

THE SOCIO-ECOLOGY OF RE-INTRODUCED LIONS IN SMALL RESERVES: COMPARISONS WITH ESTABLISHED POPULATIONS AND THE IMPLICATIONS FOR MANAGEMENT IN ENCLOSED CONSERVATION AREAS.

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INTRODUCTION.

Following South Africa's dramatic political changes of the '90s, increased eco-tourism is viewed as a potentially lucrative alternative to subsistence and intensive farming practices (which are usually at odds with wildlife). As a result, government, private land owners and local rural communities are all attempting wildlife reintroduction projects on a scale that is not occurring anywhere else in Africa. For most such projects the ultimate objective is to re-establish the large carnivores, in particular the lion.

At the beginning of 1999, at least ten projects had attempted to re-establish a free-ranging lion population in areas from which they had been eradicated in South Africa.

Such a large-scale effort represents an unique opportunity to study the process of restoring large carnivores to areas they formerly inhabited. The Lion Project at the University of Natal was initiated in 1996 with one of its main aims being the unification of numerous efforts at lion re-introduction in South Africa.

The project aims to gather data on lion restoration into a central database so that information and experience from different reserves is available to all practitioners of reintroduction. Presently, seven significant sites are involved in the project with data collection mostly complete from the first release of lions (which began in 1992; Table 1). These reserves represent a cross-

section of all forms of conservation land management in South Africa, i.e. National Parks, Provincial parks, privately-owned reserves and cooperative reserves comprising private owners and rural communities.

This report provides a general overview of the University of Natal Lion Project, concentrating on the research on re-introduced lion populations. It outlines the specific questions the project is examining, the study sites and the personnel involved.

The project is also collaborating with three significant long-term studies of lion populations in Africa, in Kruger National Park, South Africa (with Gus Mills), in the Serengeti/Ngorongoro Crater ecosystem in Tanzania (with Craig Packer) and in the Hluhluwe-Umfolozi Game Reserve, South Africa, but these won't be dealt with here.

Table 1. Reserves involved in the Lion Project.

Reserve	Location (province)	Size (km²)	Date lions	Number of	Founder
Phinda	KwaZulu-Natal	170	1992	13	KNP
Pilanesberg	North-west	550	1993	19	Etosha
Makalali	Northern Province	150	1994	5	KNP
Madikwe	North-west	650	1995	12	Etosha
Welgevonden	Northern Province	250	1997	5	Etosha
Ligwalagwala	Mpumalanga	140	1998	13	KNP
Entabeni	North-west	25	1999	4	Etosha

QUESTIONS. The section details some of the specific questions the project is investigating.

I. Habitat requirements, local carrying capacities and dispersal patterns in lions.

Long-term data from the Tanzanian field studies, and historical Kruger Park and Hluhluwe-Umfolozi records will provide the foundation to make a geographical assessment of each South African reserve in order to predict future ranging and dispersal patterns. Among the aims of this section, we will employ GIS analyses of the South African reserves to predict the following:

(a) Where the first colonists in each reserve will centre their home ranges. Colonising lions have first choice as to where to centre their home range within the reserve and would be expected to seek out the set of features most similar to those that confer rapid reproductive rates in similar habitat in the Kruger Park or Serengeti ecosystems.

(b) Where each successive cohort of dispersing subadults will settle. As each new set of surviving offspring leave their mothers' pride, they will have to move to areas of lower quality and should establish a range that contains the best set of remaining geographic features. This aspect of the study should also facilitate identifying those areas from which subadults are most likely to disperse out of the reserve.

(c) The likelihood that the population will persist. Coupled with data on prey biomass, the geographic study should permit a preliminary estimate of reproductive rates for each part of the reserve and thus whether the population would be likely to persist.

II. The effect of lion introduction on population size and diversity of herbivore species.

The project is assessing the impact of lion predation on community structure by monitoring the size and demographic parameters of herbivore populations in each reserve. In some of the reserves, there are large areas of the reserve where predators are excluded, thus we can make a direct comparison between predator-free and predator-present areas. Given the closed nature of each reserve, the lions will almost certainly cause some sort of change in the composition of each prey community, causing some species to decrease in abundance compared to others, or causing an overall decline in prey abundance. Data from Phinda have already documented a decline in some 'preferred' prey species as well as modified vigilance behaviour by

herbivores following lion reintroduction (Hunter 1998a,b). Where conditions exist that predators can sustain their numbers on abundant prey species, species at low densities which experience high predation pressure may undergo a population decline. A critical aim of this project is to assess the response of ungulate populations following introduction of lions and if local extinction of prey species could result from predation by reintroduced lions.

III. Monitoring and managing the genetics and health of small populations.

Reintroduced lion populations will all be subjected to an initial bottleneck (the largest number of colonists is less than 20 animals), the average population size is likely to remain small, and the effective population size (the number of individuals that breed and contribute to the next generation) may be considerably smaller. Thus even if most reserves can sustain lion populations in the short term, it is not clear whether they can be maintained in the long term without active management, including the managed movement of individuals between reserves so as to establish a meta-population. The project is collecting blood samples from every animal in every population to prepare for eventual genetic analysis. The first stage of this project is being undertaken by Jenny Grubich, in Paulette Bloomer's laboratory at the University of Pretoria.

Small populations are also subject to serious threat from infectious disease. By regularly collecting blood samples from re-introduced lions, we can monitor their exposure to serious feline pathogens, including CDV, calicivirus, coronavirus and parvovirus. In addition, as some of the study populations have been exposed to feline immunodeficiency virus (FIV) while others have not, these studies will permit perhaps the best opportunity to study the pathogenicity of FIV, which causes AIDS in domestic cats but appears to cause no disease in lions. Finally, this regime may also have benefits in tracking the emerging problem of tuberculosis in southern African lions.

IV. The influence of population complexity on vocal organisation in African lions.

Reintroduced lion populations provide unique opportunities to investigate lion vocalisation. All the parks under study are less than 1000 km² and the lion populations in each are correspondingly small (from one to several prides) reducing the complexity of the lion 'social neighbourhood'. Additionally, intensive monitoring of reintroduced lion populations has furnished an extensive database of the genetic and

social relationships between individuals, meaning that we are able to predict with accuracy all the individuals in a population which with each lion is familiar. In some cases, all individuals are familiar with all others, a situation which does not occur in established populations. The unique combination of geographic and social factors in small reintroduced populations may allow lions in small parks to have an unusually complete understanding of their neighbours and the social environment in which they live. This aspect of the project seeks to examine the effects of population size and geography on the social functions of vocal communication within and between groups of lions in small, reintroduced populations.

Specifically, this section of the research aims to address a number of questions:

1: What can listening lions learn about roarers by eavesdropping on lion vocal networks?

2: How does the complexity of the social network affect the interpretation of the roars of strangers, neighbours, and kin?

3: Do kin, group members or populations share recognisable vocal signatures?

This part of the project is being performed by Jon Grinnell, who is based at Wooster College in the USA. This will be a continuation of the work Jon performed in the Serengeti, as part of his PhD research (Grinnell, 1995; Grinnell *et al*, 1995; Grinnell & McComb, 1996).

THE RESERVES.

This section includes a brief introduction to each reserve involved in the study, listed in chronological order (i.e. from the time of lion introduction). Only summary demographic data is included here. The project maintains a complete register of all reintroduced lions and their offspring, too extensive to present here but currently in preparation for publication.

Phinda Resource Reserve.

Phinda was the first project in South Africa to reintroduce lions on a relatively large scale and as part of a planned restoration project. Lion introductions took place as two separate releases on May 1992 and February 1993. Phinda pioneered the 'bonding' of unrelated, unfamiliar animals to create prides, which was later greatly expanded upon at Pilanesberg and Madikwe (see below). Monitoring of lions was intensive since their release and all lions were located essentially daily from release until September 1995.

These data and later demographic information (such as births, deaths etc.) have been written up as a doctoral thesis and papers. (Hunter 1998a, b; Hunter & Skinner, 1998, in press). Since the reintroductions, 47 cubs have been born at Phinda: the survival rate is around 87%. 30 lions have been translocated to other sites. Phinda is privately-owned (Conservation Corporation Africa) and has one of only two free-ranging lion populations in the province, the other being Hluhluwe-Umfolozi.

Pilanesberg National Park.

Pilanesberg is the only reserve of National Park status which has reintroduced lions. All of Pilanesberg's founders were wild-caught in Etosha National Park, Namibia and were released in four separate events between July and September 1993. Unlike Phinda which sourced lions opportunistically, Pilanesberg introduced cohesive prides and demonstrated that entire prides would re-establish themselves at the release site. At least 52 cubs have been born at Pilanesberg with a survival rate of almost 79%. 18 lions have been translocated to other sites. Gus van Dyk is the resident field ecologist at Pilanesberg and is completing his MSc through the University of Natal on the Pilanesberg lions with an emphasis on the financial implications of lion introduction.

Makalali Private Game Reserve.

Makalali is entirely privately owned. Makalali introduced 5 lions in December 1994, all originating from the same pride. 9 cubs have been born in the reserve and all have survived. However, as the founders are all related, these cubs are inbred and in the first experiment of its kind in the project, Makalali exchanged two males with Kapama Game Reserve for a pair of unrelated males in 1999.

With its proximity to Kruger Park, Makalali is an important site to assess lion re-establishment in an environment very similar to the south-west region of KNP where lions occur at a high density. The historical records from this region will act as a comparative database by which we will be able to determine if the Makalali lions establish themselves as the demographic patterns from KNP would predict. Similarly, this also applies to Ligwalagwala (see below) which is very close to the southern boundary of KNP. Demographic and location data on lions at Makalali are currently being collected by rangers at the reserve, and collated by Audrey Delsink.

Madikwe Game Reserve.

Madikwe is the largest of the reserves involved with the project (see Table 1) and the second reserve in the

project under the jurisdiction of North-West Parks (Pilanesberg being the other). Madikwe's 12 founding lions originated from Pilanesberg and Etosha and were all released in 1995 with the exception of one Etosha-caught male released in 1998. Madikwe is presently the only site under study to have a full complement of large African carnivores: in addition to lions and resident leopards, reintroductions of cheetahs, African wild dogs and spotted hyaenas have taken place. Madikwe is a unique opportunity to investigate the parallel re-establishment of these different species. 26 lion cubs have been born at Madikwe and all have survived. 4 lions have been translocated to other sites. Initial data were mainly collected by Markus Hoffmeyer, who is now based at Kruger National Park. Data are currently being collected by Declan Hoffmeyer.

Welgevonden Private Game Reserve.

Welgevonden introduced 5 lions of Pilanesberg/Madikwe stock in 1997. Their behaviour and ecology is the focus of an MSc study by Johannes Killian through the University of Pretoria. Welgevonden is privately owned by a consortium of 25 owners: each owner owns 500Ha and the reserve's management operates on a constitutional basis. Welgevonden is part of the Waterberg range and abuts the Marakele/Kransberg National Park. Welgevonden and Entabeni (see below) are in close proximity and similar habitat, and so will provide comparative data on lion restoration from similar sites where the main difference will be the size of the recipient reserve, and hence the number of ungulates present. The comparison between Welgevonden and Entabeni may prove the most valuable in determining the minimum area and ungulate population sizes necessary to successfully re-establish lions.

Ligwalagwala Co-operative Reserve.

To date, Ligwalagwala is the only reserve in the project to restore lions to Mpumalanga Province and is also the only project of this sort in the country which combines private game farms, and farmland of a local tribal community (in this case, the Matsamo) under the guidance and management of the provincial conservation authority (Mpumalanga Parks Board). Furthermore, Ligwalagwala has demonstrated that it is possible to take 'problem' animals and re-establish them, in reclaimed conservation areas. Some of the Ligwalagwala founders are confirmed stock-killers caught on agricultural land surrounding Kruger; these animals have successfully been re-established at Ligwalagwala. Normally such animals are shot and are difficult to place in reintroduction efforts because of

the assumption that they will return to stock-killing behaviour.

14 lions were released at Ligwalagwala in 1998. Ligwalagwala is the first reserve attempting lion reintroduction to encounter the emerging problem of tuberculosis in lions: an earlier attempt to introduce 4 lions in June 1997 was aborted when the animals tested positive for TB and they were destroyed. Gerrie Camacho (MPB) is overseeing the project, with primary data collection in the field being conducted by Johanna Swayne.

Entabeni Private Game Reserve.

Entabeni is the most recent effort to reintroduce lions in South Africa. Four individuals of Pilanesberg/Madikwe stock were released in January 1999. At 2500 Ha, Entabeni is by far the smallest reserve involved in the project and as such, offers some unique research opportunities for lion restoration. Due to its small size and accessibility, it is possible to do very accurate game counts at Entabeni which, when repeated over time, is anticipated to yield the most precise estimates of the effect on herbivore populations of lion predation. Ultimately, this will provide valuable data in determining the minimum viable area necessary for successful lion reintroduction. Entabeni is entirely privately owned with ecotourism as its primary agenda.

CONCLUSION

The University of Natal Lion Project is ongoing and data collection is anticipated to run for at least 10 years. It probably represents the most comprehensive effort to date to gather detailed data following felid reintroduction, a field which has been poorly researched in the past, particularly in Africa. In addition to the unique ecological data the project will collect, it will also contribute valuable insight into management and conservation techniques for large cats. Beyond its application in southern Africa, this information could be applied to reintroduction projects on more endangered taxa, for example, the Asiatic lion, threatened sub-Saharan lion populations in parts of west and central Africa and the proposed restoration of lions to North Africa (see Yamaguchi, Issue #1). Furthermore, as the human population continues to grow in Africa and place increasing pressure on wildlife populations, the opportunity for these exercises on such an extensive scale may not present itself again.

For further detail on this research, contact the Project Leader, Rob Slotow, and see www.lionresearch.org/current/reintro.html and www.und.ac.za/und/lesc/lion/lion_home.htm