Aspects of the conservation of oribi (*Ourebia ourebi)* in KwaZulu-Natal

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Abstract

The oribi *Ourebia ourebi* is probably South Africa's most endangered antelope. As a specialist grazer, it is extremely susceptible to habitat loss and the transformation of habitat by development. Another major threat to this species is illegal hunting. Although protected and listed as an endangered species in South Africa, illegal poaching is widespread and a major contributor to decreasing oribi populations. This study investigated methods of increasing oribi populations by using translocations and reintroductions to boost oribi numbers and by addressing over-hunting.

Captive breeding has been used as a conservation tool as a useful way of keeping individuals of a species in captivity as a backup for declining wild populations. In addition, most captive breeding programmes are aimed at eventually being able to reintroduce certain captive-bred individuals back into the wild to supplement wild populations. This can be a very costly exercise and often results in failure. However, captive breeding is a good way to educate the public and create awareness for the species and its threats. Captive breeding of oribi has only been attempted a few times in South Africa, with varied results. A private breeding programme in Wartburg, KwaZulu-Natal was quite successful with the breeding of oribi. A reintroduction programme for these captive-bred oribi was monitored using radio telemetry to assess the efficacy of such a programme for the oribi. As with many reintroductions of other species, this one was not successful and resulted in many mortalities. However, many variables have been identified that contributed to the failure of this programme and they can be adapted to increase the chances that captive breeding and reintroduction be a viable conservation tool for oribi.

Besides captive breeding and reintroductions, the translocation of wild animals can also be effective in sustaining wild populations. Translocations usually appreciate a higher rate of success than reintroductions. A translocation of wild oribi was attempted in this study. This involved the translocation of four males and eleven females and a year-long monitoring programme. This translocation proved to be extremely successful in establishing a sustainable wild population of oribi with few mortalities and several births. However, such translocations can only be attempted when there is suitable habitat and high security from poaching.

One source of oribi for the translocation part of the study was from a housing estate that had a high density population of oribi. The existence of such a thriving population of animals on what is often a controversial type of development led to a case study investigation. Housing developments are increasing in size and in numbers in South Africa, and are rarely held accountable for the destruction caused to local habitat or wildlife. This case study used this housing estate as an example of development and conservation cooperating and enjoying the success of a thriving population of endangered oribi. Many variables have been identified that contribute to the success of this venture and that could be used as a requisite for planned housing developments in the future. In particular, clustering of houses to leave open wild areas that are managed ecologically.

Finally, the issue of illegal hunting was identified as a very serious threat to oribi conservation. Using surveys, residents of rural settlements and landowners were probed about this issue so that a demographic profile of hunters could be created. This profile could then be used to make recommendations on ways to slow the spread of illegal hunting as well as educate hunters and conservation laws. The results showed that many rural people hunt on a regular basis and most hunt with dogs. It also

showed that there is a high level of ignorance amongst these people on the laws concerning conservation and wildlife species.

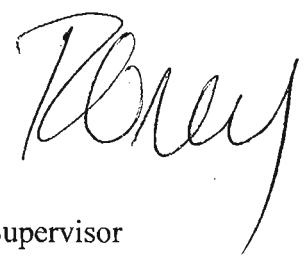
It was concluded from this study that captive breeding and reintroduction of oribi might be a way to enhance wild populations, but might be more useful in creating public awareness. Translocation, on the other hand, was extremely successful as a way of saving doomed populations and augmenting stable ones. However, it requires suitable and protected habitat. Using housing estates as havens for endangered species is an option but only if the right legislation is passed and cooperation demanded with large portions of land remaining undeveloped. Addressing illegal hunting is the most important, and possibly the most difficult hurdle for oribi conservation besides habitat destruction. Finally, recommendations for oribi conservation and management were made based on the results from this study.

Preface

This research was conducted at the School of Biological and Conservation Sciences at the University of KwaZulu-Natal, Pietermaritzburg. The project was supervised by Professor Colleen Downs and co-supervised by Professor Kevin Kirkman.

This study represents my original work and has not been submitted in any form to another University. It is presented with chapters as manuscripts prepared for submission to various journals.

Candidate



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Acknowledgements

This research could not have been accomplished without the help of many generous people. At the beginning of my study, I was a foreigner in a new country and did not know anybody, did not know how to drive a manual car, and did not know what an oribi looked like. Thanks to the kindness of everyone involved in this project, I have overcome all my initial frustrations and have made South Africa "home". This project has also made me extremely passionate about oribi and trying to save them.

Without funding this research would never have been possible, and my utmost gratitude goes to the Taeuber Family for making this possible. They were most accommodating and friendly during my field trips to Fountainhill and will always remain life long friends.

The World Wildlife Fund generously controlled funding for this project over its two year extent. Their involvement kept my budget in line and accurate until the last penny!

The students who have assisted me throughout these two years of field work put in long, sometimes hard hours of work tracking oribi or interviewing survey participants. They often sacrificed weekends or vacations to assist me or take over when I was unavailable. They deserve the highest praise for their hard work and great attitudes.

The non-profit group the Bateleurs were immediately up to the challenge of helping me count oribi from the air in their microlights. The pilots that flew and the causes they fly for are acknowledged.

Cliff Dearden was instrumental in educating me about radio telemetry and it's endless possibilities. He was always available whenever I called on him for assistance and always made a plan for short notice work.

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The Oribi Working Group committee has been extremely gracious and supportive since the first day I sat through a meeting. As the youngest member and only woman on the committee, I have never felt disrespected or unimportant. They have assisted me with anything I have ever needed, and they are a dedicated group of people all sharing one goal: saving the oribi.

Dr. Dave Rowe-Rowe has not only provided endless hours of reading material with all his publications over the years about oribi, but he has also been available to chat anytime I needed to consult his wealth of knowledge. Thi is greatly appreciated.

Prof. Kirkman in the Grassland Science Discipline, School of Bilogical and Conservation Sciences at the University of KwaZulu-Natal has been assisting me from the moment I set foot in South Africa. His help with getting this project started and checking to make sure things were on track is appreciated, as are his constructive comments on all aspects of this document.

Prof. Colleen Downs was the most influential person assisting me with this research. When things were not going well, Colleen took me on as a student and has given me a sense of respect and friendship that very few advisors share. Such an understanding made it extremely difficult to let her (and ultimately myself) down during the formation of this document. All of her help and insight will never be forgotten, thank you.

Mike Ross was initially a great help with the capturing and collaring of study animals, but very quickly became more than an assistant, he became my husband. Being a husband-wife team has not always been easy, but we pull it off and I love you for that. Thank you for all your hard work and putting up with long hours of me typing!

Last but not least, my wonderful family..... I still wonder how I managed to leave you in Texas and move here. The hardest part of doing all this research was being apart from you. And yet, you are the ones who made it possible to be here. Mom, how you put up with such a tomboy as a daughter I have no idea, but you supported me no matter what. Dad, you planted the "Africa" seed after all those years of hearing your Zim stories. And you've supported this adventure in more ways than one. You two will never know how much I love and appreciate you.

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Chapter 1

Introduction

The oribi *Ourebia ourebi* is a member of the family Bovidae and tribe Neotragini, or dwarf antelopes. It averages about 14 kg and is the most gazelle-like of the Neotragini (Estes 1991). Oribi are a light tan colour with a characteristically black tail. Only the males in the species have horns which average 8-19 cm in length (Estes 1991). Oribi possess six of the seven different sets of scent glands, including the: preorbital, subauricular, inguinal, hoof, carpal and metatarsal (Estes 1991).

The oribi historically had quite a wide distribution ranging from Senegal to Ethiopia south to the KwaZulu-Natal, Eastern Cape, Free State and Mpumalanga provinces of South Africa (Adamczak 1999). This small antelope (males average 58 cm high and 14 kg while females average 59 cm and 14.2 kg, Smithers 1983, Skinner & Chimimba 2005) is the only member of the Neotragini tribe that is primarily a grazer (Estes 1991). Prime oribi habitat consists of northerly and easterly slopes that contain a high percentage of 'sweet' palatable grass species such as *Themeda triandra* and *Andropogon schirensis*, and gentle slopes and open grassland are preferred (Perrin & Everett 1999). Oribi require high quality forage due to their small size and high metabolic rates. Grass species that decrease in abundance when veld condition deteriorates in condition are put in the decreaser category of grasses according to Tainton (1981). Decreaser species are highly selected for in the oribi's diet, such as the above-mentioned *T. triandra*, *A. schirensis*, and also *Monocymbium ceresiiforme* (Everett et al. 1992).

When considering the selective nature of the oribi in both grassland habitat and dietary requirements, it is vital to realize the importance of good management practices. In a study done by Everett et al. (1991), oribi responded positively to recently burnt or mowed grassland because of their preference for short grass for feeding, and longer grass

areas for resting, cover, and the concealment of young (Everett et al. 1991). The most effective management combination is a biennial autumn burn with some mowed areas, or a biennial early-spring or late-winter burn combined with the provision of mowed areas, and wide firebreaks burnt in autumn (Everett et al. 1991).

In a study done by Oliver et al. (1978) on the population ecology of oribi, oribi were found in group sizes ranging from one to six, with an overall mean group size of 1.89 and an overall typical group size of 2.22. However, group size was found to vary from montane to lowland grasslands with adults occurring as pairs or single animals in the former (Rowe-Rowe et al. 1992). In tropical grassland small harem herds predominated (Rowe-Rowe et al. 1992). The oribi was described as a highly territorial antelope with males actively and aggressively chasing intruders (Oliver et al. 1978). A mean home range size of 49.2 ha was described by Oliver et al. (1978).

Loss of habitat and illegal hunting with dogs are the predominant threats contributing to the rapid rate of decline in oribi (Rowe 1985, Rowe-Rowe 1988, Marchant 1991, 2000, Millar 1970, Thompson 1973, pers. obs.). The population of oribi in KwaZulu-Natal (KZN) has recently been estimated at 2,480 based on unpublished census data, with most of those animals being on private farmland (Marchant pers. comm.). In 2005, the oribi's status was upgraded from vulnerable to endangered in the Red Data Book of South Africa (Friedmann & Daly 2004). It is important to recognize that numbers from provinces other than KZN in South Africa and other countries included in the oribi's historical distribution range have not been estimated and are unknown.

In 1981 a questionnaire survey of all antelope on private land in KwaZulu-Natal (KZN), South Africa, was conducted. In the random survey 273 farmers responded, and on 66 farms oribi were present, while on 20 (23%) oribi had disappeared within living memory (Howard & Marchant 1984). The fact that oribi had at that stage already

disappeared from so many farms, in addition to the now fragmented distribution of oribi due to loss of grassland habitat, afforestation and agriculture, was cause for concern. In 1998 a follow-up survey to assess status of oribi on the same farms involved in the 1981 survey gave even more alarming results. Oribi had gone extinct on 25% of the farms since 1981, and the numbers had decreased on an additional 31% of farms (Marchant 2000). The number of oribi on these farms declined significantly from 632 to 282. Provisional analysis of a far more extensive oribi survey in 2000/2001 (covering 292 farms so far) has given similar results (unpublished, Figure 1). Projections from habitat transformation modelling indicate that virtually the entire grassland habitat of oribi in KZN is likely to disappear if no interventions are made (Ezemvelo KZN Wildlife unpublished data). In southern Africa, the grassland biome is seriously threatened by human impacts (O'Connor & Bredenkamp 1997, Hoffman 1997). The oribi is now one of Africa's most threatened antelope species (Marchant pers. comm., Friedmann & Daly 2004).

Various aspects of oribi ecology and behaviour have been studied. The basic ecology and reproduction of oribi has been reported by Leuthold (1977), Oliver et al. (1978), Reilly (1989), Everett (1991), and Jongejan (1991). Everett et al. (1992), Reilly et al. (1990) and Shackleton and Walker (1985) researched the diet of oribi at various sites, while the habitat preferences and management have been examined extensively (Rowe 1985, Shackleton & Walker 1985, Everett et al. 1991, Mduma & Sinclair 1994, Van Teylingen & Kerley 1995, Perrin & Everett 1999). The unique behavioural aspects of oribi have been covered by Adamczak (1999), Arcese (1999), Brashares and Arcese (1999), Gosling (1972) and Viljoen (1982).

Very few records of oribi in captivity exist (pers. comm. with zoos worldwide). Sixty-three records from three different facilities (National Zoological Gardens in Pretoria,

Lichtenburg satellite facility of the National Zoological Gardens, and Johannesburg Zoo) in South Africa were obtained on the proviso that the data were not published. These data were analyzed and showed that oribi tend not to do well in captivity. The records date back from 1931 to 2005, and showed that of 45 captive-bred oribi, 42% died within their first year, and of 18 wild caught oribi, 67% died with their first year (Grey, unpublished data). This suggests that the captive husbandry and management of oribi is not well understood.

There were several objectives to this study. First was to start a monitoring programme for an existing reintroduction programme for oribi. Unfortunately, thorough post-release monitoring is often neglected in reintroduction programmes (Scott & Carpenter 1987, Griffith et al. 1989, Beck et al. 1994, Sarrazin & Barbault 1996, Kleiman 1997, Fischer & Lindenmayer 2000) and failures are rarely reported (MacNab 1983). Beck et al. (1994) report that as recently as 1994, less than half of projects known to have reintroduced captive-born animals had documented in detail their procedures and outcomes. Information gathered from this monitoring programme can be used to formulate recommendations for future captive breeding programmes and reintroductions.

Second, as one of the factors causing oribi to decline is hunting, another goal of this research was to conduct surveys in rural settlements that could help identify the demographic of people most likely to hunt illegally and the mechanisms behind poaching. White et al. (2005) note that "quantifying public perceptions is becoming a key component in translating ecology into management" and that "questionnaires are useful for quantifying human behaviour, for example perceptions or attitudes towards conservation strategies and/or the implementation of environmental conservation directives" (Kerr & Cullen 1995, White et al. 1997, 2001, 2003, Jim & Xu 2002, Obiri &

Lawes 2002, Bouton & Frederick 2003). This part of the study probed the social aspect of illegal hunting which contributes so much to the oribi's decline.

Third, this study aimed to document the outcome of the translocation of wild oribi. Many oribi populations face local extinction due to rural land transformation and hunting pressures. Translocation of oribi occurs on a limited basis in South Africa, and this has never been well documented, monitored or followed up to gauge its efficacy as a conservation tool for this species. Translocation was defined by Wilson and Stanley Price (1994) as "involving movement of wild-born individuals or populations from one part of their range to another". Translocation attempts have been shown to enjoy a higher success rate than releasing captive-bred animals (Griffith et al. 1989, Wolf et al. 1996) and need to be explored as another way of re-establishing depleted oribi populations.

Fourth, this project conducted a case study of a housing estate located in KZN that takes great measures to protect its local oribi population and has seen a very successful growth. Land development is forever on the increase, and can significantly change habitats and detrimentally affect oribi populations (Hoffman 1997). However, depending on the development type, and with certain management pre-requisites and ongoing management practices, such schemes could assist oribi and other conservation efforts. In particular these areas can form reservoirs and safe havens for endangered species like oribi.

Each of the above is covered in separate chapters that are in journal format. These are followed by a conclusion chapter and management recommendations.

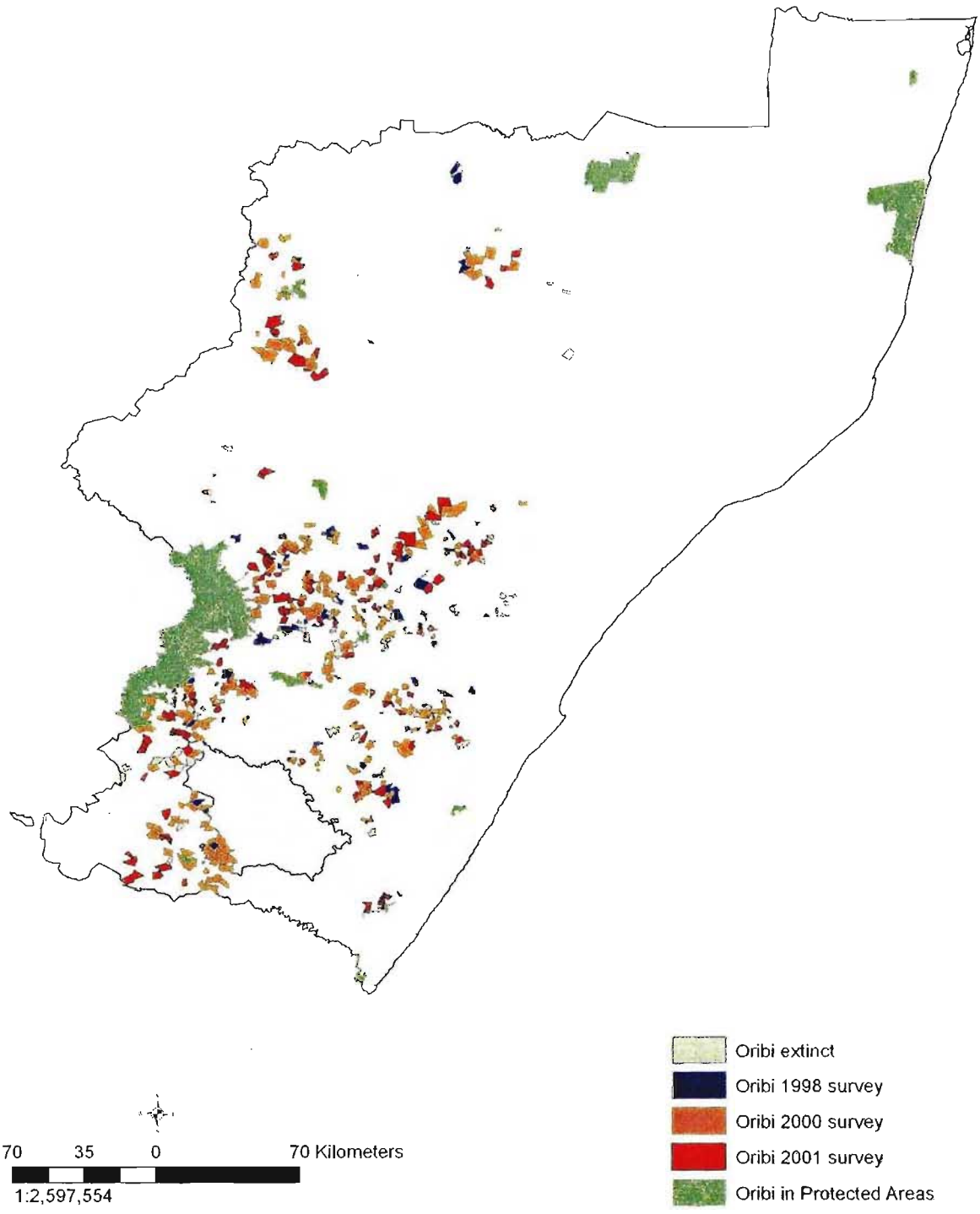

Figure 1. Distribution of Oribi in KZN (Marchant, unpublished)

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Chapter 2

Monitoring of reintroduced, captive-bred oribi *Ourebia ourebi*

Chapter prepared for submission to the Journal of African Zoology.

Abstract

A privately owned captive breeding facility for oribi *Ourebia ourebi* in KwaZulu-Natal has been reintroducing captive-bred oribi on to the surrounding agricultural/game farm for the previous 10 years. However, the success of these reintroductions was unknown. Consequently the aim of this study was to monitor the success of the reintroduction of captive-bred oribi. As in previous years, ten captive-bred oribi were released by the facility onto the surrounding farm. Survivorship of the reintroduced oribi was monitored using radio telemetry, and to identify the factors involved in a successful or failed reintroduction attempt. Within two months, seven of the ten oribi were dead, their causes of mortality varied, but predation by natural predators and humans was a major factor. Consequently no further reintroductions on to this property were advised. All factors are of concern need to be addressed in future captive breeding, reintroduction and management of oribi.

Introduction

The oribi *Ourebia ourebi* is widely distributed on the African continent from Senegal to Ethiopia down to the KwaZulu-Natal, Eastern Cape, Free State and Mpumalanga provinces of South Africa. In South Africa, oribi are most predominant in KwaZulu-Natal (KZN), with patchy distributions extending into the Eastern Cape, the Free State and Mpumalanga (Adamczak 1999).

As a consequence of its specialized habitat requirements, the oribi, a small antelope (males average 58 cm high and 14 kg while females average 59 cm and 14.2 kg, Smithers 1983) is confined to grasslands that can provide high quality grazing as well as cover (Everett 1991). Its distribution in South Africa has been greatly reduced in living memory as grasslands are converted for agricultural uses and illegal hunting with dogs becomes more prevalent. Oribi are preyed upon by hunting dogs (Millar 1970, Thompson 1973, Rowe 1985, Rowe-Rowe 1988, Marchant 1991, 2000) and populations can go extinct or decline rapidly after a few assaults by poachers. As of 2004 only 2,480 oribi remained in KZN and of those, 75% are on private land (Marchant pers. comm.). These threats and the declining populations are the reason that oribi have recently been upgraded from vulnerable to endangered in the Red Data Book of South Africa (Friedmann & Daly 2004).

The Oribi Working Group (OWG) was established as an extension of the Natal Parks Board (now Ezemvelo KZN Wildlife) and the Endangered Wildlife Trust to bridge the gap between private landowners and conservation officials so that the remaining oribi on private land can be adequately protected and managed. Another goal of the OWG is to identify ways to restore oribi populations. Besides protecting wild populations, an alternative was captive breeding as a possibility to restore populations through reintroduction (Rushworth 2003).

Several South African zoological institutions display captive oribi but show poor breeding history and high mortality rates. Very few records of oribi in captivity exist (pers. comm. with zoos worldwide). Sixty-three records from three different facilities in South Africa were obtained on the proviso that the data were not published. The records date back from 1931 to 2005, and showed that of 45 captive-bred oribi 42% died within their first year, and of 18 wild caught oribi 67% died within their first year (Grey, unpublished data). These data were analyzed and showed that oribi tend to do poorly in captivity. This suggests that the captive husbandry and management of oribi is not well understood.

In the early 1990's, measures were taken by a private farming family to initiate a captive breeding programme for oribi in KZN in light of the rapidly declining wild populations. Initially, this programme was not managed scientifically and records were not kept on births and mortalities of oribi. However, in recent years the owners identified the need to manage the facility and animals more closely with the assistance of captive breeding experts. This privately owned captive breeding facility is one of the few successful oribi breeding facilities on record in South Africa. Following the successful breeding of oribi, the owners had been reintroducing captive-bred oribi on to their surrounding agricultural/game farm for the past 10 years. However, the success of these reintroductions was unknown as there was no post-release monitoring programme in place. These reintroductions were conducted with the objective of establishing viable oribi populations in the wild from captive-bred founders on the property. Of concern was that over the last ten years, none of the over 50 oribi released on this property by the landowners had established on the farm or had been observed frequently after their releases (Taeuber V., pers. comm.).

Generally thorough post-release monitoring is often neglected in reintroduction programmes (Scott & Carpenter 1987, Griffith et al. 1989, Beck et al. 1994, Sarrazin & Barbault 1996, Kleiman 1997, Fischer & Lindenmayer 2000) and failures are rarely reported (MacNab 1983). Beck et al. (1994) report that as recently as 1994, less than half of projects known to have reintroduced captive-born animals had documented in detail their procedures and outcomes. Of these, very few have focussed on grazing antelope (Dunham et al. 1993).

Consequently in 2004 a post-release monitoring programme was initiated to assess the outcome of the reintroductions of captive-bred oribi from the private breeding facility on to the surrounding agricultural/game farm. In the first year of the post-release monitoring programme it was decided to follow the protocol that had been previously used with no changes to their husbandry and no pre-release preparations with the exception of radio-collaring the oribi so that they could be monitored using radio-telemetry. Other southern African small antelope have been drugged and radio-collared successfully in other studies (Lawson 1986, Bowland 1990, Chapter 3).

Ten captive-bred oribi from the breeding facility were reintroduced as had been done previously. The primary objective of this first year of the post-release monitoring was to identify the factors involved in either a successful or failed reintroduction attempt. It was envisaged that these results would influence the subsequent years' protocol for the husbandry, reintroduction and management of oribi at this facility, as well as other proposed facilities.

Methods

Study Area

Fountainhill Estates is a long established private commercial farm and nature reserve outside the town of Wartburg, KZN (Fig. 1), SA (S 29° 27' 02.5" E 30° 32' 42.3"). Its size is approximately 3000 ha with 1600 ha left in its natural state and conserved for wildlife. The area is a mix of Valley Thicket Biome and Natal Central Bushveld Savanna Biome (Low & Rebelo 1996). Many large mammal species, both natural and introduced, occur on the property, including zebra *Equus burchelli*, blesbok *Damaliscus dorcas*, reedbuck *Redunca arundinum*, impala *Aepyceros melampus*, nyala *Tragelaphus angasii*, kudu *T. strepsiceros*, bushbuck *T. scriptus*, giraffe *Giraffa camelopardalis*, caracal *Felis caracal*, black-backed jackal *Canis mesomelas* and leopard *Panthera pardus*. Most of the property is secured by a 2-m high standard game fence enhanced by electrified strands. The property is bordered by other sugarcane farms.

The Fountainhill captive breeding facility for oribi was situated in the centre of the property and consisted of nine individual pens situated close to an inhabited farmhouse. At the time of this study, the breeding paddocks varied in size from 1-3 ha and also varied in vegetation type and cover. Some paddocks contained extremely thick bush while others were entirely grassland. Management of the Fountainhill captive oribi was poorly recorded and unscientific up to the 2004 release. A keeper checked on and fed them a supplemental game pellet coated with a deworming agent every morning but there were no detailed records of breeding, births, deaths, movement or release over the years. There is very little documentation of how many original founders there were or where they came from. No genetic considerations were made for these captive oribi in that matings were random and not planned to avoid possible inbreeding.

Censusing of wild oribi at Fountainhill Estates

A number of census's for presence of wild oribi on the Fountainhill property were conducted prior to and after the release of the captive-bred oribi in 2004. Due to its small size, social behaviour and camouflaged colouring, the oribi is a difficult species to accurately count. Consequently two techniques, aerial censusing and known group counts, were attempted (Collinson 1985).

Aerial counts are very popular for game counts. Use of either a fixed-wing airplane or a helicopter are generally considered ideal for this, but are normally exorbitant in cost. Until recently microlights had not been used much to census wildlife, but are relatively inexpensive to run and much quieter. Although less accurate than a helicopter count, microlight counts are more accurate than fixed-wing aircraft (Peel & Bothma 1995). Two weeks prior to the 2004 release of captive-bred oribi all grassland habitat on Fountainhill Estates was surveyed using microlight aerial surveys. Three microlights took off at 6am on April 3rd, 2004, and flew strips over the Fountainhill grassland habitats. In addition the captive oribi pens were also flown over to determine the number seen there. In each microlight there were two observers (including the pilot) that looked for presence and numbers of oribi within a 100m strip on either side of the microlight. The microlights travelled approximately 300 ft above ground at a rate of 60 km per hour. The entire count took 30 minutes.

The known group count method (Mentis 1978, Collinson 1985) involves searching the entire census area systematically and continually until all individuals or groups of oribi are identified and counted, and the area surveyed completely. Because oribi are territorial animals and resident groups are relatively easy to distinguish from one another, this allows them to be counted over a series of drives and observations both day and night

(Everett 1991, Marchant pers. comm.). Fountainhill grassland habitats were surveyed repeatedly in the months prior to and after the 2004 reintroduction of captive-bred oribi using the known group count method.

Capture, fitting of radio-collars and release of captive-bred oribi

Prior to the release, the 22 captive-bred oribi in the Fountainhill pens were observed randomly over a period of four months. Of these, ten oribi were chosen for the 2004 reintroduction on the basis of good health and existing family groups. The paddocks they were in varied in size from 0.5-1.5 ha.

A professional game capture team, Ross Game Capture, and a veterinarian, Dr. Rick Mapham, began the capture at 7am on April 5th 2004, using two methods, chemical darting and net capture. Chemical darting using the immobilizing drug M-99 (Novartis, 1 mg per male, 1.2 mg per female) from a maximum of 25 m away was possible for seven animals. As the drug action was rapid, darted oribi were immobilized within two minutes and captured. A short term tranquilizer, Haloperidol (Kyron Laboratories, 5 mg per animal) was given immediately after capture to calm the animals before their release (Drug volumes were based on average oribi body mass described by Smithers, 1983). The reversal drug M50-50 was administered to each animal (Novartis, 2 mg per male, 2.4 mg per female) within three minutes of immobilization to reverse the effects of M-99. Net capture was employed for three animals that were difficult to dart. A net was set up along one side of the particular paddock and beaters directed the oribi into the nets where they were caught by hand and then injected with Haloperidol as above.

As each animal was caught, basic measurements (total length, tail, hind foot, height at withers, head plus neck, girth and horns), body mass and gender were recorded by an

assistant. In addition, each was fitted with an eartag for identification and a radio collar (Sirtrack, NZ, weight of collar < 5% of total body mass) that was fastened around the neck. Each radio collar consisted of a soft leather collar portion that measured approximately 19 cm once fixed around each animal's neck and was connected with two small bolts. The collar enclosed a battery powered Sirtrack transmitter designed to transmit for up to two years. Each had a mortality sensor designed to set off a distinct signal if the animal was still for more than six hours. As soon as the measuring and fitting process was finished, each oribi was placed into an individual holding plywood crate (144l x 44w x 123h cm). Each crate had sliding doors at both ends as well as five ventilation holes on each door. Animals were transported in the crates to the nearby grassland habitat in the nature reserve section of Fountainhill Estate where previous captive-bred oribi had been released. Within this area two pre-determined release sites were chosen where oribi were released within three hours of their capture. Established pairs were released together. Five animals were released at each location. All ten animals, consisting of 4 males and 6 females, were adults although their exact ages remain undetermined. All ten animals appeared in good condition when examined by a veterinarian prior to release. Their body measurements are shown in Table 1. No supplemental feeding was given after the release. These procedures with the exception of the measurements followed the previous protocol used by the landowner when releasing the captive-bred oribi.

Post-release monitoring using radio telemetry

Initially, the ten reintroduced oribi were located every 2-3 days using radio telemetry for the first month. Monitoring using radio telemetry was conducted from a vehicle until the

animal was within 100m and then approached on foot. The exact location (latitude and longitude) of the animal was obtained using a Global Positioning System (GPS) (Garmin eTrex personal navigator). In addition, date, time, weather conditions, habitat type, and notes on activities of the oribi were recorded. The GPS data of oribi locations was plotted in Arcview (Environmental Systems Research Institute, Redlands, California) and distances calculated using the measuring tool. If the radio-transmitter mortality sensor was activated, the position of the signal was tracked and the reason investigated and recorded. For animals that survived the first month, frequency of post-release monitoring was reduced to weekly sightings and then monthly sightings after 3 months post-release for a period of a year.

Changing of release protocol for captive-bred oribi and release in subsequent year

As a consequence of the results from the initial release and the lack of oribi on Fountainhill Estates, no further releases were conducted during this study.

Results

Censusing

No oribi were seen during the microlight surveys in the grassland habitat of Fountainhill Estates. Only one oribi out of 22 in the captive pens was seen from the microlights and this was only during a second fly-over. Although this low count of the captive oribi was possibly a consequence of the dense vegetation in some of the pens, it suggests that this count method is inappropriate for oribi.

When doing known group counts, a total of 430 km were driven on 23 different monitoring trips both before and after the release from March 2004 to March 2005. Only

one young, male oribi was observed on the Fountainhill Estates during this period. This emphasizes that there were very few oribi present on Fountainhill Estates despite prior releases over a period of at least ten years. Furthermore, the property owner had seen one pair of oribi only twice in the last six months prior to the 2004 release, and another one or two animals very sporadically thereafter (Taeuber, pers. comm.).

Survival of captive-bred oribi post release on Fountainhill Estates 2004

In April 2004, ten captive-bred oribi were reintroduced onto grasslands on Fountainhill Estates. Mortalities of reintroduced oribi occurred very rapidly and for a variety of causes (Table 2). Within one week of release (exact dates listed in Table 2), the first death occurred. This was a male oribi that had no visible signs of trauma, and a necropsy performed by a veterinarian could not confirm a cause of death but suggested a toxin might be involved (Tatham, pers. comm.). Two weeks after that, another male was found with a badly broken leg that appeared to have been caused by getting caught in a fence. Veterinary intervention was requested and the animal was placed back in captivity with a strapped leg that has since healed. It was assumed for the purposes of this study that he would have died without medical attention. That same day, the first female mortality was documented. Bite marks and feeding pattern suggest that it was preyed upon by a caracal *Felis caracal* (Rowe-Rowe pers. comm.). Five days later, the fourth death was recorded. This was the first animal taken by poachers. It was a female oribi that had moved off Fountainhill Estates onto a neighbouring property three days earlier for reasons unknown. With use of telemetry, the skin and collar were found in an informal, rural settlement on the outside of the southern boundary of Fountainhill. The very next day the fifth death, also a female was found poached at another nearby settlement of farm labourers outside the eastern boundary of Fountainhill. Only a few days after these poaching incidences

another oribi, the sixth mortality, a male was found dead. Its remains did not give evidence as to the cause of death because they were too spread out and had been scavenged, making it unclear as to whether the animal was killed by a predator or died and was then scavenged. Despite daily repeated attempts to locate her, a female that could not be located for a week was also found dead 39 days after release. Its cause of death remains unknown because its remains were too decomposed to conduct a necropsy. However, inadequate nutrition is suspected based on its prior locations before death which were thick vegetative areas along a streambed where there was no suitable grazing (pers. obs.). This female had moved away from the release site for reasons unknown. Another female jumped through two game fences to return to its original paddock. It was decided to leave her in the paddock. Soon after, the collar of male #500 was found without any clues to his demise. As seen in Table 3, most of the reintroduced oribi died not far from where they were released and survived less than three months post-release in the wild (Table 2).

As of May 2005, only one of the original ten animals is still in the 'wild'. This female travelled (Table 3) considerable distances (like her deceased counterparts), but eventually established herself close to the captive breeding facility. The female paired up with an uncollared male which could be the one found in the known group count censusing method.

Distances tracked from release sites and distance from release site to mortality site

The reintroduced oribi moved an average of 4520m before their deaths (calculated by measuring straight lines from each observation to the next) (Table 3). Several animals travelled more than 6000m from their release site before their demise and did not appear

to have any pattern in their movements. The mean distance from release site to mortality site was 1832m (calculated by measuring straight lines from release site to mortality site) (Table 3, Figure 2). Home ranges were not defined because the animals did not settle and because there were so few fixes. Movement data shows that the oribi dispersed almost immediately upon release and did not stay in the vicinity of the release sites or in groups (Table 3, Figure 2).

Discussion

This reintroduction of captive-bred oribi was a failure, as shown by the post-release monitoring programme. This emphasizes the need for monitoring reintroductions, especially of captive bred animals. This was not the first reintroduction of captive bred oribi on this property, but it was the first implementation of a monitoring programme of reintroduced oribi. Unfortunately the regular monitoring revealed the reality of what has more than likely happened to the over 50 released (as reported by landowner, no records kept as to dates of previous releases), captive-bred oribi over the past ten years., particularly as few oribi were observed on the property. It appears that the protocol for release of captive-bred oribi needs to be revised. Any further reintroduction attempts of the captive-bred oribi on to the property were halted pending further research on the best methods of breeding and reintroducing captive-bred oribi.

As mentioned, this study was a monitoring programme of the procedure and success of released, captive-bred oribi at Fountainhill Estates as implemented previously for ten years, and so no changes were made in the way the reintroductions were implemented, despite our concerns. Before the release of the captive-bred oribi, several variables were identified as potentially affecting the successful outcome of this reintroduction. The first

was the relative tameness of the captive population. Due to poor records, there was no way of knowing the ages of the release candidates, but because they were all adults they had all been living in captivity for at least several years (as reported by landowner). Animals in captivity, such as these oribi, or in isolated populations that have not had any experiences with predators may not express appropriate antipredator behaviour and may therefore be more at risk to predators upon release (Griffin et al. 2000, Griffin et al. 2001, Blumstein et al. 2002). The captive oribi were used to being approached daily by a keeper who brought them food, therefore acclimatizing them and positively reinforcing them to the sight, sound and smell of humans. These variables certainly contributed to the mortality of at least four study animals. It is, however, important to note that wild oribi also fall prey to similar threats such as poaching, predators etc., but to what extent is unknown (Marchant, pers. comm.).

The provision of supplemental food to the captive oribi was also a concern. The need for reintroduction candidates to be able to "acquire and process food" is essential in preparation for their release (Box 1991, Kleiman 1989, Kleiman 1997). In this case, because the breeding pens had limited forage availability in the form of grass growing inside the pens as well as antelope pellets, the landowner thought that they might not have a problem weaning off of the supplement. Previously, all captive oribi were not supplemented with food after release, so it was decided that the same procedure would be followed. In hindsight, future releases on Fountainhill should consider supplemental feeding. However, as animals dispersed into unsuitable habitat, further reintroductions on Fountainhill should be discouraged. In the case of the two unknown mortalities that occurred during this study, it is possible that the inability to identify appropriate forage was one reason as they had moved into an area of unsuitable vegetation.

Poaching and natural predation were the main causes of death with this group of reintroduced oribi. These are also thought to be primary causes of death amongst wild oribi (Marchant pers. comm.), however, these factors would probably have been much less of a concern had it not been for the previously mentioned concerns (i.e. tameness, lack of predator avoidance) associated with these animals being held in captivity for so long.

A third concern regarding the reintroduction of these captive-bred oribi was the position of the release site itself. Although there is some suitable oribi habitat on Fountainhill Estate, it is limited in size and surrounded by sugar cane farms and informal settlements (pers. obs.). This site is, in effect, a fragmented and isolated area that would not allow for a safe dispersal of animals into other secure areas as recommended by Wolf et al. (1996). Releasing animals into the core of their historical range has been suggested as another criterion for successful reintroduction (Griffith et al. 1989, Wolf et al. 1996, Kleiman 1997) and Fountainhill Estate does not fit that prerequisite (pers. obs.). It also became clear that the oribi are adept at moving through various styles of fencing, including standard game fences and electrified fences. Therefore, they are not easily restricted to a particular property even with apparently secure fencing.

Having identified some of the problems affecting the reintroduction of oribi bred at Fountainhill Estate and due to the very poor success rate, it is suggested that a new management regime must be implemented for reintroduction to be considered as a viable conservation tool. To address the tameness that occurred, human contact must be restricted to an "as needed" basis only. Age of release candidates must be considered as one method of circumventing this problem as suggested by some studies. Young animals survived longer after release than old animals in the reintroductions of golden lion tamarin *Leontopithecus r. rosalia* in Brazil (Kleiman et al. 1991) and mountain gazelle

Gazella gazella at Hawtah Reserve, Saudi Arabia (Dunham et al. 1993). In contrast, Sarrazin and Legendre (2000) warn of consequences of releasing juveniles versus adults. During the present study, immature oribi appeared to be far more cautious and fearful of humans both prior to, and post-release, suggesting that young animals may be more likely than adults to avoid humans and other predators (pers. obs.). In the present study, only adults were released.

Selection of release candidates in reintroduction programmes has often been exclusively dependant on satisfying the criteria of age, sex and health (Yalden 1993, Sarrazin & Legendre 2000, Bremner-Harrison et al. 2004). Bremner-Harrison et al. (2004) and Mathews et al. (2005) propose using behavioural assessment as a "potential predictor of survival rates in released animals and used as a tool for animal selection and preparation" by assessing the natural vigilance of individual animals' and their reactions to threatening situations. Pre-release conditioning involving antipredator training in captive animals is also becoming popular as a means of eliciting proper responses to predators (Griffin et al. 2000, Griffin et al. 2001, Blumstein et al. 2002) and therefore increasing the animals' suitability as a release candidate. Behavioural assessments and predator recognition training may increase chances of success for released oribi and should be considered in future reintroduction attempts.

In future captive oribi reintroductions, other aspects of breeding oribi in captivity must be scrutinized to increase breeding productivity and population health prior to release/reintroduction, as many of these could not be controlled for in the present study, but are important. Inbreeding in various captive ungulate populations caused higher juvenile mortality than in non-inbred young (Ralls et al. 1979, Ralls et al. 1980, Ballou & Ralls 1982). The genetic viability of both captive and wild oribi is currently in question and being investigated (Rushworth, unpublished data), but genetic management of all

captive oribi in the form of a studbook should be immediately implemented. Studbooks are necessary to keeping good records and tracking a species in captivity (Mohr 1968, Glatson 1986, Ballou & Foose 1997, Shoemaker & Flesness 1997). Basic husbandry aspects of oribi such as dietary requirements, pen size and design, and social interactions also need to be re-examined and tested for maximum efficacy so that future breeding programmes are as successful as possible.

Despite the above recommendations that could improve breeding of oribi in captivity, there is some evidence to suggest it may not be viable even with the best of care. Records from zoological institutions having oribi in captivity show poor survival and little evidence of successful breeding as mentioned earlier.

The present study has highlighted that options other than captive breeding and reintroduction of oribi is required. One of these options is to translocate wild oribi from one area to another. In South Africa, because of land transformation and illegal hunting, many oribi populations are threatened and facing local extinction. Translocation of wild oribi occurs on a limited basis in South Africa (pers. obs.), and has never in itself been detailed, monitored or followed up to gauge its efficacy. Translocation is defined by Wilson and Stanley Price (1994) as "involving movement of wild-born individuals or populations from one part of their range to another". Translocation attempts have been shown to enjoy a higher success rate than releasing captive-bred animals (Griffith et al. 1989, Wolf et al. 1996) and need to be explored as another way of re-establishing depleted oribi populations. There is currently an urgent call to catch and translocate "doomed populations" of oribi that are heavily pressured by poaching and habitat loss on private land, providing the opportunity to investigate this alternative further with monitoring programmes.

In conclusion, despite the fact that this reintroduction of captive-bred oribi was not successful, it does not mean that the captive breeding and reintroduction of oribi is not an option for oribi conservation. However, unless all of the previously mentioned factors are taken into account, reintroduction of captive-bred oribi is the least preferred option, and requires well managed, scientific captive programmes and input from antelope breeding specialists and reintroduction specialists based on lessons learned from reintroductions of other species. Monitoring of this species using radio telemetry has proved invaluable to track the outcome of such an exercise and should be considered for any movement of the species, whether it be future reintroductions or translocations. The study was not repeated as planned because of the problems experienced, particularly poaching. This precluded further evaluation of the release of captive breeding using improved techniques including modifying the supplemental feeding system, size of paddocks, predator training etc. This had a significant effect on the scope of the overall MSc study, particularly from the perspective of evaluating scientific method. Shortcomings of this particular part of the study include lack of habitat assessment before release. This is defended on the basis of repeating previous practice. Detailed habitat assessment would have been part of any future releases. In future habitat assessment after release may give some information on the possible causes of death of some of the animals, and possible causes of stress which may have led to the animals moving large distances and not settling. Also, information on the required area needed per animal in relation to the total area of grassland available would be useful.

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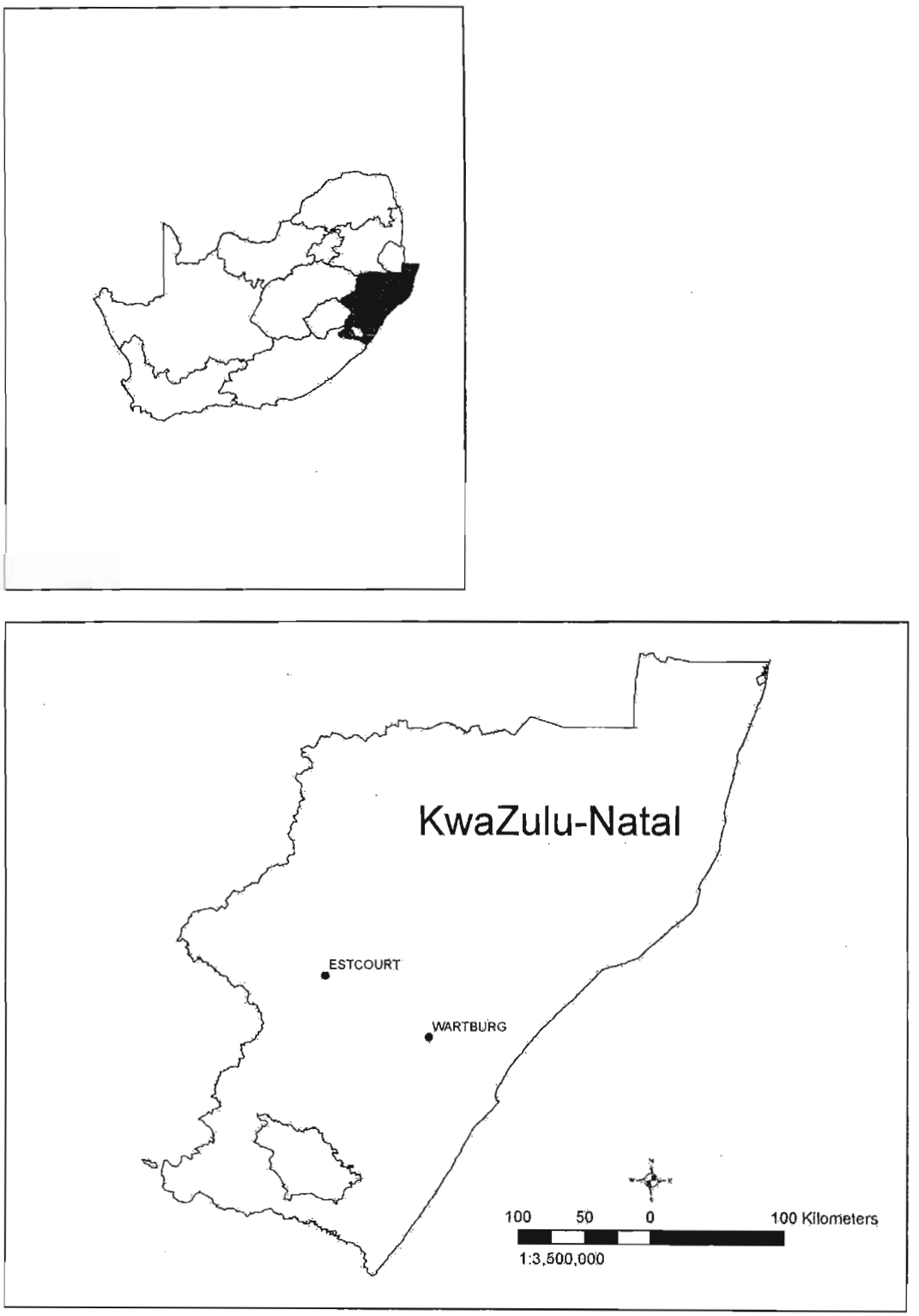

Figure 1. Location of Wartburg within KZN and South Africa near where Fountainhill Estates is located.

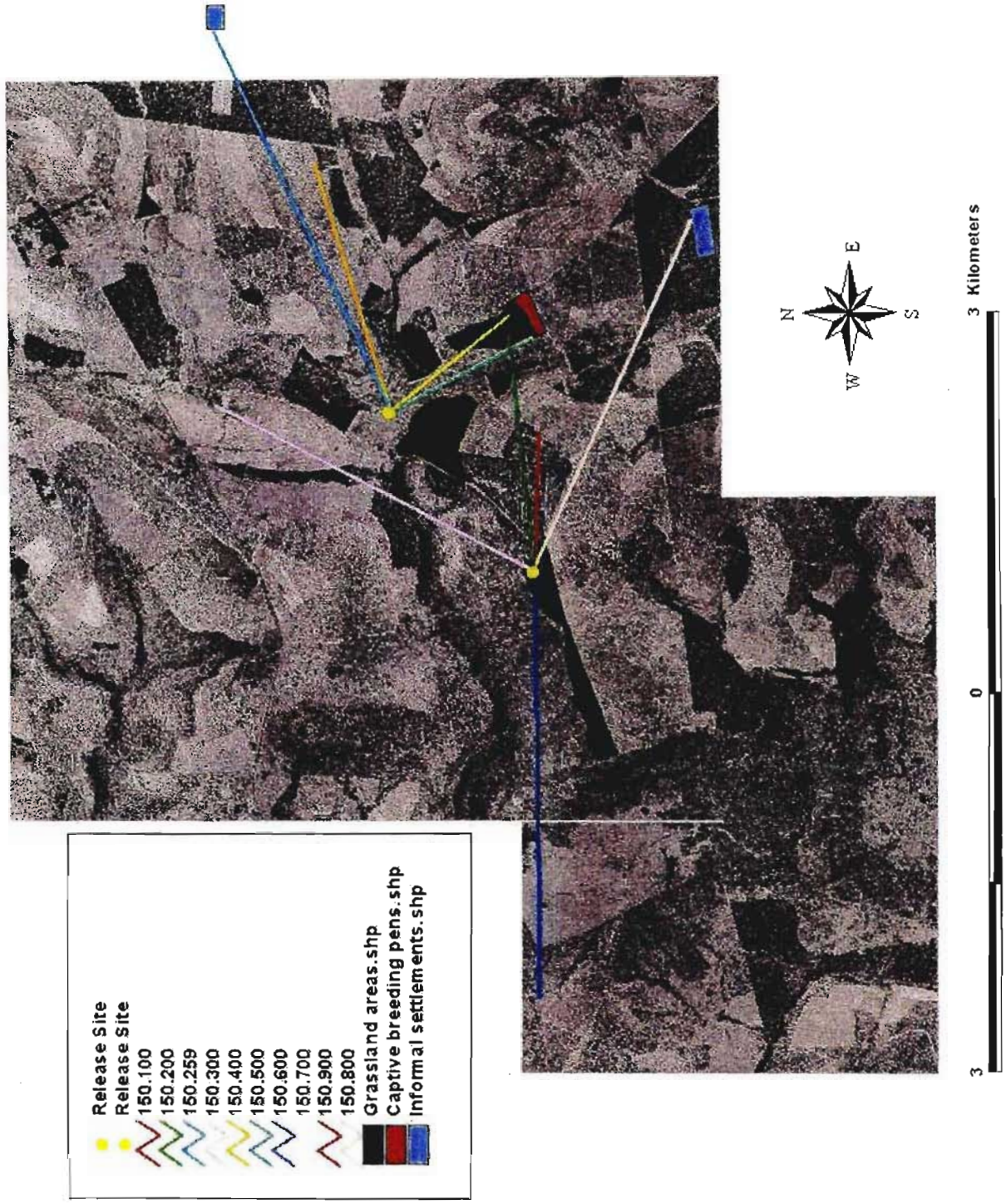

Figure 2. Distance from release site to site of mortality of each oribi reintroduced and monitored at Fountainhill Estates in 2004.

Table 1. Body Measurements of captive-bred, collared oribi prior to release

Animal	Sex	Body Mass (kg)	Total Length (cm)	Tail (cm)	Hind Foot (cm)	Height at Withers (cm)	Head plus Neck (cm)	Girth (cm)	Horns (cm)
150.259	F	15	111	9	29.4	62	49	58	n/a
150.400	F	21.5	115	7	31	67	49	61	n/a
150.100	F	22	115	5	31	65	52	60	n/a
150.200	F	18	114	8	30.5	67	49	60	n/a
150.600	F	17	110	7	31	66	50	59	n/a
150.700	F	14.5	113	7	30	64	48	54	n/a
150.900	M	12	104	7	28.5	58	46	52	10
150.300	M	14	102	8	30	63	41	54	9.5
150.800	M	13.5	102	6	29	62	46	55	11
150.500	M	14.5	104	6	30	56	47	54	10.5
Females	**N**	6	6	6	6	6	6	6	n/a
	Mean	18	113	7.2	30.5	65.2	49.5	58.7	n/a
	Min.	14.5	110	5	29.4	62	48	54	n/a
	Max.	22	115	9	31	67	52	61	n/a
	SD	3.2	2.1	1.3	0.7	1.9	1.4	2.5	n/a
Males	**N**	4	4	4	4	4	4	4	4
	Mean	13.5	103	6.8	29.4	59.8	45	53.8	10.3
	Min.	12	102	6	28.5	56	41	52	9.5
	Max.	14.5	104	8	30	63	47	55	11
	SD	1.1	1.2	1.0	0.8	3.3	2.7	1.3	0.6

Table 2. Survival and mortality of reintroduced radio-collared oribi at Fountainhill Estates during 2004/2005

Date	Sex	Cause of Death
12-Apr-2004	Male-#900	Unknown
23-Apr-2004	Male-#300	Broken Leg
23-Apr-2004	Female-#400	Caracal predation
28-Apr-2004	Female-#700	Poaching
29-Apr-2004	Female-#259	Poaching
05-May-2004	Male-#800	Predation
15-May-2004	Female-#600	Unknown
13-Sep-2004	Female-#100	Cold weather
?-Jan-2005	Male-#500	Unknown (only collar found)
N/a	Female-#200	Still alive (July 2006)

Table 3. Total distances tracked and survivorship period of captive-bred oribi released at Fountainhill Estates in 2004.

Sex/ID No.	Survival Time After Release	Total Distance Tracked from Release Site* (m)	Distance from Release Site to site of Mortality (m)
Male-#900	6 days	1087	1087
Male-#300	17 days	7192	2853
Female-#400	17 days	6124	2062
Female-#700	22 days	3699	3043
Female-#259	23 days	3420	3317
Male-#800	29 days	2247	1273
Female-#600	39 days	7857	338
Female-#100	160 days	6272	1213
Male-#500	8 months	5173	1271
Female-#200	N/a	2128	1866
Mean		**4520**	**1832**

*This value was obtained by measuring a straight line from fix to fix.

Chapter 3

Translocation of oribi *Ourebia ourebi*: is this an effective conservation tool?

Chapter prepared for submission to Conservation Biology

Abstract

The oribi *Ourebia ourebi* is an endangered small antelope that requires conservation strategies and intervention to prevent their extinction. Use of translocation as a conservation tool for subpopulations facing extinction has been proposed for antelope. Fifteen oribi from threatened populations were translocated to a nearby large private game reserve in KwaZulu-Natal, South Africa. Radio telemetry was used to monitor the translocated oribi for one year to assess the efficacy of translocation as a species conservation tool and the survival of the translocated oribi. Only one mortality was recorded during the year of observations. It appears that translocation is a viable tool for conserving wild populations of oribi, however, other factors such as suitable grassland habitat and prevention of poaching are prerequisites.

Introduction

The oribi *Ourebia ourebi* is a small antelope (males average 58 cm high and 14 kg while females average 59 cm and 14.2 kg) (Smithers 1983) found with a sparse distribution from Senegal to Ethiopia down to East Africa and the country of South Africa. In South Africa, oribi are found in fragmented subpopulations in several provinces, including the Eastern Cape, Free State and Mpumalanga, but appear to be most common in KwaZulu-Natal (KZN) (Adamczak 1999, Marchant pers.comm.).

The oribi is a specialist grazer requiring short, highly palatable grass species for grazing and long grass for cover and concealment of young (Everett 1991). Once quite common in KZN, the oribi is fast becoming South Africa's most endangered antelope due to two main threats. Land use changes are converting pristine grasslands in KZN to more economically attractive options such as sugar cane and timber (Neke & Du Plessis 2004), reducing the habitat of oribi and other grassland species such as South Africa's national bird, the endangered blue crane *Anthropoides paradiseus* (International Crane Foundation http://www.saving_cranes.org/species/blue.cfm). The other, more immediate threat is illegal hunting, specifically with dogs. Oribi fall prey to dogs very easily (Millar 1970, Thompson 1973, Rowe 1985, Rowe-Rowe 1988, Everett 1991, Marchant 1991, 2000) and fragmented subpopulations can go extinct after a successful day of dog hunting. From the 2004 oribi census, Marchant (pers. comm.) estimated only 2480 oribi were left in KZN, 75% of those on private land. Habitat loss and dog hunting have dramatically decreased oribi populations, so much so that the species has been upgraded from vulnerable to endangered in the Red Data Book of South Africa (Friedmann & Daly 2004).

The Oribi Working Group (OWG) was formed to address the threats facing oribi and to form relationships with private landowners having oribi on their properties.

Cooperation between landowners and conservation officials is crucial to the oribi's survival because most remaining oribi are on privately owned land (Marchant pers. comm.). The OWG often identifies highly fragmented and small oribi subpopulations that are vulnerable to local extinction (Marchant et al. 2005). Such populations are ideal candidates for translocation. The IUCN (1996) defines translocation as "the deliberate and mediated movement of wild individuals or populations from one part of their range to another". The OWG has identified translocation as a possible conservation strategy for oribi.

Translocations and reintroductions are often unsuccessful in establishing viable populations (Kleiman 1989, Griffith et al. 1989, Beck et al. 1994, Wolf et al. 1996, Griffin et al. 2000). Translocations and reintroductions may also be extremely expensive (Boyer & Brown 1988, Cade 1988, Phillips 1990, Kleiman et al. 1991, Wolf et al. 1996). Despite these discouraging factors, translocations and reintroductions are an increasingly popular way to try and supplement species' populations in the wild, although translocations of wild-caught animals has been shown to be more likely to succeed than were those of captive-bred animals (Griffith et al. 1989).

By looking at catalogues of game auctions held over the years and by speaking to numerous landowners, it is apparent that oribi have been translocated throughout South Africa, however, to what extent and how successful they have been is often unknown and poorly recorded. Private game capture operators and landowners have moved game species both legally and illegally, and a recent genetics study on oribi confirmed that genetically distinct sub-populations within South Africa have been mixed by the introduction of unrelated oribi (Rushworth unpub.). Marchant (1996) followed the survival of several antelope species bought at wildlife auctions using a survey. Thirty-six oribi were bought at one auction, and within two weeks of being moved only seven had

survived. Marchant found that most of the oribi were moved to unsuitable areas and habitats and this could be responsible for the deaths that occurred.

In this study, a post-translocation monitoring programme was conducted to determine whether or not translocation of oribi can be successful and what factors might contribute to the success or failure of translocations. The translocated oribi came from three populations that the OWG identified as vulnerable to local extinction. It was hoped that results would show that fragmented oribi populations may be saved by translocation efforts. Consequently the main objective of this pilot study was to determine whether translocation is a viable conservation tool for threatened oribi populations. The chief measures of success were whether most of the oribi translocated survived at least a year, remained within the private game reserve, and whether they reproduced. Unfortunately as a consequence of their rarity no other oribi were translocated during the period of study so that other instances could be monitored.

Methods

Translocation site

The Dalton Trust is a private game reserve established in 2002 near the town of Estcourt, KZN (Fig. 1), SA (S 29° 7.464' E 29° 45.9'). It is approximately 2000 ha in extent, consisting mostly of extensive grasslands, as well as thick riverine vegetation along several small streams and the Bushman's River which forms part of its boundary. The grasslands are classified as Moist Upland Grassland Biome and North-Eastern Mountain Grassland (Low & Rebelo 1996). Many species, both naturally and introduced, occur on the property, including oribi, zebra *Equus burchelli*, blesbok *Damaliscus dorcas*, common reedbuck *Redunca arundinum*, mountain reedbuck *R. fulvorufula*, red

hartebeest *Alcelaphus buselaphus*, vaal rhebuck *Pelea capreolus*, bushpig *Potamochoerus porcus*, caracal *Felis caracal*, black-backed jackal *Canis mesomelas* and leopard *Panthera pardus*. The Dalton Trust had a known population of six oribi on the property in 2004 that had been resident prior to the reintroduction. The property is surrounded by a 2.1m high standard game fence enhanced by electrified strands. Armed guards patrol the reserve 24 hours a day and check the perimeter daily.

The animals caught and translocated for this study were bought by the Dalton Trust and approved on permit by the KZN Wildlife conservation organization.

Capture and translocation of oribi

Fifteen oribi were caught and translocated to the Dalton Trust in November 2004. Eleven of the fifteen oribi came from two severely threatened subpopulations in KZN and were chosen by the OWG as translocation candidates due to the high threat levels. Five of these oribi came from a property in Middelrus, KZN that was being sold to the government of South Africa as part of a land restitution program. With such a change in land ownership and associated farming practices, such populations of oribi are vulnerable. The other six oribi came from a property near Richmond, KZN that was suffering from increased poaching. These oribi were caught by a professional game capture team, Ross Game Capture, using a helicopter and net boma. A funnel-shaped boma made up of special game nets was built on a carefully selected site. The helicopter then chased the oribi, usually one at a time, into the net boma where they were then trapped and caught manually. Haloperidol, a short term tranquilizer (Kyron Laboratories, 5ml per animal) was given immediately after capture to relax the animals before their

release. Drug amounts were based on average oribi body mass described by Smithers (1983).

The remaining four oribi came from a 60 ha property called Wedgewood Housing Estate in Hilton, KZN whose oribi population had apparently reached its carrying capacity and had surplus animals. This property was too small to use a helicopter, so a line of beaters was set up to herd the oribi into a net boma where they were also successfully caught and tranquilized as detailed above.

As each animal was caught, an eartag was put on and a radio collar (Sirtrack, NZ; weight of collar < 5% of total body mass) was fastened around its neck. The radio collars consisted of a battery powered Sirtrack transmitter designed to transmit for up to two years. Each had a mortality sensor designed to set off a distinct signal if the animal was still for more than six hours. The collar itself was made of soft leather connected with two small bolts. Each collar measured approximately 19 cm once fixed around each animal's neck. As soon as this process was finished, each oribi was placed into an individual holding crate constructed of plywood (144 x 44 x 123 cm). Each crate had sliding doors at both ends as well as numerous ventilation holes. The sex and approximate age (juvenile or adult based on body size and horn length after Smithers (1983)) of each animal was recorded, although other morphometrics were not recorded so as not to stress the animals further during the capture.

All animals were caught over a period of 4 days and transported in the crates to one pre-determined release site on the Dalton Trust within five hours of their capture. The release site was selected by the authors and landowners based on two criteria, firstly it is quite central on the reserve, reducing the chances of the oribi moving off the property. Secondly, although most of the Dalton Trust is suitable oribi habitat (as defined by

Everett 1991), this particular site is most suitable and easiest to manage (i.e. burn/mow) as per Everett's (1991) recommendations.

Post-release Monitoring

Initially, the fifteen translocated oribi were monitored once a week for two months using radio telemetry to determine their positions and their survival. In February 2004, tracking sessions were reduced to once a month and continued for another year. Tracking was conducted from a vehicle until, based on the intensity of the signal, the animal seemed close enough to approach on foot. The exact location (latitude and longitude) of the animal was obtained using a Global Positioning System (GPS) (Garmin eTrex personal navigator). Date, time, weather, location (latitude and longitude) and behaviour was recorded for each sighting.

The Home Range Extension (HRE) for ArcView (Environmental Systems Research Institute, Redlands, California) was used to analyze the observations for each animal and generate a kernel polygon showing the range expansion of each oribi from the site of release. Home ranges were not calculated because the oribi were newly released and "exploring" their new habitat, therefore, range expansion was preferred. When choosing the kernel procedure parameters for this extension, "Unit Variance" was chosen as the standardization style. Under "Smoothing Factor Automation", it was decided to use the "optimum value with reference to a known standard distribution (i.e. href)" (Rodgers & Carr 1998). A fixed kernel method of estimating the utilization distribution was selected and volume contours, which are generally used in home range analysis (HRE Users Manual 1998), were chosen to give a 90% and 50% volume contours which surrounds an area within which an animal spends 90% or 50% of its time. The 50%

contour is considered the core range when determining home ranges (Howell & Chapman 1997, Cimino & Lovari 2003) and were assumed to be showing the establishment of territories by these oribi.

Results

Release

In November 2004, fifteen wild born oribi were captured from threatened populations and translocated to the Dalton Trust Farm. The 4 males and 11 females were released successfully and in good condition according to a veterinarian (See Table 1 for description and conditions at release for each animal). All the oribi were released at the same site on the Dalton Trust.

Distances tracked from release site and range expansion of translocated oribi

For each observation, the distance from the release site to each fix was measured using Arcview's measuring tool to see how far the translocated oribi moved from their release site to assist in further reintroductions and translocations. The maximum distance each oribi was from the release site is presented in Table 1. Median values of these were included as several oribi had one fix that was an extreme outlier and atypical of most of their movements (Table 1).

The range expansion calculated for the oribi displayed a large amount of overlap between all the animals, with most concentrated directly over the release site. This further showed that the translocated oribi were apparently extremely tolerant of each other and did not immediately set territories exclusive of one another. The considerable overlap of

each of the oribi's expansion areas in this study was shown by the proximity of their locations determined by radio telemetry fixes over a one year period (Figure 1).

Mortality

Animal 150.800 was found dead in August 2005 after a suspected caracal predation event. This was the only recorded mortality in the study to date (January 2006), and it is important to note in Table 1 that this animal was determined to be relatively old (based on horn length and wear, difficult to quantify exact age) upon its capture and would have been more vulnerable to predators.

Radio collar malfunctions are thought to be responsible for the low number of fixes (Table 1) of some of the other oribi. These oribi had survived as most were seen more than a year after release and identified by their eartags but could not be located by telemetry.

Survivorship and Reproduction

As shown in Table 1, four of the females appeared to be pregnant when they were caught and translocated. During translocation these females did not abort. Within a month of translocation a newborn was seen, and in the year of observations, four females were observed with their lambs during the November- January 2004/2005 lambing season. Two of the females that were seen with lambs were known to be pregnant upon their release. During the November- January 2005/2006 lambing season, the total number of newborns was unknown, although more than four young animals were observed during this time.

Discussion

This pilot study showed that translocation is a potential viable conservation tool for threatened oribi populations. This was based on the various measures of success: most of the oribi translocated survived at least a year, remained within the private game reserve, and reproduced. There was only one mortality recorded, and more than four surviving lambs born in the first year. However, as only one site was used in this pilot study, it emphasises that additional release sites are carefully chosen in terms of overall size, suitable oribi habitat and control measures to reduce poaching as it appears that these were major factors in the success of this reintroduction.

The maximum distance each oribi travelled from the release site is useful information when translocating these animals. Most of the fifteen translocated oribi remained in a relatively short distance from the release site, and appeared to adapt to the changed environment. The suitability of habitat most probably affects the distances oribi will move once translocated. The relatively small expansion ranges of the oribi in this study suggest that the habitat was most suitable. Releasing animals into their historical range, allowing for a safe dispersal and suitable habitat are all recommended criteria for reintroduction or translocation attempts (Griffith et al. 1989, Wolf et al. 1996, Kleiman 1997). In this study the oribi were released onto suitable grasslands that have consistently been managed specifically for oribi by a mowing/burning regime as recommended by Everett (1991). It appears that habitat suitability and security (no mortalities from poaching) are extremely important factors when choosing a suitable property to translocate oribi.

In a study done by Oliver et al. (1978) on the population ecology of oribi, oribi were found in group sizes ranging from one to six, with an overall mean group size of 1.89 and

an overall typical group size of 2.22. However, group size was found to vary from montane to lowland grasslands with adults occurring as pairs or single animals in the former (Rowe-Rowe et al. 1992). In tropical grassland small harem herds predominated (Rowe-Rowe et al. 1992). It appears that after a year the translocated oribi in this study showed a high degree of overlap. It appears that the considerable overlap of each of the oribi's expansion areas in this study, as shown by the proximity of their locations determined by radio telemetry fixes over a one year period, coincides with Everett's (1991) findings and support his comments that "home ranges include a large area of 'neutral' range" and that "competition for food is not strong", which are likely in highly suitable oribi habitat. Although oribi may be territorial at times, it has also been noted that they often stop defending territories depending on the time of year and food availability (Everett 1991, pers. obs.). Oribi are known to congregate on burnt or mown fields without any aggression whatsoever to take advantage of new growth (pers. obs.). The origin of four of the translocated oribi, Wedgewood Housing Estate, is situated on 60 ha and has a population of approximately 22. These oribi only inhabit half of the property, which is divided by a dam and wetland, therefore only about 30 ha is used by the 22 oribi, nearly one oribi per hectare (pers. obs.). These oribi are used to being in close proximity to one another and appear to tolerate each other's presence without any obvious negative effects. Therefore, it is hard to estimate the carrying capacity and minimum ha required for oribi if the habitat is suitable and the property secure from poachers.

Kleiman (1989) lists high costs and logistical difficulties as inhibiting factors for reintroductions of endangered species bred in captivity. In comparison to these reintroductions, this pilot translocation was extremely cost effective as the only cost involved was the capture of the oribi. The data from this study suggests that

translocations can be extremely successful if the following variables are addressed: 1) security of property from illegal hunting, 2) suitability of habitat (i.e. grassland) 3) carrying capacity of property and 4) willingness of landowners to cooperate and manage for oribi. Therefore, for oribi, translocation is more likely to be successful than captive breeding and reintroduction.

With the future of oribi, particularly of some subpopulations, as uncertain as it is, having translocation as a potential conservation tool to save some of these populations is reassuring for this species survival. With continued development and habitat destruction (Chapter 4), and poaching (Chapter 5), translocation appears to be useful to move fragmented populations that are doomed to extinction to more suitable areas where their survival is ensured.

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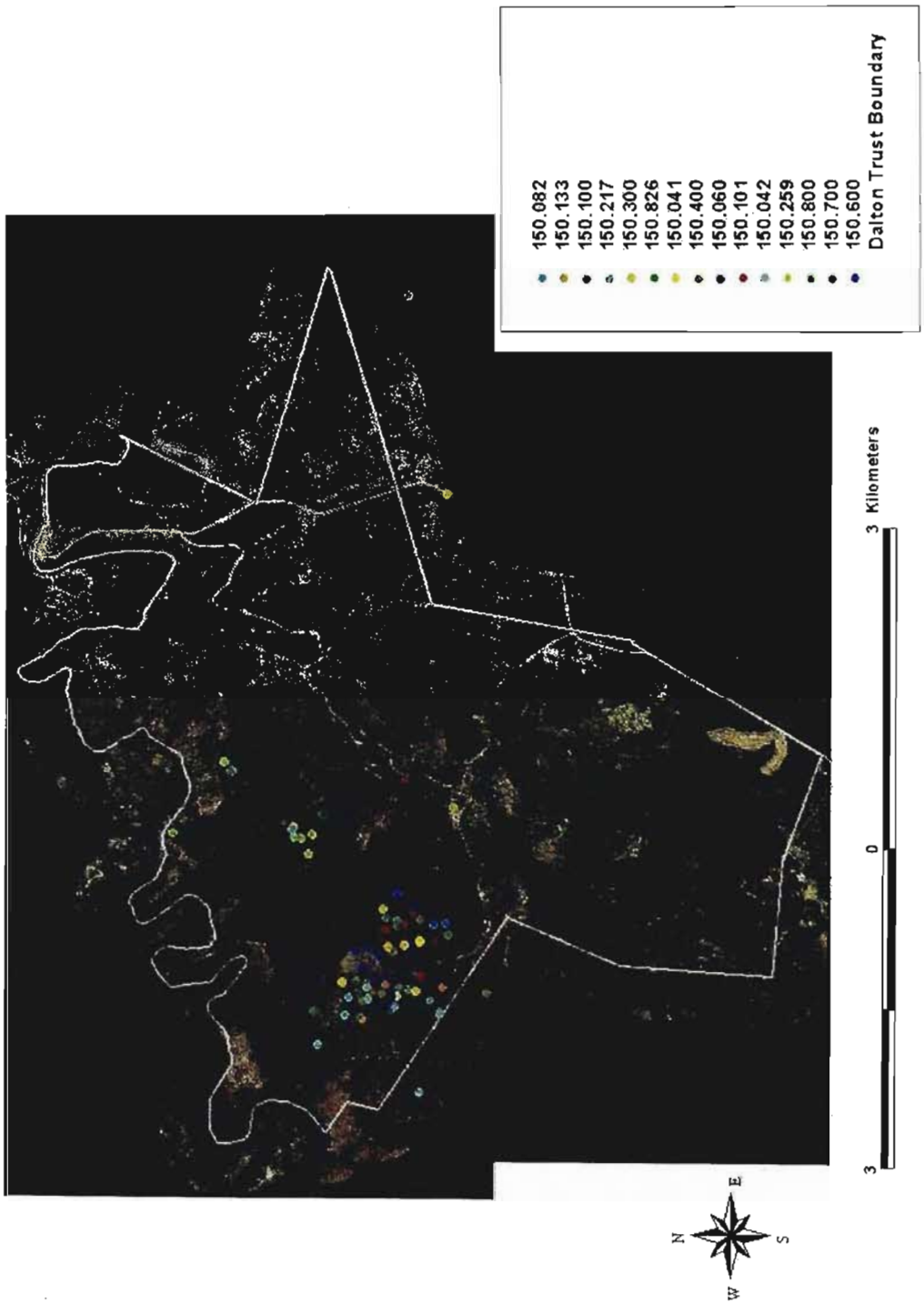

Figure 1. Aerial view of the Dalton Trust with every radio telemetry fix from November 2004-2005 for each translocated oribi represented by different colours.

Table 1. Description of study animals including number of observations, the maximum distance each animal was found from the release site, and the size of the area that each animal spent 50% and 90% of its time in.

Animal	Sex	Condition upon release	# Fixes	Maximum distance found from release site (metres)	Size of area that animal spent 90% of time (ha)	Size of area that animal Spent 50% of time (ha)
150.042	Female	Adult	12	685	448.29	92.15
150.060	Female	Adult	12	1369	203.23	50.69
150.101	Female	Adult	14	1522	260.58	32.58
150.300	Female	Pregnant Adult	3	4221	627.07	210.07
150.600	Female	Pregnant Adult	13	1410	264.17	43.22
150.217	Female	Adult	10	1606	633.66	106.82
150.259	Female	Adult	11	2538	1015.39	224.52
150.041	Female	Pregnant Adult	6	835	154.26	37.55
150.100	Female	Adult	8	910	200.99	45.79
150.082	Female	Pregnant Adult	4	492	64.97	17.18
150.133	Female	Adult	4	911	176.73	59.64
150.700	Male	Adult	3	715	131.43	34.00
150.800	Male	Old	15	1511	390.64	76.65
150.400	Male	Young	12	854	182.49	28.16
151.826	Male	Adult	6	1768	1003.11	293.85
		Females	**N**	11	11	11
			Mean	1500	368	84
			Median	1369	261	51
			Min.	492	65	17
			Max.	4221	1015	225
			Std. Dev.	1065	285	71
		Males	**N**	4	4	4
			Mean	1212	427	108
			Median	1183	287	55
			Min.	715	131	28
			Max.	1768	1003	294
			Std. Dev.	508	400	126

Chapter 4

Using housing estates as conservation tools: A case study

Chapter prepared for submission to the South African Journal of Wildlife Research

Abstract

Change and fragmentation of rural landscapes for economic reasons is increasing and causing concern to conservationists worldwide. With no end in sight, perhaps conservation and development need to co-operate and plan housing developments that are environmentally and ecologically sustainable and can serve as refuges for endangered species. In KwaZulu-Natal (KZN) grasslands are particularly threatened by land transformation for housing developments. A case study is presented of a housing development, Wedgewood Estate in KwaZulu-Natal, South Africa that has been developed and managed for conserving grassland habitat and associated species, particularly the endangered oribi (*Ourebia ourebi*). Wedgewood is an example of the viability of housing estates as refuges for endangered species and shows that the density and placement of housing, and management of the natural habitat are important. It emphasizes the need for reviewing the types and amount of housing development, management of natural habitat, and the rules and regulations they put in place to assure the integrity of the conservancy is preserved. This case study also shows the potential of such ecologically sensitive housing developments as sources of surplus game for translocation, especially in the case of endangered species such as oribi.

Introduction

The environment we live in is changing quite rapidly and drastically (Meffe & Carroll 1997, Miller 1998, Rosenzweig 2000). Human expansion and overpopulation are contributing to landscape and habitat alterations on a daily basis, affecting flora and fauna survival as well as abiotic components of the Earth (Meffe & Carroll 1997, Miller 1998, Rosenzweig 2000).

South Africa's grassland biome is considered critically endangered (Olsen & Dinerstein 1998, Reyers et al. 2001). It covers 16.5% of South Africa's land surface (Neke & Du Plessis 2004) and provides irreplaceable habitats for many threatened and endangered plant and animal species. The National Land Cover Database (NLC 1994-1995) shows that 29.2% of South Africa's grasslands have been transformed for agriculture, 3.3% by afforestation, 1.9% by mining and 0.3% by urban centres (Neke & Du Plessis 2004).

Property development is on the increase in South Africa and worldwide. In particular, in KwaZulu-Natal (KZN) there has been an increase in housing estates and small-holdings. This is a consequence of several factors, however, one is the desire of residents to feel like they are "in the country" yet secure and close to town (pers. obs.). Such developments are normally built on undisturbed or agricultural land. The most recent statistics show that in KwaZulu-Natal, South Africa, ninety-six development applications were processed by Ezemvelo KZN Wildlife in 2005 alone. Neke & Du Plessis (2004) found that urban development "produces some of the greatest local extinction rates and frequently eliminates the majority of native species". They also note that urbanization is a more permanent transformation compared with agricultural changes.

Although many applications to develop undisturbed or agricultural land are turned down, many are approved (Ezemvelo KZN Wildlife unpublished data). It appears that development is unavoidable and an unfortunate consequence of human civilization. What if there was a way for conservation and development to work hand in hand towards a co-operative goal? Is there a way for both wildlife and natural habitats to survive while allowing for sustainable development and settlement of nature-loving home owners? Eco-friendly housing estates (those that conserve their habitats and their associated dynamics, and with minimal human impact) could serve as refuges for some of the world's most threatened plant and animal species, taking the pressure off the often financially pressured zoological and botanical gardens that struggle to keep certain species in captivity alive and reproducing. However, this requires careful planning of the housing in such a manner that sufficient and suitable habitat and associated dynamics remains for wildlife to survive. In addition, it requires long-term priorities for maintaining the conservation value of such properties. In particular in KZN, the removal and control of alien vegetation must be a priority to maintain the natural and endemic habitat (Macdonald 2004) as this increases with fragmentation of the habitats and reduced burning (Wood pers. comm.). Here a case study is presented of a housing estate that has been commended by the Oribi Working Group and Ezemvelo KZN Wildlife for its role in the conservation and management of oribi *Ourebia ourebi*. Case study research is interpretive and subjective, and should complement rather than compete with an experimental stance (Cohen & Manion 1992).

Background

Wedgewood Estate is a housing estate that is located in the village of Hilton, 5 km outside Pietermaritzburg in KZN (30° 17' 54"S, 29° 31'12"E). Wedgewood was initiated

by the Walters' family in 1997 with the objective of creating a "conservation friendly" housing estate. Most of the 60 ha estate had been farmed with maize and kikuyu (*Pennisetum clandestinum*) pastures but was then ploughed and planted to *Eragrostis curvula* in 1998. An 18 stranded electric perimeter fence was also erected in 1998, the same year the first home was built. Wedgewood now consists of nine homesteads whose owners are bound to a constitution and bye-laws, as well as a conservation management plan. This estate is diamond shaped, with a large wetland area consisting of two dams in the middle of the property. The homesteads are situated around the perimeter of the estate and are all near the boundary fence. There is approximately one house for every six ha on the estate.

The success of Wedgewood as both a housing estate and a conservancy lies in its mission statement, rules, regulations and bye-laws (Walters 1999). The mission statement of Wedgewood is:

"To create and maintain a secure and friendly country estate having the ethos of beauty, group harmony and trust, and sustainable conservation management."

The key objectives of Wedgewood estate are:

1. "To preserve the spirit of the place that is already there naturally, with the silence, the views of the hills, and the variety of wildlife through sustainable conservation.
2. To develop the estate in a manner that is in harmony with its natural beauty in respect of flora, buildings, roads, dams and services.
3. To create and maintain a style of living and decision making that promotes group harmony and trust.
4. To live within the park in a manner which will ensure sustainable use, biodiversity and protection of the environment." (Walters 1999)

The rules, regulations and bye-laws of Wedgewood were put in place to enforce the almost idealistic mission statement and objectives. Of the rules and regulations, several are in place purely to preserve the integrity of Wedgewood's conservancy.

In the Wedgewood Owners Association Bye-Laws (Walters 1999), the Conservancy is described as "the central strip of land between the western and the eastern individual properties, along each side of the stream, and including the stream and water surfaces". Under section 2 (pg. 3), Conservancy Area, it says that:

"The Conservancy area is there for the enjoyment of all. Parts of it have been identified as Wetland and are to be respected as such.

The use of off-road vehicles, motor boats and motor or pedal cycles will not be allowed within the Conservancy.

Only indigenous plants shall be planted in the Conservancy." (Walters 1999)

Section 5 (pg. 3), Fertiliser and Herbicides, says that "Fertilisers and herbicides should be used with restraint owing to their propensity to impact negatively on the natural environment. Fertilisers should not be allowed to wash off properties and enter the Wetland or the dams. Herbicides should be chosen with care and should not be allowed to wash into common property or the Conservancy." (Walters 1999)

Section 12 (pg. 5), Pets and Animals, is extremely important for the safety of the wildlife on Wedgewood. It requires that all pets and animals be confined to the gardens of property owners unless under direct control outside the gardens. A maximum of three dogs is allowed on any property. Horses may be ridden on the estate but only in a way that does not disturb or endanger wildlife or the habitat. Horses may not be ridden within the wetland area of Wedgewood (Walters 1999).

In instances where property owners have been unable to control problem dogs, they are expected to re-home the dog immediately. Feral or stray dogs are not tolerated

on Wedgewood, and if they cannot be caught they are shot on sight (T. Walters, pers. comm.).

Section 13 (pg. 5), Planting and Removal of Trees, stipulates that the overall landscaping [around the houses] of individual properties and in the grassland should "result in a blend in which indigenous species predominate." In the conservancy, only indigenous trees and shrubs may be planted, and in the wetland, only suitable indigenous wetland species may be planted (Walters 1999).

Section 20 (pg. 7), Wetlands, specifies that:

"The wetlands are to be managed in accordance with the guidelines in the Rennies Wetland Campaign booklets "Wetland Fix". They are to be regarded as a fragile and valuable resource".

Management of Wedgewood's grasslands is undertaken by the Walters family and includes a burning and mowing regime that takes special consideration of the estate's oribi population.

It is the responsibility of certain Wedgewood members to observe and monitor the wildlife on the property and report anything of concern to the Walters family as managers of the Estate.

The game populations were never managed until 2004, when, after consultation with Ezemvelo KZN Wildlife, it was decided that both the oribi and common reedbuck (*Redunca arundinum*) populations were too high. In 2004, four adult oribi (one male, three females) and ten adult reedbuck were caught and translocated to alleviate the population pressures on the property (Chapter 3). One oribi ram from the Richmond, KZN, was released at Wedgewood soon after this to introduce new genetic stock to the oribi population.

Results

When Wedgewood first started, there was an existing population of five to six oribi (*Ourebia ourebi*), as well as an unknown number of common reedbuck (*Redunca arundinum*) and grey duiker (*Sylvicapra grimmia*) (T. Walters pers. comm.). The game were observed by residents of Wedgewood, however no annual game counts were conducted until 2004, when the oribi were estimated at 21. Predator species such as black-backed jackal (*Canis mesomelas*) and caracal (*Felis caracal*) have been sighted on Wedgewood from time to time since 1998 (T. Walters, pers. comm.). The perimeter fence is permeable because game, including oribi, are regularly seen jumping through the strands and therefore allows movement of game into and out of the estate.

The previously stated rules and regulations of Wedgewood were put in place for no reason other than to preserve the environment upon which the estate was built and to minimize disturbance of the wildlife that exists there. It appears that the success of Wedgewood as a safe haven for endangered species such as oribi is attributed to conservation of suitable habitat and the strict enforcement and abiding of the rules by Wedgewood's members.

Many of the stated rules are self explanatory and obviously vital to the estate's success, however, there are some that may not have been obvious initially. One of these is that Wedgewood has only allowed for nine homesteads on sixty ha of land. This is considered a low density housing estate (Hay pers. comm. Planning section, Department of Local Government and Traditional Affairs KZN). It appears that the placement of homesteads on the boundary of the estate allows the wildlife to use the majority of the remaining 51 ha, mainly in the middle of the Estate with access to water (pers. obs.). It

appears that the development of Wedgewood allows for the natural processes and dynamics to continue (pers. obs.).

Discussion

Wedgewood appears to fulfil the requirements for an "Eco-Estate" because of several factors that need to be considered in other such developments. Firstly, it appears the density of housing is crucial. At Wedgewood, the low density housing (1 house per 6 ha, Hay pers. comm. Planning section, Department of Local Government and Traditional Affairs KZN) allowed enough habitat for small game to survive. Currently there is no legislation defining a low, medium or high density housing development or the requirements for an "Eco-Estate" (Hay pers. comm. Planning section, Department of Local Government and Traditional Affairs KZN). Secondly, it appears that the placement of houses is important. At Wedgewood the placement of each house around the boundary of the estate allowed the maximum habitat left in the centre of the estate. Furthermore, placement of houses could be where unsuitable habitat is, such as stands of alien vegetation, or in clusters of houses to reduce the impact on the natural habitat. Thirdly, it appears that sound ecological management of the natural habitat, particularly in regards to grasslands, must be implemented to maintain the habitat in its natural state (Camp pers. comm.).

This case study also shows the potential of such ecologically sensitive housing developments as sources of surplus game for translocation, especially in the case of endangered species such as oribi. The success of the translocation experiment of four Wedgewood oribi shows that Wedgewood has not only a viable breeding population of oribi but that they can be used to successfully repopulate other areas (Chapter 4). Species reintroductions often use animals bred in captivity to try and boost threatened wild

populations, which is an extremely expensive and more often than not unsuccessful venture (Boyer & Brown 1988, Cade 1988, Kleiman 1989, Griffith et al. 1989, Phillips 1990, Kleiman et al. 1991, Beck et al. 1994, Wolf et al. 1996, Griffin et al. 2000). Animals bred in captivity are often dependant on supplemental feeding, too used to human contact and have lost their inherent fear of predators (Griffin et al. 2000, Griffin et al. 2001, Blumstein et al. 2002). These problems may be addressed by allowing a "soft" release and conducting pre- and post- release training exercises including teaching appropriate anti-predator responses (Griffin et al. 2000, Griffin et al. 2001, Blumstein et al. 2002). It is also difficult for such operations to breed enough individuals to be released. Alternatively, translocation of oribi may be a more effective conservation tool. Using housing estates such as Wedgewood as refuges for breeding populations of an endangered species such as the oribi that can be used in translocations may be a way to combat the expense and failures associated with reintroductions.

In 2004 Wedgewood was awarded an Oribi Custodian Board by the Oribi Working Group, a group that is in place to address to threats facing oribi (Grey pers. comm.). This award recognizes certain people or conservancies that make special efforts to conserve their oribi populations (Oribi Working Group pers.comm.). Furthermore, it appears that a by- product of Wedgewood's successful oribi conservation is the education and appreciation that its members have for oribi and the public awareness it has created (Walters pers. comm.).

If legislature could be implemented requiring housing developments on undisturbed or agricultural land to consider density and distribution of housing as well as manage the habitats appropriately, many species of plants and animals could take refuge in the development and be cultivated by its members. In addition, it could be stated that where appropriate such housing developments should maintain existing biodiversity. A

conservation body could oversee all management, reintroductions, and translocation decisions that need to be made, but require the developments to include management costs in their budgets and to monitor and report back on how the species is faring.

Development is not going away (Rosenzweig 2000). Despite conservationists' most valiant efforts, housing estates are being approved and built in South Africa and all over the world to meet the needs of a growing human population. Rather than clashing with developers, conservationists should demand cooperation and insist on requirements such as careful management and planning of housing estates that can benefit both wildlife and its human neighbours both short- and long-term. In particular, consideration of the areas of housing and prime habitats for species survival needs careful planning before development. Therafter ongoing management is required especially for oribi by maintaining the grasslands through burning and mowing techniques (Everett 1991). Such management techniques can often be costly (Camp, Wood pers. comm.).

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Chapter 5

Preliminary assessment of the extent and intensity of illegal hunting on farmland in KwaZulu-Natal, South Africa using surveys: implications for oribi *Ourebia ourebi* conservation.

Chapter prepared for submission to the Journal of Conservation Biology.

Abstract

The oribi *Ourebia ourebi* is a small antelope that is currently listed as endangered in the South African Red Data Book. One of the primary reasons for its dramatic decline is illegal hunting. Poaching in South Africa appears to be increasing, and the reasons for hunting seem to be evolving. Interviews were conducted in several rural settlements near commercial farms with conservancy areas in KwaZulu-Natal (KZN), South Africa. This was to establish information about their perceptions of illegal hunting. In addition, their knowledge of the frequency of poaching, preferred methods, and their ideas and opinions of conservation and the laws protecting game were probed. Furthermore, their knowledge of local game species was assessed to determine the degree of indigenous knowledge of the species' commonly found in KZN. Local farmers and landowners in KZN were also surveyed to gauge the effects of poaching on private land and their opinions on who is poaching and why. The results show that illegal poaching is a real threat to indigenous game. Poverty is a factor affecting the frequency of poaching, as well as the recreational and social significance of hunting. To reduce poaching and its effects, it appears to require further education and alternative meat and entertainment sources.

Introduction

Habitat loss and overexploitation (hunting and commercial trade) are the primary threats to biodiversity (Nichol 1987, Meffe & Carroll 1997, Miller 1998, Soule & Orians 2001). The status of one-third of all mammal and bird species threatened with extinction is attributed to hunting by humans (Hilton-Taylor 2000, Cowlishaw et al. 2005). The world's population currently exceeds six billion people, with more than five billion of those living in developing countries (Population Reference Bureau 2005). The world's population is projected to increase by 43% by 2050 (Population Reference Bureau 2005). At the current and future rates of population increase, the Earth's resources are in demand at unsustainable levels.

Of particular concern to international conservation is the bushmeat trade in Africa. The term "bushmeat" generally refers to meat from wild animals (Fa et al. 2003, Fa et al. 2005). Most predominant in Central and West Africa, the bushmeat trade threatens both animals and plants (Wright et al. 2000) at unsustainable levels (Robinson & Bennett 2000, Milner-Gulland 2002, Fa et al. 2003, Cowlishaw 2005, East et al. 2005). The hunting of game has occurred historically within African cultures for centuries at apparently sustainable levels (Lewicki 1974, Mendelson et al. 2003, Cowlishaw 2005). However, the bushmeat trade in Africa has developed over recent years from purely subsistence hunting into a lucrative commercial industry (Hart & Hart 1986, Wilkie et al. 1992, de Merode et al. 2004). Approximately 1-3.4 million tonnes of bushmeat, an average of six times the sustainable rate, is killed each year in the Congo Basin (Milner-Gulland et al. 2002). Even with such statistics, the Department for International Development (2002) warns that "the role that wild foods, including bushmeat, play in food security appears to be underestimated, and their importance to different groups is not well understood". A similar comment by Ntiamoa-Baidu (1998) cautions that

"Despite the obvious contribution of wildlife to the socio-economic life in Africa, there are currently no comprehensive and reliable estimates on total supply, trade and consumption of wildlife in any African country".

In Africa, the historical, sustainable harvesting of bushmeat and the more recent commercialisation of bushmeat are driven by the fact that humans have a preference for and rely on meat for most protein requirements (Peterson 2003). The Department for International Development (2002) point out that there is a dependence of many rural households on protein derived from wild animals, and bushmeat contributes a substantial percentage of the protein consumed in African countries (Asibey & Child 1991, Robinson & Bennett 2000, Fa et al. 2003). In East and Southern Africa, the growing dependence on bushmeat has been shown to be directly correlated to increasing human population and poverty (Barnett 2000). Peterson (2003) attributes the increasing consumption of wild animal meat in Africa to the loss of traditional ways, the arrival of modern weapons, modern population growth, and modern cities. Such increased reliance on bushmeat is quite obviously disastrous for wildlife, and also for those people depending on it, if it is not sustainable (Fa et al. 2003).

Despite the overwhelming evidence suggesting that people hunt for subsistence and economic benefits, the cultural significance of wildlife cannot be overlooked (Gibson & Marks 1995, TRAFFIC 2002, Yom-Tov 2003). Wildlife has invaluable social and cultural significance throughout most of the world. As a result of this, Robinson & Bennett (2000) reveal that "people in tropical forests hunt even when they have alternative sources of nutrition or income". One of the few South African published studies about the bushmeat trade documented illegal hunting in the indigenous Transkei forests in South Africa, where this occurs regardless of the fact that the meat is not an important source of protein for local communities (White 2001, Hayward et al. 2005).

Although an idea of the extent of the bushmeat crisis in West and Central Africa is becoming apparent, there is very little documentation of the extent or effects of the bushmeat trade in South Africa. One antelope species in South Africa that is under particular threat from overhunting is the oribi *Ourebia ourebi*. Poaching, particularly with dogs has drastically reduced oribi numbers (Millar 1970, Thompson 1973, Rowe 1985, Rowe-Rowe 1988, Marchant 1991, Marchant 2000). Census data suggests that there are only 2,480 left in KwaZulu-Natal (KZN), South Africa as of 2004, with 75% of those remaining on private land (Marchant pers. comm.). As a consequence, the Red Data Book of South Africa (Friedmann & Daly 2004) has raised the status of the oribi from vulnerable to endangered, and the Bushmeat Crisis Task Force lists the oribi as a species affected by the bushmeat trade in Africa (Stein & Bushmeat Crisis Task Force 2001).

Many of the methods used by illegal hunters, i.e. dogs and snares, are extremely unselective with respect to what species they target (Arcese et al. 1995, Looibooki et al. 2002). In their position statement, the Wildlife and Environmental Society of South Africa (WESSA) defines Taxi Hunts as: "where a group of mini-bus taxis arrive at private farms at night or in the early hours of the morning and disembark a group of hunters who release their dogs immediately to hunt at will on unsuspecting landowner's property, frequently mauling livestock and game in the process. Participants place bets on the outcome and the owner of the first dog to bring an animal down scoops the "pot". This form of hunting is extremely cruel and most certainly causes the animals a very painful death" (http://www.wildlifesociety.org.za/documents/WESSApositions.doc). In KZN, these taxi hunts are a popular form of sport that involves large groups of hunters with their packs of hunting dogs. Taxi hunts appear not to be done for subsistence, rather they are a way to gamble on the best dogs in the packs and to see whose dog can make the first kill. Increasing access to forests, hunting by people from outside local

communities, the use of weapons and changes in utilization practices by local communities are major threats to indigenous wildlife in the Transkei forests of South Africa (White 2001, de Villiers 2002, Hayward et al. 2005), demonstrating that such hunting activities are not unique to KZN.

It was expected that poaching on privately owned land in KZN has increased in recent years and that most illegal hunting of species such as oribi is for subsistence and as a form of sport and means to gamble. In light of the oribi's precarious situation and with illegal hunting on the increase (pers. obs.), we conducted a survey to establish information about the perceptions of poaching, the frequency of poaching, preferred methods, and the public's ideas and opinions of conservation and the laws protecting game. Firstly, we interviewed residents of various rural communities (including farm labourers) near commercial farms with conservation areas in parts of KZN. Secondly, local farmers and landowners in KZN were also surveyed. The use of surveys is increasing in the field of applied ecology (Kerr & Cullen 1995, White et al. 1997, 2001, 2003, Jim & Xu 2002, Obiri & Lawes 2002). White et al. (2005) highlight that questionnaires enable researchers to "quantify human behaviour, for example perceptions or attitudes towards conservation strategies and/or the implementation of environmental conservation directives". A species like the oribi has little chance if the main threat of hunting is not addressed, and despite attempts by landowners to protect their properties in more traditional ways such as shooting dogs and arresting trespassers, the incidence of hunting is reported to be on the increase by most landowners (Marchant, pers. comm.). Working with local communities and assessing their needs and attitudes may be the only hope for the oribi. As White et al. (2005) put it: "quantifying public perceptions is becoming a key component in translating ecology into management."

Methods

Questionnaires

Two questionnaires were devised. One was for interviewing people in rural settlements near commercial farmland, and the other for landowners. Justification for the choice of who to survey included the following:

1. Organised hunts are probably quite random and it is difficult to predict when and where poachers might strike. If they do target an area, a whole population might be destroyed.
2. Other typical poachers who enjoy shooting something illegally usually operate far from home, also in a random manner.
3. Subsistence poachers or hunters usually operate close to home in a more predictable manner. For this reason, it was decided to sample local residents.
4. Local residents can be divided into land owners/managers and residents who are non landowners.

The questionnaire used for interviewing people in rural settlements near commercial farmland with conservation areas in KZN was divided into two sections. The first section aimed to identify the demographic profile of each respondent (i.e. age, sex, marital status, etc.) and their views/habits on hunting and conservation. The second section asked specific questions about six locally found antelope species to assess the respondents' abilities to identify species and to determine which species might be under threat from hunting. Usually a photograph of a male representative of the species was shown, despite sexual dimorphism in most of the species. It was felt that the only species where this may have caused confusion was for the bushbuck *Tragelaphus scriptus* and the nyala *T. angasii*. The majority of questions were closed-format with selected options. There were

also some open-ended questions that attempted to learn more about the respondents' opinions and feelings on certain topics.

The questionnaire sent to landowners and land managers comprised thirteen questions aimed at assessing the frequency of illegal hunting on private land and the attitudes and opinions of landowners on why they think illegal hunting is or is not prevalent. There were also some questions intended to test the possibility that the implementation of minimum wages and therefore the loss of rations in farm labour may be a reason behind increased poaching. All thirteen questions were closed format, however many of these respondents offered additional information.

Surveys

The survey for the local residents was carried out by in-person interviews conducted in rural township areas near commercial farming areas in Wartburg, Estcourt and Creighton, KZN. Where necessary, all questions were delivered in the interviewee's home language so as to avoid any language barriers. In-person interviews were chosen for two reasons. Firstly, White et al. (2005) argue that in-person interviews are a preferable sampling method to postal and telephonic surveys, especially of rural people who do not have easy access to post or telephone, and are often illiterate. Secondly, we wanted to target specific rural settlements based upon their proximity to conservation areas known to have illegal hunting. The interviewers were both black, Zulu-speaking male Social Science students with experience in conducting interviews with rural people, and who could comfortably navigate the settlements and earn the trust of the often hesitant respondents.

The survey aimed at KZN farmers and landowners was sent out electronically via email to more than 250 people. It was emailed to a local KZN farmer's union listserv as well as several other listservs that targeted landowners. It is impossible to quantify the

percentage of returns for this survey because the emailed survey was, on numerous occasions, forwarded on by one interested party to others without our knowledge.

Data Analysis

The data from all questionnaires was collated and entered into a spreadsheet. Summary statistics were calculated. Chi-square tests, assuming that all answers were equally likely, were done using the Excel extension Poptools (Microsoft). Percentages were then calculated.

Results

Questionnaire Interviewing People In Rural Settlements In Commercial Farming Areas

Ninety-two people were interviewed in various rural settlements in commercial farming areas (96% male, 4 % female). Initially, these interviews were not going to be gender-biased in their selection of respondents, however, it was found that females were reluctant to be interviewed. Furthermore, most of the people in these rural settlements surveyed were Zulu, and culturally only Zulu males participate in hunting activities (Arcese et al. 1995, Hofer et al. 1996, Looibooki et al. 2002). Consequently, for the majority of interviewees, males were specifically targeted, particularly any males from the age of eighteen years or more that were willing to participate were interviewed. The interviewers found some reluctance to participate in the interview despite confidentiality guaranteed. Nearly 50% of the participants were younger than 25 years of age (Table 1). Of those interviewed, 88% were not permanently employed or unemployed compared with 12% that were employed. Most of the respondents (87%) did not eat meat every day, 91% of these were not permanently employed. There was a significant difference in monthly income of respondents (Table 1). Most received low monthly incomes (Table 1).

Although most respondents were single or divorced, many had children to support (Table 1).

A significantly high percentage of respondents hunted illegally as youngsters (83%) and continue to do so as adults (82%, n = 75). Of those that hunt, 51% hunt on a weekly basis, primarily for meat (42%) while others do it for fun, gambling and sport (Table 2). There was a significant difference in method used for hunting . The preferred method of those hunting illegally was with dogs (46%). Others used dogs accompanied by various weapons, especially knobkerries (a strong, short wooden club with a heavy rounded knob or head on one end, traditionally used by Southern African tribes, 26%).

The respondents' perceptions and knowledge of illegal hunting varied. Many of the respondents (65%) did not know the laws concerning hunting. In addition, the majority did not know why game is protected (70%), although 47% knew that certain animals were specially protected by law. There was little difference in whether respondents had a preference for hunting a certain type of game (46% No, 54% Yes). When respondents were asked for suggestions on how to reduce the amount of illegal hunting and conserve wild animals, a variety of methods were proposed. Despite most of the respondents acknowledging that they hunted illegally, 27% suggested an increased arrest/prosecution rate for those found hunting illegally, with another 8% recommending that warnings be issued once, followed by prosecution for second offences (Table 2).

The data collected in the second part of this survey was very informative about those in rural settlements knowledge of common game species (Table 3). The gray or common duiker *Sylvicapra grimmia* was the only antelope on the survey that was correctly identified by more than 50% of the respondents (Table 3), and was also the only one hunted by more than 50% of respondents (Table 3). It is important to note that this is also the most common of the antelope species in the areas interviewed. The next most

correctly identified and hunted antelope was also the most endangered, the oribi. Following the oribi, came the common reedbuck *Redunca arundium*, the greater kudu *Tragelaphus strepsiceros* and bushbuck, and finally the nyala.

Survey of Landowners

Local farmers and landowners in KZN were also surveyed to gauge the effects of poaching on private land and their opinions on who is poaching and why (Table 4). Of the fifty-six respondents there was a variety of farming practices (Table 4). Most (62%) reported that they rarely or never encountered poaching on their properties compared to only 20% monthly, 14% weekly or 4% daily. Significant differences were found when participants were asked how often they find snares on their properties (Table 4). 72% of landowner respondents reported having 20 or more farm labourers living on their property, while a significant amount (90%) had labourers living within a 1 – 5 km radius of their properties (Table 4). Of the participants, 81% had provided rations for their labour in the past while 75% no longer continued to do so. A majority of the latter (71%) discontinued this practice after the inception of minimum wage, 82% of these because they were forced to implement this practice. Of landowners, 43% believed that their own labour were hunting game on their properties but only 36% reported an overall increase in hunting over the years. A majority of respondents (94%) did not think that there was a correlation between increased hunting and the decrease in ration provision.

The final question of this survey asked landowners why they think hunting appears to be on the increase. There was a significant difference in opinions, with 43% believing gambling/sport to be the primary reason (Table 4). This demonstrates that landowners concur with results that many hunt illegally for recreation as seen in Table 2. Several respondents listed taxi hunts, lack of respect for the law, lack of commitment by

authorities, and the need for meat as other reasons for poaching (Table 4). All of these listed are for subsistence or sport, and not for commercial gain.

Discussion

The results from the interviews of rural people in commercial farming areas of KZN give a preliminary perspective of their perceptions of poaching, their knowledge of the frequency of poaching, preferred methods, and their ideas and opinions of conservation and the laws protecting game. Furthermore, their knowledge of local game species assisted in determining the degree of indigenous knowledge of the species' commonly found in KZN. Generally, most people from rural settlements were unemployed and earning less than R500 per month to support themselves, and in many cases, their families. It was not surprising then that 82% of these admitted to hunting illegally with more than half of them hunting on a weekly basis. Generally, meat was not a common component of their diets and, when linked to the fact that so many are unemployed and perhaps suffering from extreme stress and boredom, this accounts for the high percentage of participants that hunt both for meat and sport. A majority of respondents (87%) did not eat meat on a daily basis, thus hunting would provide a source of meat. This is particularly important when considering the previously discussed dependence of people on protein (Asibey & Child 1991, Robinson & Bennett 2000, Fa et al. 2003, Peterson 2003), specifically the correlation between bushmeat, the increasing human population and poverty (Barnett 2000). The expressed preference for hunting with dogs and the high percentage of people hunting for fun/sport/gambling showed the potential impact of illegal hunting in KZN. Furthermore, with the high levels of incorrect animal identifications and ignorance of laws and conservation, the first recommendation to combat illegal poachers is to educate them. Perhaps then they can begin to understand the

concepts of conservation and sustainability, as well as which animals have special protection and why.

Many of the interviewed respondents were unaware of the laws concerning the hunting of indigenous wildlife. This ignorance is not only dangerous to wildlife but also to society. Even with good educational programs in place, poaching will still be a problem due to the desperate poverty faced by many rural people in KZN and throughout South Africa as well as the cultural significance of hunting. Of particular concern is the discrepancy between those interviewed, where 64% of participants admitted hunting on a daily, weekly, or monthly basis, and the landowners who reported little or no illegal hunting on their properties. However, these results of landowners' perceptions may not be an accurate representation of the amount of poaching occurring on private land in KZN due to several factors, including the electronic method of survey and the fact that many private landowners are unaware of or are underestimating the amount of illegal hunting occurring on their properties. In addition, the survey was sent out via email to several listservers aimed at conservation in some cases and farming in others. It could be that this survey appealed more to those landowners that are conservation-minded and work hard to eradicate poaching on their properties.

Currently, it appears that very few poachers in KZN are caught and prosecuted in relation to the numbers poaching. Some KZN landowners suggest that they are fearful to take action because of potential retaliations such as burning crops down or even more serious violent crimes such as farm attacks that are not uncommon in KZN, with 141 farm attacks committed in 1999 in KZN (Schönteich & Steinberg 2000). In some areas of South Africa, organized groups of poachers are often well armed and can intimidate even police and conservation officers (White 2001, de Villiers 2002, Hayward et al. 2005).

Yom-Tov (2003) found that Israeli farmers were apathetic to poaching by their own labour, despite having the ability to reduce the hunting considerably. This may also be the case in South Africa. Stricter laws and punishment for crimes against wildlife may begin to dissuade perpetrators if they are caught. Therefore landowners, in collaboration with police and conservation officers must cooperate and form a strong and consistent security presence that will deter potential illegal hunting. The use of hunting packs of dogs can, as previously stated, have a major impact on small populations of animals such as oribi, and is incredibly effective as an indiscriminate hunting method (White 2001, de Villiers 2002, Hayward et al. 2005). It is however, important to note that Rowcliffe et al. (2004) found that species-specific legal protection (i.e. oribi being endangered) has no effect on a hunter's prey choice and that wildlife protection laws are not effective at protecting vulnerable species.

The survey data support Robinson and Bennett's (2000) findings that, due to social and cultural significance, many people may hunt despite having access to other sources of protein or income. Therefore, a third option to try and reduce poaching is to give hunters another activity that could replace hunting as a form of sport and means to gamble. The Oribi Working Group (OWG), a committee based in KZN addressing all issues affecting oribi, has suggested that dog racing be legalized. Although extremely controversial, dog racing could have all the right elements in place to convince a hunter to convert. A hunter would still be allowed to run dogs (many of which are worth thousands of rand, pers. obs.) and gamble, but without the risk of going to jail or being heavily fined. Animal rights organizations oppose dog racing due to the risk of animal abuse occurring (National Society for the Prevention of Cruelty to Animals Statement of Policy). However, poaching wild animals is a notoriously cruel and normally indiscriminate pastime. Snares are unselective and often affect non-target species (Hofer

et al. 1993, Arcese et al. 1995, Hofer & East 1995). Many times they are left forgotten until an unsuspecting animal gets caught and takes days to die. The use of hunting packs, sometimes hundreds of dogs strong, leaves the quarry with little chance of escaping and is indiscriminate in that males, pregnant females, young animals etc. are all acceptable trophies to the hunters (pers. obs.). Dog racing seems like a tame alternative when one considers these facts.

We also expected that an increase in subsistence poaching may be linked to the implementation of minimum wage in South Africa. South Africa only began using the minimum wage system in 1998 with the Employment Act of 1997. Prior to that, farm labourers were often paid in part with rations, including meat, by their employer (pers. comm.). With minimum wage requirements, it appears that most farmers no longer provide rations. This may have led to an increase in rural subsistence poaching. However, landowner respondents did not believe this to be the case and this seems to be supported by the fact that most of the rural interviewees who hunt illegally are not permanently employed. Further research is required, however, to determine if the change in the wage laws has affected the degree of poaching.

Programmes that address the nutritional deficits and poverty in rural communities may also result in a decline in illegal hunting (Looibooki et al. 2002). Providing incentives to community residents for assistance in the protection of indigenous game and allowing them to have some "ownership" of the game are ways to start successful community-based wildlife management programmes (Gibson & Marks 1995, Mesterton-Gibbons & Milner-Gulland 1998) and educate residents in a cooperative manner.

A combination of education, tougher enforcement and providing an alternative would probably be most effective in reducing poaching. It is important to realize that poaching is also a social issue, not only a conservation one. Conservationists cannot

attempt to address the illegal hunting and trade in wildlife without understanding the social mechanisms behind it.

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Table 1. Results of the interviews with residents of rural settlements near commercial farms with conservancy areas in KZN to show their age, status of employment, financial income and family dependants, and their frequency of eating meat (n = 92 ,* denotes significant difference).

Question with Answers	%	Chi2	df	P value
Age		10.76	4	0.03*
10-25	48			
25-35	9			
35-45	17			
45-55	14			
55+	12			
Monthly income (SAR)		24.16	6	0.0005*
R 0	5			
0-250	8			
250-500	34			
500-1000	26			
1000-1500	1			
1500+	7			
Variable	19			
How many wives do you support?				
0	64			
1	30			
2	4			
3	0			
4	0			
Divorced	1			
Widowed	0			
How many children do you support?		38.17	3	0.0001*
0	49			
1-5	37			
6-10	12			
11+	1			

Table 2. Results of the interviews with residents of rural settlements near commercial farms with conservancy areas in KZN that did hunt showing their perceptions of illegal hunting (* denotes significant difference).

Question with Answers	%	Chi2	df	P value
If yes, how often do you hunt?		30.50	6	0.0001*
No answer/don't hunt	16			
Daily	10			
Weekly	51			
Monthly	3			
A few times a year	4			
Winter	5			
Variable	10			
If yes, why do you hunt?		38.91	7	0.0001*
Meat	42			
Fun	15			
Skins	1			
Gambling/Sport	18			
Meat/Sport	8			
Meat/Skins	8			
Skins/Sport	1			
Meat/Fun	6			
Do you have any suggestions that would reduce the amount of illegal hunting and conserve wild animals?		24.15	9	0.0001*
Don't care	2			
Don't know	13			
Arrest/prosecute illegal hunters	27			
Need permit system	10			
Animals should be kept in reserves	8			
Better security on farms	10			
Education	2			
Warning must be issued, then prosecution for those caught	8			
Nothing must be done	6			
Other	13			

Table 3. Results of the interviews with residents of rural settlements near commercial farms with conservancy areas in KZN showing their ability to recognize commonly found game species (n= 92).

	Do you recognize this animal?		Identification Test	
Species	***Don't Recognize (%)***	***Recognize (%)***	***Correct ID (%)***	***Incorrect ID (%)***
Reedbuck	37	63	27	73
Duiker	18	82	67	33
Kudu	23	77	8	92
Bushbuck	46	54	20	80
Nyala	53	47	12	88
Oribi	34	66	35	65

	Do you ever see this animal?		Do you ever hunt this animal?	
Species	***Don't See (%)***	***See (%)***	***Don't Hunt (%)***	***Hunt (%)***
Reedbuck	45	55	65	35
Duiker	27	73	34	66
Kudu	41	59	69	31
Bushbuck	58	42	73	27
Nyala	73	27	86	14
Oribi	42	58	61	39

Table 4. Results of questionnaires completed by landowners and farmers in KZN showing their perceptions about the frequency and motives of illegal hunting on private land (n=56).

Question with Answers	%	Chi2	df	P value
What is your main farming activity?		6.2	4	0.18
Cattle	16			
Crops	34			
Game	7			
Other	27			
More than 1	16			
How often do you find snares on your property?		9.47	4	0.0001*
Daily	4			
Weekly	9			
Monthly	20			
Rarely	61			
Never	7			
Do you have labourers living near your property?		10.72	3	0.0001*
No	11			
Yes, within 1km	63			
Yes, within 3 km	20			
Yes, within 5km	7			
Why do you think hunting is on the increase?		27.13	7	0.0004*
People pressures	0			
Unemployment	8			
Gambling/sport	43			
Other	20			
All of the above	10			
Unemployment and gambling/sport	16			
People pressures and unemployment	2			
People pressures and gambling/sport	2			

Chapter 6

Conclusions and Management Recommendations

The future of the oribi *Ourebia ourebi* is in question if no major steps are taken to reverse its dramatic decline. This study aimed to understand the threats facing oribi in more detail so they could be addressed. In addition, two possible conservation strategies for oribi, reintroduction of captive-bred oribi and translocation of wild populations, were piloted. This study proved invaluable by improving the understanding of this species as well as the various conservation options for the species. An added bonus of this study was the increase in public awareness of the threats facing oribi from the questionnaires and interviews, as well as the popular articles and television documentary that documented the research.

The monitoring of the reintroduction of captive-bred oribi (Chapter 2) was not done under the most ideal of circumstances. Over a period of more than ten years, captive-bred oribi at a private facility on farmland with conservation areas had been reintroduced into the wild there but with no monitoring of the success of this. Consequently, our aim was to monitor the success of such a reintroduction. Successful breeding programmes and reintroductions require satisfying a number of criteria (Griffith et al. 1989, Yalden 1993, Wolf et al. 1996, Kleiman 1997, Griffin et al. 2000, Sarrazin & Legendre 2000, Griffin et al. 2001, Blumstein et al. 2002, Bremner-Harrison et al. 2004, Mathews et al. 2005). Captive breeding and reintroductions of oribi have the potential be successful. However, the preliminary evidence suggests that oribi suffer a high mortality rate in captivity (Chapter 2, Zoological Institutions pers. comm.), as well as high mortality when reintroduced using the protocol followed by the private breeding facility

(Chapter 2). However, one benefit of having captive oribi breeding programmes is that the species could receive greater public awareness. Problems were experienced with the release of the captive bred oribi in the present study. However, these problems highlight procedural issues and do not necessarily mean that captive breeding should be ignored. This highlights the need for further research on captive breeding research, with emphasis on the feeding and release procedures.

Based on the questionnaire and survey results in Chapter 5, it is apparent that many residents of rural settlements near commercial farms with conservation areas in KwaZulu-Natal (KZN) South Africa do not recognize oribi or know of their endangered status. Zoological institutions are invaluable in educating the public about a species and the threats facing it through educational programmes as well as media attention (Hutchins & Conway 1995). Keeping a few "token" oribi in zoos would be extremely beneficial to the species from this point of view.

The success of translocating wild oribi (Chapter 3) suggests that translocation of oribi to restock suitable grassland habitat is far more feasible and economical than reintroducing captive-bred oribi. Translocations of various wild-caught species have obtained higher success rates than the reintroduction of captive-bred animals (Griffith et al. 1989). With so many fragmented subpopulations of oribi in KZN and throughout South Africa (Marchant 2000, unpublished data), more translocations need to be attempted in the future. Although translocations are not always successful (Kleiman 1989, Griffith et al. 1989, Beck et al. 1994, Wolf et al. 1996, Griffin et al. 2000), this pilot study demonstrated that it is a potentially useful conservation tool for this particular species. As total numbers of oribi in South Africa are low (Marchant 2000, unpublished data), not saving three or four could be a substantial loss for the species both in pure numbers as well as genetically. It is suggested that translocations should only be carried

out when the source population is either severely threatened or has reached carrying capacity with no suitable habitat available for animals to disperse (Oribi Working Group, OWG unpublished data). Oribi should only be translocated to properties that have suitable habitat and are completely secure from illegal hunting (OWG unpublished data). Owners of such properties must be willing to co-operate with conservation authorities and manage their properties according to the recommendations suggested by Everett (1991) as well as any future data and management guidelines from the OWG. If this is done, it will guarantee that there will be some secure populations of oribi that remain even if the threats to the species persist.

Another possible conservation tool to consider in the context of land development and pressure on suitable oribi habitat in South Africa, particularly KZN, is to encourage housing developments to be structured so as to conserve and allow management of natural habitat for species survival. The case study presented here of Wedgewood Estate shows that there are options to secure small, but viable populations of oribi within housing developments that conserve and manage the natural habitat (Chapter 4). Such housing developments have the potential to act as "safe havens" for small numbers of oribi that can still breed in the wild. This case study also shows the potential of such ecologically sensitive housing developments as sources of surplus game for translocation, especially in the case of endangered species such as oribi (Chapter 4). Although there may be few estates that can accomplish what Wedgewood has, this is another way of increasing public awareness, and of forcing developments to play a part in saving South Africa's flora and fauna.

Various conservation tools for oribi in KZN, South Africa, have been presented. However, if the threats facing the species such as loss of habitat and illegal hunting continue unabated, the species faces impending extinction here. The bushmeat trade in

Africa is responsible for the sharp decline in numerous wildlife species (Robinson & Bennett 2000, Wright et al. 2000, Milner-Gulland 2002, Fa et al. 2003, Cowlishaw 2005, East et al. 2005). Subsistence hunting has occurred historically at sustainable levels (Lewicki 1974, Mendelson et al. 2003, Cowlishaw 2005), however, a new wave of financially driven hunters are emerging that are decimating local wildlife (Hart & Hart 1986, Wilkie et al. 1992, de Merode et al. 2004). Dog hunting is one of the primary reasons oribi numbers are declining (Marchant 2000, unpublished data). The results of interviews with residents of rural settlements near commercial farmland with conservation areas (Chapter 5) shows that most have a poor knowledge of oribi and their conservation. Most of those interviewed were not permanently employment and poached illegally as a source of meat (Chapter 5). It may be difficult to recommend an alternative to poor, rural people hunting for protein purposes. It appears that illegal hunting has several social and economic roots including cultural, gender-based or nutrition-based (Chapter 5). Addressing these issues needs to be a priority in all aspects of conservation of South Africa for species that are threatened by illegal poaching, such as the oribi. Bringing educational and community-based programmes into "disadvantaged schools", especially in areas bordering areas of conservation significance, needs to become a priority for conservation organizations and the South African government. It also appears that another reason for illegal hunting is for sport and gambling (Chapter 5). Consequently offering rural people an alternative to hunting could be key to reversing the increasing trend of illegal hunting. Despite being controversial, legalizing dog racing could give people the form of entertainment they want while still in keeping with the cultural significance of showing off one another's dogs and betting on their abilities (Chapter 5).

In conclusion, the various options and their constraints for conserving oribi in South Africa, particularly KZN, are summarised in Figure 1. The future of oribi needs the co-operation of private landowners, rural people and conservation officials. Public awareness is essential to overcoming the ignorance surrounding the oribi and the threats facing it. Conserving suitable grassland habitat, both within reserves and on private land, is also key to sustaining large populations of the species. The oribi has become a flagship species for grasslands in KZN, and if the threats continue unaddressed the species will disappear. Education and habitat conservation are the two highest priorities for long-term oribi conservation. In the meantime, translocations and reintroductions can be attempted as backups to save small populations of oribi from extinction.

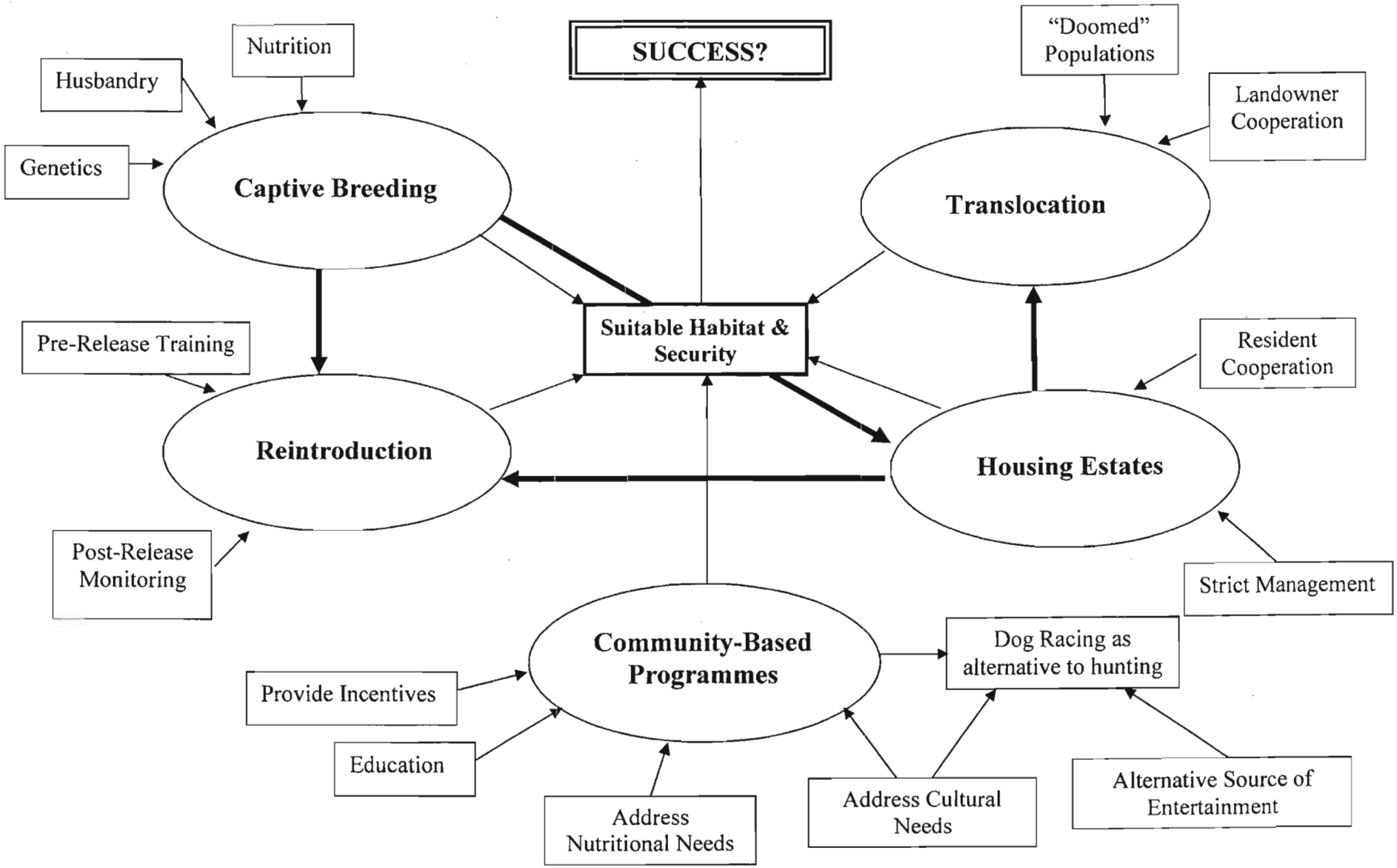

Figure 1. Possible conservation tools and their associated dynamics for oribi in South Africa

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