Waterbuck	1	Loma				
18-Oct-09	Waterbuck	1	Rundi	Yes			
18-Oct-09	Waterbuck	1	Rusha	Yes			

18-Oct-09	Impala	20	Kea	Yes			
18-Oct-09	Impala	20	Kwandi	Yes			
18-Oct-09	Impala	20	Loma	Yes			
19-Oct-09	Impala	20	Kea				
19-Oct-09	Impala	20	Kwandi				
19-Oct-09	Impala	20	Loma				
21-Oct-09	Impala	1	leja	Yes			
21-Oct-09	Impala	1	Toka				
21-Oct-09	Impala	1	Zulu				
21-Oct-09	Rabbit	1	leja				
21-Oct-09	Rabbit	1	Toka				
21-Oct-09	Rabbit	1	Zulu				
22-Oct-09	Waterbuck	4	Kea	Yes			
22-Oct-09	Waterbuck	4	Kwandi	Yes			
22-Oct-09	Waterbuck	4	Loma	Yes			
23-Oct-09	Giraffe	1	Kea	Yes			
23-Oct-09	Giraffe	1	Kwandi	Yes			
23-Oct-09	Giraffe	1	Loma				
25-Oct-09	Impala	12	Kea				Kea first to move. Response stopped when encountered. Eles
25-Oct-09	Impala	12	Kwandi				Response stopped when encountered. eles
25-Oct-09	Impala	12	Loma	Yes			Loma was just following Kwandi. Response stopped when encountered. elephants

25-Oct-09	Elephant	15	Kela				
25-Oct-09	Elephant	15	Kwandi				
25-Oct-09	Elephant	15	Loma				
26-Oct-09	Bushbuck	1	Temi				
26-Oct-09	Bushbuck	1	Tswana	Yes			
27-Oct-09	Giraffe	1	Kela	Yes			
27-Oct-09	Giraffe	1	Kwandi	Yes			
27-Oct-09	Giraffe	1	Loma	Yes			Loma was kicked by Giraffe, hence 0m but no 'contact'. Kela saw it last, only saw it when Loma started to chase and Giraffe started to run
27-Oct-09	Impala	15	Leya				
27-Oct-09	Impala	15	Toke	Yes			
27-Oct-09	Impala	15	Zulu	Yes			
28-Oct-09	Buffalo	2	Temi				
28-Oct-09	Buffalo	2	Tswana	Yes			
29-Oct-09	Impala	20	Kela	Yes			
29-Oct-09	Impala	20	Kwandi	Yes			
29-Oct-09	Impala	20	Loma	Yes			
29-Oct-09	Impala	1	Kela	Yes			
29-Oct-09	Impala	1	Kwandi	Yes			
29-Oct-09	Impala	1	Loma				
30-Oct-09	Buffalo	1	Rundi	Yes			
30-Oct-09	Buffalo	1	Rushia	Yes			

1-Nov-09	Baboon	30	Kela	Yes			Chase was 'medium' speed
1-Nov-09	Baboon	30	Kwandi	Yes			Chase was 'medium' speed
1-Nov-09	Baboon	30	Loma	Yes			Chase was 'medium' speed
2-Nov-09	Impala	50	Kela				
2-Nov-09	Impala	50	Kwandi				
2-Nov-09	Impala	50	Loma	Yes			
2-Nov-09	Giraffe	1	Rundi	Yes			
2-Nov-09	Giraffe	1	Rusha	Yes			
2-Nov-09	Monitor Lizard	1	Rundi	Yes			
2-Nov-09	Monitor Lizard	1	Rusha	Yes			
3-Nov-09	Impala	40	Rundi	Yes			
3-Nov-09	Impala	40	Rusha	Yes			
4-Nov-09	Giraffe	6	Kela	Yes			Got shook off
4-Nov-09	Giraffe	6	Kwandi				
4-Nov-09	Giraffe	6	Loma				
5-Nov-09	Buffalo	1	Kela				All saw it together, just chased
5-Nov-09	Buffalo	1	Kwandi				
5-Nov-09	Buffalo	1	Loma				
5-Nov-09	Impala	1	Leya	Yes			Chased for about 90m but was too fast
5-Nov-09	Impala	1	Toka				
5-Nov-09	Impala	1	Zulu				

9-Nov-09	Duiker	1	Terni		Yes		
9-Nov-09	Duiker	1	Tswana		Yes	Started eating before the duiker was dead	
9-Nov-09	Warthog	1	Kela			Only Kela saw it	
9-Nov-09	Warthog	1	Kwandi				
9-Nov-09	Warthog	1	Loma				
10-Nov-09	Impala	5	Terni			Impala ran before Lions ran	
10-Nov-09	Impala	5	Tswana				
10-Nov-09	Impala	5	Terni			Impala ran before Lions ran	
10-Nov-09	Impala	5	Tswana			Note: This is definitely a different incident to 304!	
11-Nov-09	Duiker	1	Leya			Distracted from chase by warthog crossing path	
11-Nov-09	Duiker	1	Toka				
11-Nov-09	Duiker	1	Zulu				
11-Nov-09	Warthog	1	Leya			Saw warthog while chasing duiker, left duiker and followed warthog	
11-Nov-09	Warthog	1	Toka				
11-Nov-09	Warthog	1	Zulu				
11-Nov-09	Giraffe	8	Leya	u/k	Yes	Handlers were too far behind the chase to see what happened	
11-Nov-09	Giraffe	8	Toka			During feeding Toka and Zulu showed aggression to one another, Toka only backed down once	
11-Nov-09	Giraffe	8	Zulu			During feeding Toka and Zulu showed aggression to one another, Toka only backed down once	
12-Nov-09	Impala	4	Rundi				
12-Nov-09	Impala	4	Rusha	Yes			

13-Nov-09	Impala	10	Kela	Yes		
13-Nov-09	Impala	10	Kwandi	Yes		
13-Nov-09	Impala	10	Loma	Yes		
16-Nov-09	Giraffe	8	Rundi			
16-Nov-09	Giraffe	8	Rusha			
16-Nov-09	Bushbuck	1	Rundi	Yes		
16-Nov-09	Bushbuck	1	Rusha			
19-Nov-09	Impala	3	Rundi			
19-Nov-09	Impala	3	Rusha	Yes		
21-Nov-09	Duiker	1	Temi			Temi went after bushbuck instead
21-Nov-09	Duiker	1	Tswana			
21-Nov-09	Bushbuck	1	Temi			
21-Nov-09	Bushbuck	1	Tswana			Tswana was chasing duiker
23-Nov-09	Buffalo	2	Kela	Yes		
23-Nov-09	Buffalo	2	Kwandi	Yes		
23-Nov-09	Buffalo	2	Loma	Yes		
23-Nov-09	Impala	4	Kela	Yes		
23-Nov-09	Impala	4	Kwandi	Yes		
23-Nov-09	Impala	4	Loma	Yes		
24-Nov-09	Impala	20	Rundi			
24-Nov-09	Impala	20	Rusha	Yes		
						Close enough to jump when buffalo turned and charged

24-Nov-09	Francolin	2	Leya	Yes			
24-Nov-09	Francolin	2	Toka	Yes			
24-Nov-09	Francolin	2	Zulu				
24-Nov-09	Impala	3	Leya	Yes			
24-Nov-09	Impala	3	Toka				
24-Nov-09	Impala	3	Zulu				
25-Nov-09	Bushbuck	2	Leya				
25-Nov-09	Bushbuck	2	Toka				
25-Nov-09	Bushbuck	2	Zulu				
25-Nov-09	Bushbuck	1	Temi				Out of sight at conclusion of chase
25-Nov-09	Bushbuck	1	Tswana				
25-Nov-09	Bushbuck	1	Temi	Yes			
25-Nov-09	Bushbuck	1	Tswana				
30-Nov-09	Impala	40	Temi	Yes			
30-Nov-09	Impala	40	Tswana	Yes			
30-Nov-09	Impala	2	Temi				
30-Nov-09	Impala	2	Tswana	Yes			
3-Dec-09	Duiker	1	Rundi	Yes			
3-Dec-09	Duiker	1	Rusha				
4-Dec-09	Giraffe	1	Leya				Out of sight at conclusion of chase
4-Dec-09	Giraffe	1	Toka				
4-Dec-09	Giraffe	1	Zulu				

5-Dec-09	Impala	2	Leja	Yes				
5-Dec-09	Impala	2	Tokla	Yes				
5-Dec-09	Impala	2	Zulu					
8-Dec-09	Baboon	15	Rundi	Yes				Baboons turned and chased lions, Rundi turned and ran away
8-Dec-09	Baboon	15	Rusha	Yes				
9-Dec-09	Duiker	1	Leja					
9-Dec-09	Duiker	1	Tokla					Distracted by impala - next response
9-Dec-09	Duiker	1	Zulu					
9-Dec-09	Impala	20	Leja					
9-Dec-09	Impala	20	Tokla					Impala were blocked in by thick bush and ran back past tokla. He got confused and failed to single one out
9-Dec-09	Impala	20	Zulu					
10-Dec-09	Buffalo	30	Temu	Yes				
10-Dec-09	Buffalo	30	Tswana	Yes				
12-Dec-09	Waterbuck	1	Temu	Yes				
12-Dec-09	Waterbuck	1	Tswana					
12-Dec-09	Bushbuck	1	Leja					
12-Dec-09	Bushbuck	1	Tokla	Yes				
12-Dec-09	Bushbuck	1	Zulu					
13-Dec-09	Duiker	1	Rundi	Yes				
13-Dec-09	Duiker	1	Rusha	Yes				
13-Dec-09	Impala	9	Rundi	Yes				
13-Dec-09	Impala	9	Rusha	Yes				
13-Dec-09	Monitor Lizard	1	Leja	Yes				No one ate the lizard, just played with it for a while
13-Dec-09	Monitor Lizard	1	Tokla	Yes				No one ate the lizard, just played with it for a while
13-Dec-09	Monitor Lizard	1	Zulu	Yes				Killed it by crushing its head

14-Dec-09	Tortoise	1	Leya				Showed no interest at all
14-Dec-09	Tortoise	1	Tokla				Did not approach it, but hit it while Zulu was playing/holding it
14-Dec-09	Tortoise	1	Zulu	Yes			Crunched through shell
16-Dec-09	Vervet monkey	10	Leya				Leya did not show any interest until Zulu had already caught and killed it
16-Dec-09	Vervet monkey	10	Tokla				Tokla did not show any interest until Zulu had already caught and killed it
16-Dec-09	Vervet monkey	10	Zulu	Yes			
23-Dec-09	Monitor Lizard	1	Rundi	Yes			
23-Dec-09	Monitor Lizard	1	Rusha	Yes			
23-Dec-09	Waterbuck	1	Rundi	Yes			
23-Dec-09	Waterbuck	1	Rusha				
23-Dec-09	Impala	2	Rundi	Yes			
23-Dec-09	Impala	2	Rusha				
24-Dec-09	Monitor Lizard	1	Temi	Yes	Yes		Monitor lizard played dead once it was caught
24-Dec-09	Monitor Lizard	1	Tswana	Yes	Yes		Monitor lizard played dead once it was caught
24-Dec-09	Impala	1	Temi	Yes			Temi started stalking Tswana when she began stalking the impala
24-Dec-09	Impala	1	Tswana	Yes			
24-Dec-09	Bushbuck	1	Rundi	Yes			Was a baby bushbuck
24-Dec-09	Bushbuck	1	Rusha				
2-Jan-10	Giraffe	6	Rundi	Yes			
2-Jan-10	Giraffe	6	Rusha	Yes			

2-Jan-10	Bushbuck	1	Terni					
2-Jan-10	Bushbuck	1	Tswana	Yes				
8-Jan-10	Giraffe	1	Terni	Yes			Handlers threw stick in direction of prey to get cubs to notice	
8-Jan-10	Giraffe	1	Tswana	Yes			Handlers threw stick in direction of prey to get cubs to notice	
8-Jan-10	Guinea Fowl	4	Terni	Yes				
8-Jan-10	Guinea Fowl	4	Tswana	Yes				
8-Jan-10	Guinea Fowl	1	Terni					
8-Jan-10	Guinea Fowl	1	Tswana				GF jumped out of tall grass right in front of Tswana; she jumped for it out of instinct but seemed shocked and didn't pursue	
18-Jan-10	Impala	15	Terni					
18-Jan-10	Impala	15	Tswana	Yes				
18-Jan-10	Baboon	2	Rundi	U/K	U/K	U/K	Cubs ran off into dense trees and bushes; baboon cries were heard, Rusha emerged with a baboon	
18-Jan-10	Baboon	1	Rusha	U/K	U/K	Yes	Cubs ran off into dense trees and bushes; baboon cries were heard, Rusha emerged with a baboon	
20-Jan-10	Tortoise	1	Terni	Yes	Yes		Played with it for a while but didn't break shell, handlers pushed it back into the water and it swam away	
20-Jan-10	Tortoise	1	Tswana					
21-Jan-10	Vervet monkey	2	Rundi	Yes				
21-Jan-10	Vervet monkey	2	Rusha	Yes				
24-Jan-10	Monitor Lizard	1	Rundi	Yes			lizard thrashed and got away	
24-Jan-10	Monitor Lizard	1	Rusha					
25-Jan-10	Giraffe	2	Rundi	Yes				
25-Jan-10	Giraffe	2	Rusha					
25-Jan-10	Baboon	10	Terni	Yes			Baboon & impala together; lions stopped chasing when baboons started calling	
25-Jan-10	Baboon	10	Tswana	Yes			Baboon & impala together; lions stopped chasing when baboons started calling	

25-Jan-10	Impala	3	Temi	Yes			Baboon & Impala together; lions stopped chasing when baboons started calling
25-Jan-10	Impala	3	Tswana	Yes			Baboon & Impala together; lions stopped chasing when baboons started calling
3-Feb-10	Bushbuck	1	Temi	Yes			
3-Feb-10	Bushbuck	1	Tswana	Yes			
3-Feb-10	Bushbuck	1	Rundi	Yes			
3-Feb-10	Bushbuck	1	Rusha	Yes			
3-Feb-10	Baboon	4	Temi				
3-Feb-10	Baboon	4	Tswana	Yes			
8-Feb-10	Baboon	20	Rundi		Yes		Baboon had an injury on its right front arm
8-Feb-10	Baboon	20	Rusha		Yes		Baboon had an injury on its right front arm
14-Feb-10	Monitor Lizard	1	Temi	Yes			
14-Feb-10	Monitor Lizard	1	Tswana				
14-Feb-10	Giraffe	4	Temi	Yes			
14-Feb-10	Giraffe	4	Tswana	Yes			
14-Feb-10	Baboon	10	Rundi				
14-Feb-10	Baboon	10	Rusha	Yes			
14-Feb-10	Baboon	10	Rundi	Yes			
14-Feb-10	Baboon	10	Rusha	Yes			
15-Feb-10	Guinea Fowl	7	Temi				
15-Feb-10	Guinea Fowl	7	Tswana				
28-Feb-10	Impala	1	Rundi	Yes			Morning long walk
28-Feb-10	Impala	1	Rusha	Yes			Morning long walk

28-Feb-10	Monitor Lizard	1	Rundi				Morning long walk
28-Feb-10	Monitor Lizard	1	Rusha		Yes	Yes	Morning long walk
6-Mar-10	Warthog	1	Rundi	Yes			
6-Mar-10	Warthog	1	Rusha	Yes			
7-Mar-10	Elephant	2	Terni				Handlers stopped Tswana going closer
7-Mar-10	Elephant	2	Tswana	Yes			
14-Mar-10	Zebra	2	Terni				Zebra turned and chased cubs - see response below
14-Mar-10	Zebra	2	Tswana				Zebra turned and chased cubs - see response below
14-Mar-10	Impala	20	Terni				Terni did not see impala - fleeing from zebra!
14-Mar-10	Impala	20	Tswana				Impala were already running from sound of lion/zebra chase when Tswana ran into them; disappeared from sight for about 10 minutes, so
16-Mar-10	Duiker	1	Terni	Yes			
16-Mar-10	Duiker	1	Tswana	Yes	Yes	Yes	
25-Mar-10	Impala	30	Terni	Yes			
25-Mar-10	Impala	30	Tswana	Yes			
5-Apr-10	Hippo	1	Rundi	Yes			
5-Apr-10	Hippo	1	Rusha				

References

- Adamson, Joy. 2000. *Born free: A lioness of two worlds*. New York: Pantheon.
- Administrator. 2008. An approach to conservation that integrates science, culture, education and enterprise development to protect a rare endangered animal and to help alleviate poverty in surrounding communities. <http://whitelions.org/new/index.php/home>.
- The African Lion Database. Center of Environmental Science, Leiden University. http://www.africanindaba.co.za/Conservation/bauerMerwe_african_lion_db_2002.pdf.
- ALERT. 2007. Stage two update. *Newsletter*. November.
- ALERT. 2009. Behavioural sequencing and personality development study update. *Newsletter*. February.
- ALERT. 2010a. The African lion and environmental research trust. <http://www.lionalert.org/index.html>.
- , 2010b. The program's current star hunters, the 3Ss, truly cannot be stopped. *Newsletter*. March.
- , 2010c. Night encounter update. *Newsletter*. May.
- , 2010d. The 4RTs move to Dambwa. *Newsletter* July.
- , 2010e. Life in the pride. *Newsletter*. October.
- ALERT. n.d. a. *Antelope Park: Supporting ALERT*. N.p.
- , n.d. b. *African lion rehabilitation and release into the wild*. N.p.

- Antelope Park. 2010. Location. <http://www.antelopepark.co.zw/location.html>.
- AZA Guidelines. 1997. Guidelines for Reintroduction of Animals Born or Held in Captivity. <http://www.aza.org/reintroduction/>.
- Bauer, H., P. Chardonnet, W. Crosmay and K. Nowell. 2005. Status and distribution of the lion (*Panthera leo*) in West and Central Africa. Paper presented at the West and Central African Lion Conservation Workshop, Cameroon.
- Bauer, H., K. Nowell, and C. Packer. 2008. *Panthera leo*. www.iucnredlist.org.
- Bauer, H. and S. Van Der Merwe. 2004. Inventory of free-ranging lions *Panthera leo* in Africa. *Oryx* 38 (1): 26-31.
- Bertram, Brian. 1998. *Lions*. Minnesota: Voyageur Press, Inc.
- Bourke, A., and J. Rendall. 2009. *A lion called Christian*. Great Britain: Transworld.
- Brambell, M. R. 1977. Reintroduction. *International Zoo Yearbook* 17 (1):112-117.
- Carr, Norman. 1962. *Return to the wild: A story of two lions*. New York: E.P. Dutton & Co., Inc.
- Caporella, D. 2010. Is The African Lion On The Verge Of Extinction? http://www.streetdirectory.com/travel_guide/30077/pets/is_the_african_lion_on_the_verge_of_extinction.html.

- Chardonnet, P. 2002. *Conservation of the African lion: Contribution to a status survey*. N.p.
- Chivers, D. 1991. Guidelines for reintroductions: Procedures and problems. *Symposia of the Zoological Society of London*, no. 62:89-99.
- CNBC. 2010. Lion movie highlights dangers in South Africa. <http://www.cnbc.com/id/39672785>.
- Cutler, J. 2007. Agriculture and development in Africa. http://www.eoearth.org/article/Agriculture_and_development_in_Africa.
- Father of Lions. 2010. George Adamson: Lion's best friend. <http://www.fatheroflions.org/>.
- Food and Agriculture Organization. 2006. Livestock impacts on the environment. *Spotlight Magazine*. <http://www.fao.org/ag/magazine/0612sp1.htm>.
- Fischer, J., and D. B. Lindenmayer. 2000. An assessment of the published results of animal relocations. *Biological Conservation* 96 (1): 1-11.
- Frank, L., G. Hemson, H. Kushnir, and C. Packer. n.d. *Lions, conflict and conservation*. <http://www.lionconservation.org/ScientificPapers/Lions-conflict-and-conservation, Frank-et-al.pdf>.
- Gareth Patterson. 2010. The lion man of Africa. <http://www.garethpatterson.com/home.htm>.

- Graham, K., A. Beckerman, and S. Thirgood. 2003. Human-predator-prey conflicts: Ecological correlates, prey losses and patterns of management. *Biological Conservation* 122 (2): 159-171.
- Griffin, Andrea S., Daniel T. Blumstein, and Christopher S. Evans, 2000. Training captive-bred or translocated animals to avoid predators. *Conservation Biology* 14 (5): 1317-1326.
- Griffith, B., J. M. Scott, J. W. Carpenter, and C. Reed. 1989. Translocation as a species conservation tool: Status and strategy. *Science* 245 (4917): 477-481.
- Hook, R. A., and W. L. Robinson. 1982. Attitudes of Michigan citizens towards predators. In *Wolves of the World: Perspectives of behavior, Ecology and Conservation*, eds. Harrington, Fred, and Paul Paquet, 382-394. Park Ridge, New Jersey: Noyes Publications.
- Hunter, Luke. 1998. Early post-release movements and behaviour or reintroduced cheetahs and lions, and technical considerations in large carnivore restoration. Paper presented at the Symposium on cheetahs as game ranch animals. Pretoria, South Africa.
- Hunting Legends. 2010. Hunting in Tanzania prices. <http://www.huntinglegends.com/prices/hunting-in-tanzania-prices/>.
- ImpactLab. 2010. 10 unbelievable animal friendships. <http://www.impactlab.net/2010/06/24/10-unbelievable-animal-friendships/>.

- IUCN. 1998. IUCN Guidelines for reintroductions. <http://www.iucnsscrg.org/download/English.pdf>.
- , 2005. The African lion: Assuring its conservation in West and Central Africa. October 27. <http://www.iucnredlist.org/details/15951/0>.
- Jule, K., L. Leaver, S. Lea. 2008. The effects of captive experience on reintroduction survival in carnivores: A review and analysis. *Science Direct* 141 (2):355-363.
- Kenya. 2004. Transfer of the lion *Panthera leo* from Appendix II to Appendix I. Proponent: Kenya. Proposal presented at the 13th Conference of the Parties to CITES, Thailand. CoP13 Prop 6. <http://www.cites.org/eng/cop/13/prop/E13-P06.pdf>.
- King, R. 2009. Lion population in Kenya could disappear in 10 to 20 years. http://news.mongabay.com/2009/0820-ryking_lions.html.
- Kleiman, D. 1989. Reintroduction of captive mammals for conservation. *BioScience* 39 (3): 152-162.
- Lehmann, M., P. Funston, C. Owen and R. Slotow. 2008. Feeding behaviour of lions (*Panthera leo*) on a small reserve. *South African Journal of Wildlife Research* 38 (1): 66-78.
- Lion Research Center. 2010. Daily life. <http://www.cbs.umn.edu/eeb/lionresearch/about/dailylife.shtml>.

- Lima, S. L., and L. M. Dill. 1990. Behavioural decisions made under the risk of predation: A review and prospectus. *Canadian Journal of Zoology* 68 (4):619-640.
- Mathews, F., M. Orros, G. McLaren, M. Gelling and R. Foster. 2005. Keeping fit on the ark: assessing the suitability of captive-bred animals for release. *Biological Conservation* 121 (4):569-577.
- McCarthy, T. 2004. Nowhere to roam. *Time*, August.
- Myers, N. 1975. The silent savannahs. *International Wildlife* 5 (5):4-11.
- Norman Carr Safaris. 2010. Norman Joseph Carr MBE. http://www.normancarrsafaris.com/cm/about_us/norman_carr.
- Nowell, K., and P. Jackson. 1996. *Wild cats: Status survey and conservation action plan*. Gland: IUCN.
- Packer, C. 2010. Managing human-lion conflict. <http://www.cbs.umn.edu/eeb/lionresearch/research/conflict.shtml>.
- Packer, C., D. Ikanda, B. Kissui and H. Kushnir. 2006. The ecology of man-eating lions in Tanzania. *Nature & Fauna* 21 (2): 10-15.
- Packer, C., M. Kosmala, H. Cooley, H. Brink, L. Pintea, D. Garshelis, G. Purchase, M. Strauss, A. Swanson, G. Balme, L. Hunter, and K. Nowell. 2009. Sport Hunting, Predator Control and Conservation of Large Carnivores. *Plos One* 4 (6): 1-8.
- Packer, C. and A. Pusey. 1997. Divided we fall: Cooperation among lions. *Scientific American* 276 (5): 32-39.

- Panwar, H. S., and W. A. Rodgers. 1986. The reintroduction of large cats into wildlife protected areas. *Indian Forester* 112 (October): 939-944.
- Patterson, Gareth. 1994. *Last of the free: Final chapter in the Born Free saga*. St. Martin's Press: New York.
- Patterson, Gareth. 1995. *With my soul amongst lions*. St. Martin's Press: New York.
- Pictures of Cats. 2010. History of the big cats. <http://www.pictures-of-cats.org/History-of-the-Big-Cats.html>.
- Reading, R., and T. Clark 1996. Carnivore reintroductions: An interdisciplinary examination. In *Carnivore Behavior, Ecology and Evolution*, ed. Gittleman, John, 296-336. Ithaca: Cornell University Press.
- Roach, John. 2001. Female Lions Are Democratic in Breeding, Study Finds. *National Geographic News*, July 26. http://news.nationalgeographic.com/news/2001/07/0726_lionequality.html.
- SafariNow. 2010. South African Wildlife. <http://www.safarinow.com/cms/african-wildlife/irie.aspx>.
- Schaller, G. B. 1972. *The Serengeti lion: a study of predator-prey relations*. University of Chicago Press: Chicago.
- Seddon, Philip, Doug Armstrong, and Richard Maloney. 2007. Developing the science of reintroduction biology. *Conservation Biology* 21 (2): 303-312.

- Sharma, Rishi Kumar. n.d. Carnivore re-introductions: Applying science to management. Wildlife Institute of India.
- Smithers, R. H. N. 1983. *The mammals of the southern African subregion*. Pretoria, South Africa: University of Pretoria.
- Stander, P. E. 1992. Foraging dynamics of lions in semi-arid environment. *Canadian Journal of Zoology* 70 (1):8-21.
- Tucker, Abigail. 2010. The truth about lions. *Smithsonian*, January.
- USAID. 2009. Environmental guidelines for small-scale activities in Africa: Livestock production. http://www.encapafrika.org/EGSSAA/Word_English/livestock.doc.
- Van Orsdol, K. G. 1982. Ranges and food habits of lions in Rwenzori National Park, Uganda. *Symp. Zool. Soc. London* 49:325–340.