AN INTERDISCIPLINARY STUDY ON THE HUMAN-BABOON INTERFACE IN ROOIELS, SOUTH AFRICA

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ABSTRACT

The ongoing transformation of natural habitat for urban land use has negatively affected most wildlife, but some species are capable of adapting to novel human-dominated landscapes and even exploit anthropogenic resources. Primates are particularly adept at exploiting resources in human-modified landscapes, and in Africa, chacma baboons (*Papio ursinus*) are arguably the most successful primate urban exploiters. However, these spaces present novel risks to their health and survival, and baboons can damage urban infrastructure, access food from gardens, vehicles, and houses, and pose health and safety risks to people and pets. Consequently, in the interests of both people and baboons, the latter are typically actively discouraged from entering urban areas through a variety of interventions. There is, however, a notable exception to this exclusionary approach with the small coastal village of Rooiels (Western Cape Province, South Africa) having opted to share their properties and village with the local baboon troop. This provided a unique opportunity to explore the local community's acceptance of baboons, and to investigate how, when given a choice, baboons use urban versus natural habitat. Additionally, the absence of formal deterrents in the urban area allows for a rare opportunity to explore how the use of an urban area may influence the ranging patterns, activity budget, diet, and life history of baboons. I explored the spatial and behavioural ecology of the Rooiels troop using GPS data and behavioural observations, respectively, and used questionnaires to understand the attitudes, emotions, and value orientations of the local community towards the troop. The troop had a small home range of 5.78 km^2 with a clear preference for both low-lying land and the village. Within the village, the troop selected for developed properties and roads over undeveloped erven, and amongst the developed erven they preferred those with larger areas of grass, properties where residents did not actively deter them and where food was provisioned. Their diet in urban areas was comprised predominantly of natural fynbos vegetation, with grass from lawns a commonly consumed fallback food. Aside from some deliberate provisioning, which greatly influenced the troop's space use within the village, human-derived foods, including foods from houses, vehicles, and bins, comprised <4% of their overall diet but their access to these foods peaked during the summer holidays when visitors were prevalent. The troop's activity budget more closely mimicked those of provisioned primates, with the least amount of time spent feeding, and considerable time spent resting and socialising. However, fecundity was not greater than troops living in natural habitats and mortality was high with 20 deaths occurring during the research period, of which 75% were due to anthropogenic causes, namely vehicles and dogs. Most residents held a mutualist wildlife-value orientation, had a positive attitude towards baboons, and expressed low levels of fear and stress in response to baboon visits. Consequently, most residents were willing to share the urban space with baboons, and this acceptance increased over time, developing into a culture of community stewardship which encouraged responsible behavior aimed at enabling the existence of the troop in the village. Despite this, the high level of anthropogenic mortality poses a risk to the persistence of the troop and suggests that this, and other urban areas, act as an evolutionary trap for baboons. Thus, the application of this inclusion model to other urban areas is ill-advised, although promoting community education and awareness to promote wildlife responsible behaviour and so reduce the potential for negative interactions associated with occasional urban incursions, is strongly advised. This interdisciplinary study has shown that communities can learn to adjust their behaviour and attitudes to wildlife in a manner that promotes coexistence, but if space sharing has unintended negative impacts on wildlife, it should not be encouraged until those impacts are mitigated.

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In the confrontation between the stream and the rock, the stream always wins
- not through strength, but by perseverance.
H. Jackson Brown, Jr.

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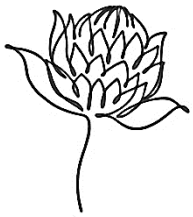

Dedicated to my beautiful friend Cornelia De Villiers,
who devoted her quest for knowledge,
her creativity, and her empathy,
to baboons and communities.

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Cover image:
Juvenile male baboon (JA) peers back at the Rooiels village from the mountain on the edge of the village. Image by Joselyn Mormile.

CHAPTER ONE

GENERAL INTRODUCTION

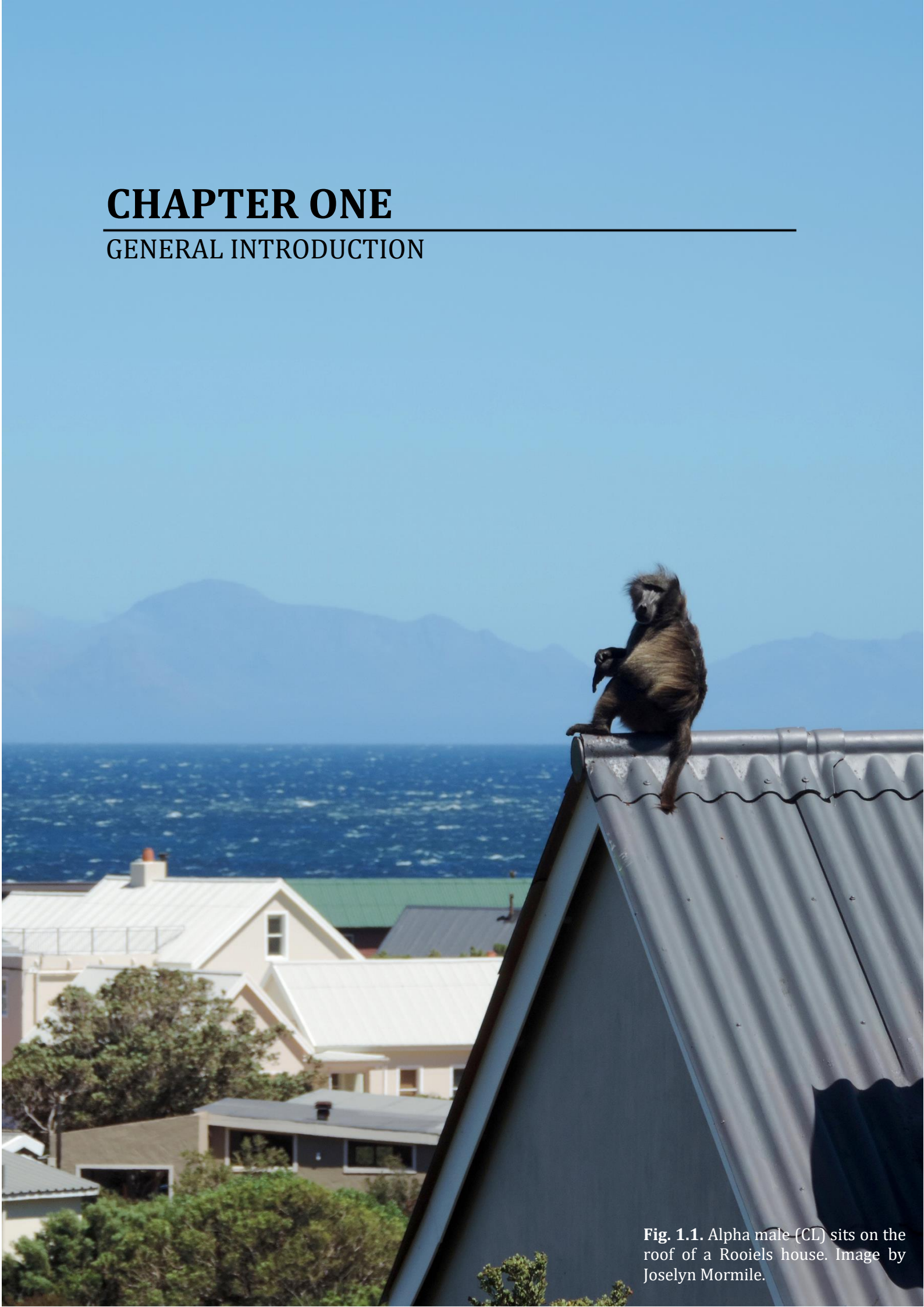


Fig. 1.1. Alpha male (CL) sits on the roof of a Rooiels house. Image by Joselyn Mormile.

1.1 INTRODUCTION

The human-wildlife interface

With a global population of over 8 billion (United Nations, 2022), humans are undoubtedly one of the most successful vertebrate species. This success has however resulted in the destruction and fragmentation of natural land, the disruption of ecosystems and high levels of biodiversity loss worldwide (Pimm & Raven, 2000). Alarmingly, in the year 2000, only one quarter of all global landscapes were estimated to consist of wild, unaltered land (Ellis et al., 2010). Wildlife species that are unable to adapt to these altered environments are thus forced to persist in the diminishing natural habitats which remain. Behaviourally flexible species, on the other hand, may be able to adapt to changing habitats but at the risk of direct interaction with humans (Else, 1991; Siex & Struhsaker, 1999). Interactions between wildlife and people in human-dominated landscapes may be neutral or positive in nature (Harris et al., 2023), but when these interactions result in competition for access to space or resources, they may result in conflicts between the two parties.

Human-wildlife conflict

Human-wildlife conflict is defined by the Worldwide Fund for Nature as "struggles that arise when the presence or behaviour of wildlife poses actual or perceived direct, recurring threats to human interests or needs, often leading to disagreements between groups of people and negative impacts on people and/or wildlife." (Gross et al., 2021). Competition over resources has resulted in a long history of conflict between humans and wildlife globally. Most commonly these conflicts manifest as nuisance issues, for example, damage to gardens by deer (*Odocoileus virginianus*) (Conover, 1998), the nesting of pigeons (*Columba livia*) on buildings (Haag-Wackernagel & Geigenfeind, 2008), and rodent infestation of houses (Tobin & Fall, 2004). Though less prevalent, threats to human safety are typically viewed as the most undesirable interaction that can occur with wildlife. Among some of the species considered to place humans at greatest physical risk are tigers (*Panthera tigris*) (Inskip et al., 2013), great white sharks (*Carcharodon carcharias*) (Englebrecht et al., 2017), mountain lions (*Puma concolor*) (Conover, 1998), hippopotamuses (*Hippopotamus amphibius*) (van Houdt & Traill, 2022), and venomous snakes (Yue et al., 2019). Some wildlife species pose risks to human health by way of zoonotic disease transmission such as the rabies virus which can be transmitted by various mammalian vectors (Thirgood et al., 2005). Overlap with wildlife may also impose economic losses to people, most notably within the agricultural sector. Livestock losses occur due to predation by species such as jackal (*Canis aureus*) and caracal (*Caracal caracal*) (Drouilly et al., 2018), leopards (*Panthera pardus*) and tigers (Bargali & Ahmed, 2018) and wolves (*Canis lupus*) (Kirilyuk & Ke, 2020). Agricultural crop losses occur due to innumerable wildlife species from arthropods (Sharma et al., 2017) and birds (Anderson et al., 2013), to African elephants (*Loxodonta africana*) (Mackenzie & Ahabyona, 2012). Negative

interactions between humans and wildlife are not one-sided, however. In addition to the most fundamental concept of massive land utilization by humans, the resulting human-dominated landscapes pose infinite health and welfare threats to wildlife that threaten their survival. Some of these threats include exposure to litter and environmental toxicants (e.g., albatross (*Phoebastria nigripes*) (Hyrenbach et al., 2017), caracal (Leighton et al., 2022)), motor vehicle collisions (Taylor & Goldingay, 2004), infrastructure collisions (Gradolewski et al., 2021), domestic dog (*Canis lupus familiaris*) and cat (*Felis catus*) depredation (Seymour et al., 2020; Villatoro et al., 2019) and intentional retaliatory injury or killing due to conflict (e.g., Asian elephant (Elephas maximus) (Gubbi et al., 2014), lion (*Panthera leo*) (Hazzah et al., 2013)). Such adverse outcomes for wildlife have placed human-wildlife conflict as a leading cause of biodiversity loss (Nyhus, 2016).

Human-primate conflict

Many generalist non-human primate species (hereafter: primates) that exhibit both dietary and behavioral flexibility are not only able to survive, but even thrive in human-dominated landscapes (Strum, 2010). The presence of primate species in some such settings may be met with acceptance where they are perceived to have ecological and existence value (e.g., various species in India, Pebsworth & Radhakrishna, 2021), or are revered due to spiritual significance (e.g., various species in Sri Lanka, Nahallage & Huffman, 2012). A far larger focus of human-primate research however centers on the complex challenges primates present due to their intelligence, agility, manual dexterity, and adaptability (Hill, 2017; Strum, 2010). This adaptability has led to increasing competition with humans in landscapes that have been transformed by urban or agricultural use (Lee & Priston, 2005). The majority of this research concentrates on the exploitation of crops by primates including chimpanzees (*Pan troglodytes*) (Hockings & McLennan, 2012), orangutans (*Pongo abelii*) (Campbell-Smith et al., 2010), langurs (*Trachypithecus vetulus*) and macaques (*Macaca sinica*) (Nijman & Nekaris, 2010), baboons (*Papio anubis*) (Hill, 2000) and vervet monkeys (*Chlorocebus pygerythrus*) (Saj et al., 2001). Additionally, unparalleled global human population growth over the last century has resulted in vast, rapid urbanization. As over half of the human population resides in urban areas (United Nations, 2019), research on wildlife interactions within urban landscapes and urban human communities has surged over the last few decades (Soulsbury & White, 2015). Literature focusing on the conflicts and conservation of primates frequenting urban areas have been documented for primate species globally, including Costa Rica (Lindshield, 2016), Brazil (Cunha et al., 2006), India (Sharma et al., 2011), Singapore (Yeo & Neo, 2010), South Africa (Patterson et al., 2018) and Nigeria (Olaleru et al., 2020) among others. Similar to primates in the agricultural context, their intelligence and adaptability makes them challenging wildlife species with which to overlap in the urban context (Hurn, 2011; Sinha & Vijayakrishnan, 2017).

Human-baboon conflict

Baboons (*Papio* spp.) are some of the most prolific primate species overlapping with people and human-dominated landscapes throughout much of their distribution. These large-bodied, predominantly terrestrial monkeys maintain a complex social organization with approximately 10 to 200 individuals per troop (Else, 1991; Swedell, 2011). They range throughout sub-Saharan Africa and the Arabian Peninsula (Wildman et al., 2004), making them one of the most widespread primate genera. Baboons inhabit a diverse array of natural habitats including forests, coastal regions, deserts, savannahs, and seasonal floodplains (Altmann, 1974; Cowlishaw, 1997; Lewis & O'Riain, 2017; Okecha & Newton-Fisher, 2006). Their ability to successfully occupy various habitats is attributed to their intelligence, dexterity, agility, high levels of sociality, and dietary and behavioural flexibility (Else, 1991; Swedell, 2011), all of which allow them to adapt well to land transformation. However, due to their success in exploiting cultivated foods, baboons have been labeled as agricultural 'pests' throughout much of their sub-Saharan range (e.g., Uganda (Hill, 2000), Nigeria (Warren, 2009), Kenya, (Strum, 1994)) and their presence in urban areas is viewed no differently (Boug et al., 1994; Kansky & Gaynor, 2000).

Urban human-baboon conflict

Perhaps the best-known urban human-baboon interface occurs in the Cape Peninsula of South Africa. The first recorded negative interaction took place over 300 years ago on the slopes of Table Mountain where early European settlers attempted to establish vegetable gardens (Gerber, 2004; Skead, 1980). Over many decades, development on the Peninsula shifted from agricultural to urban, and with that transition the degree of negative interactions between people and baboons escalated as baboons learned to enter houses and vehicles in their search for food. In recent years, research in the area has illustrated a general intolerance for the presence of baboons due to the associated tangible costs such as property damage and food loss, as well as the intangible costs of worry over the health and safety of family and pets (Kansky et al., 2016). The intolerance for the presence of baboons in urban spaces has manifested in high levels of retaliatory injury and killing of baboons (Beamish, 2011). This mortality rate mirrored rates of naturally ranging populations undergoing substantial predation pressure (Cheney et al., 2004) and placed the long-term survival of the local baboon population at risk (Kansky & Gaynor, 2000).

Urban baboon management

Traditionally, management efforts have focused on attempting to completely exclude baboons from agricultural and urban landscapes using a combination of non-lethal and lethal methods. These include guarding and chasing (Hill, 2000), fencing (Kaplan, 2013), translocation (Strum, 2010), poisoning

(Katsvanga et al., 2006) and the killing of individuals or culling of whole troops (Fergusson, 2005; Skead, 1980). Over time, within the Cape Peninsula, there has been a general move away from culling and indiscriminate killing of baboons to more nuanced non-lethal measures including the use of trained rangers equipped with a range of deterrents to keep baboons away from urban spaces (Kaplan et al., 2011; van Doorn & O'Riain 2020). This now world-renowned program has achieved considerable success in reducing the time baboons spend in urban spaces and consequently reducing negative interactions with residents who were historically the primary cause of baboon mortality in the Peninsula (Beamish & O'Riain, in press). Other South African municipalities and communities have followed the Cape Peninsula's management lead in seeking to use predominantly non-lethal methods to deter baboons from urban areas (e.g., Greyton (White, 2019), Knysna: ("Knysna Municipality addressing baboon issue", 2016), Overstrand Municipality ("Overstrand baboon management", 2022), George ("The baboons and monkeys are back", 2018)). However, a major challenge of this approach is the financial cost of having rangers in the field from sunrise to sunset year-round. In Cape Town this cost is approximately R13m/annum (~$700,000 USD) for 10 troops which is a substantial investment for a small population of an IUCN Red List least concern species (Sithaldeen & Rylands, 2020). Consequently, new approaches are constantly being sought, ranging from more effective exclusion using baboon-proof fencing (Walsh et al. 2023) and baboon-proof urban infrastructure to limit baboon access to human food sources (Kaplan, 2013), to increased tolerance of baboons in urban areas with an emphasis on adjusting human behaviour (NCC Environmental Services, 2023).

Human dimensions of wildlife conflict

The field of human-wildlife conflict has been approached from a largely anthropocentric perspective, focusing on the negative impact wildlife have on people (Treves & Santiago-Ávila, 2020). In a review of human-wildlife literature, König et al. (2020) revealed that 80% of studies focused on biological or ecological aspects of wildlife in conflicts. This is likely related to the historical framing of wildlife as the 'problematic' party involved in interactions. Redpath et al. (2015a) called into question the use of the default term 'human-wildlife conflict' as it creates the potential for misinterpreting human-wildlife interaction scenarios and may lead to negative consequences for wildlife while simultaneously failing to address the root cause of the issue at hand. Ultimately, human views and behaviours guide the succession and outcome of interactions with wildlife, and thus a greater emphasis should be placed on understanding the human dimension of such interactions (Manfredo & Dayer, 2004). The delayed integration of wildlife studies and human dimensions is unsurprising as the fields of wildlife biology and social science have little intrinsic overlap. However, there now exists a growing call for human-wildlife interaction research to take a more interdisciplinary approach (Redpath et al. 2015b). Research which aims to objectively understand the drivers of conflict for both wildlife and people in any given location, will provide a more holistic understanding of the impacts at hand, and may better guide

wildlife managers, stakeholders, and educators in addressing and resolving conflicts.

1.2 STUDY JUSTIFICATION

In a review of the literature on primate behaviour in anthropogenic landscapes, McLennan et al. (2017) highlighted that only 15% of studies that describe the behaviour of primates in urban settings. The widespread distribution and adaptable nature of baboons paired with continued urbanization throughout sub-Saharan Africa predicts increasing overlap of baboons with urban areas. This necessitates a more detailed understanding of the behaviour of baboons in these settings, the impacts of urban overlap for baboons and people, and potential new management approaches in the interests of both parties. Little research has been conducted on the human dimension of urban human-baboon interactions (Kansky et al., 2016; Mormile & Hill, 2017), an area of research now considered a requirement of human-primate interaction studies (Fuentes, 2023; Hockings, 2016). Additionally, research on human-baboon interactions across human-dominated landscapes has focused solely on conflicts that arise between people and baboons, but no research to date has explored the neutral or positive relationships between them within urban landscapes, which may provide insights on how to reduce conflicts (Frank & Glikman, 2019; McLennan et al., 2017). Furthermore, there is neither research on elective urban space sharing where baboons have unfettered access to an urban area, nor examination of the causes and consequences of such inclusion through an interdisciplinary lens where the impacts are concurrently assessed from both baboon and human perspectives (Thatcher et al., 2023).

1.3 STUDY SITE

This study took place in the village of Rooiels in the Western Cape Province of South Africa where the community approaches the presence of the local baboon troop through the use of an inclusion model, whereby the troop has unconstrained access to the village (**Fig. 1.2**) (see Appendix 1 for geographic location in reference to other baboon troops studied in the region). Rooiels was established as a township in 1948 (RERA, 2018), covering 1.15 km^2 that spans across a low-lying area surrounded by mountain ranges and False Bay (**Fig. 1.3**). The R44 provincial road, which serves as the only access road to Rooiels and neighbouring villages, cuts through the eastern section of the village. The village has a total of 350 erven[1], 240 of which contained built houses at the time of the study (Overstrand Municipality, 2017). Approximately 125 of these residences were permanently occupied, with the remainder being holiday or weekend houses. The low degree of housing development and other infrastructure in the village best qualifies it as a semi-urban area (Meeus & Gulinck, 2008) however for ease of discussion, it is referred to as an urban area throughout the thesis.

[1] Erf (pl. erven) is the South African term for a cadastral unit of land (South African Deeds Registries Act, 1937.)

The Rooiels village and surrounding area forms part of the greater Kogelberg Biosphere Reserve, which was listed as the first South African UNESCO biosphere reserve in 1998 (UNESCO, 2019). The reserve covers 1036km^2 and is approximately 70km from Cape Town (34° 14'S, 18° 59'E) (UNESCO, 2019). The reserve is comprised of three areas: 1) the core, which is the most ecologically sensitive area and where human activity is prohibited, 2) the buffer, which surrounds the core zone and where limited human activity is allowed, 3) the transition zone, the outermost area of the reserve where several human activities such as housing developments, agriculture and recreation are permitted (Attwell, 2017). The reserve falls within the heart of the Cape Floral Kingdom, the smallest of the world's floral kingdoms. The area is comprised of approximately 80% mountainous landscapes and contains approximately 1,880 plant taxa, of which an estimated 77 taxa are endemic to the area (Kogelberg Biosphere Reserve Company, 2022). Nutrient-poor sandstone fynbos covers most of the area, providing low-quality vegetation for local wildlife, resulting in low vertebrate animal biomass in the area (Johns et al., 2012). As a result of exclusion of fire from the Rooiels village, the fynbos within the village is more mature than within the surrounding natural areas, where extensive human-caused burns have occurred (RERA, 2018) (**Fig. 1.4**).

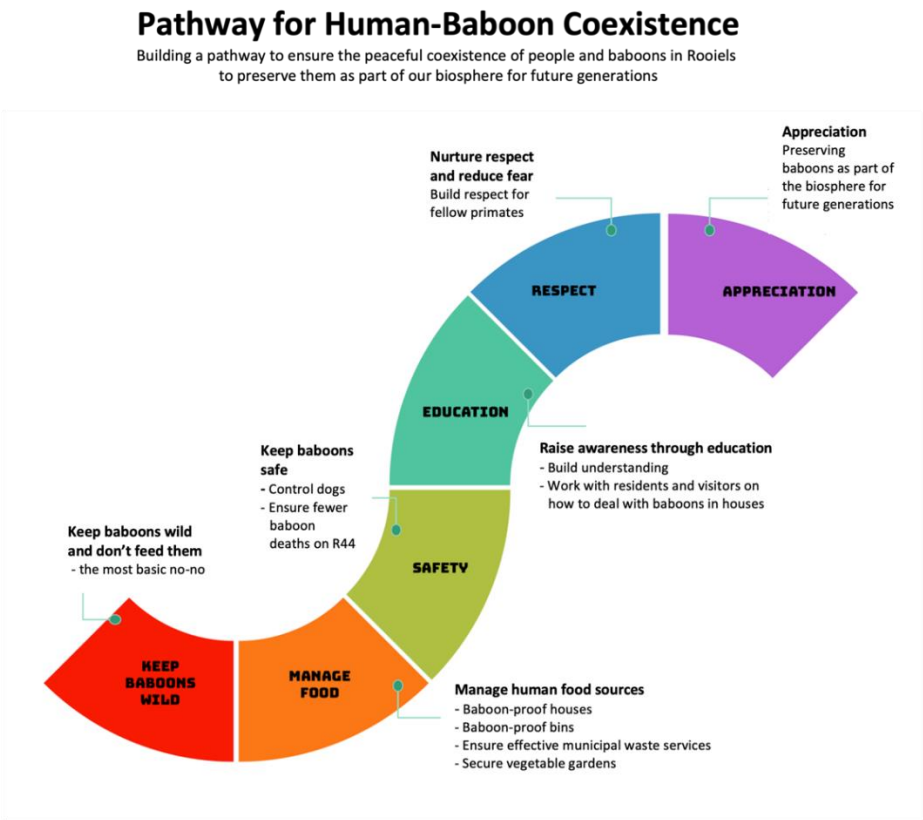


Figure 1.2. The Rooiels community's pathway to human-baboon coexistence (REC, 2021).

The Rooiels community is comprised of predominantly white residents (Firth, 2011) of higher socioeconomic class (Pfaff et al., 2019). In 2004, the village became a registered urban conservancy with CapeNature, the provincial nature conservation authority. The democratic community decision to

become a registered conservancy was put forth by the Rooiels Conservancy committee following the adoption of the document: "Living the Vision of Rooiels and the Kogelberg Biosphere Reserve: a property owner's guide", by the community (REC, 2023). The overarching principles of the document, which were written by the Rooiels Conservancy, state the following:

> ***Vision****: Rooiels is a conservation community, caring together today… for tomorrow.*
>
> ***Values****: We strive to be a caring community united by our passion to conserve the natural splendor of Rooiels and keen to share our appreciation of the environment with others.*
>
> ***Pledge****: United by our passion for the natural splendor of Rooiels, we pledge that here:*
> *Nature will be nurtured. Flora, fauna and marine life, protected. Our every impact on the area, limited.*
> *Our custodianship of the environment respected. Our community spirit strengthened.*
> *So that our lives and those of generations to come, will be enriched by our care!*

The document details how to live responsibly in the area including how to nurture indigenous gardens, combat alien invasive plants, preserve wildlife, behave appropriately around baboons and baboon-proof properties, limit one's property footprint and limit pollution from waste, light, noise, and pets. The document also includes information and a map of the Kogelberg Biosphere Reserve which shows the location of the village within the World Heritage site. Over many years, the document was provided to new residents by members of the Rooiels Conservancy committee and typically served as the first communication of the village's social norms and expectations as a pro-environmental community (J. Stark, pers. comm., 2022). This document was later added to the Rooiels community website (Rooiels.org), in addition to further detailed information on living in the area, for ease of reference to all residents, the public, and prospective buyers researching the village and community.

Figure 1.3. Drone image of the Rooiels village illustrating low-lying development surrounded by mountainous terrain and coast. Image by Illah Nourbakhsh.

Figure 1.4. Drone image of the Rooiels village illustrating the proximity to the coastline and showing the areas that were burnt in the most recent wildfires (grey patches along the foothills of the mountains). Image by Illah Nourbakhsh.

1.3 STUDY TROOP

A troop of Cape chacma baboons has been frequenting the Rooiels village for several decades (Guyett, 2006; van Beuningen, 2011) without physical management or restriction from the urban space (**Fig. 1.5**). As a result, the troop is highly habituated to the close presence of people, which readily facilitates individual baboon identification and behavioural observation. The troop sleeps on mountain cliffs surrounding the Rooiels village (van Beuningen, 2011). An ongoing camera trap survey in the natural area surrounding Rooiels (Cape Leopard Trust and Rooiels Conservancy, 2013 - present) has confirmed the presence of leopards, the local natural predator of baboons. Additionally, many residents in the village keep domestic dogs, which may behave in a predatory fashion towards baboons. At the start of the study, the troop had a total of 24 individuals comprised of one adult male, nine adult females, no subadults and 14 juveniles of both sexes.

Figure 1.5. The Rooiels baboon troop in the Rooiels village. Images by Joselyn Mormile.

1.4 BROAD AIMS & OBJECTIVES

The aim of this study is to assess an urban inclusion model for baboons from both resident and baboon perspectives. The objectives include (i) assessing the baboon troop's use of their home range including natural and urban areas, (ii) determining the baboon troop's activity budget and diet within the urban space, (iii) mapping the life history of the baboon troop and determining birth rates, mortality rates and causes of mortality, and (iv) determining the drivers of resident acceptance of baboons in Rooiels. Together these results allow for a discussion of the viability of this inclusion model for both humans and baboons, as well as its potential applicability to other areas of urban human-baboon overlap.

1.5 THESIS STRUCTURE

In **Chapter 2**, I utilize GPS data to map the baboon troop's home range and model the ecological and human social variables that influence their spatial preferences at different spatial scales (home range, urban landscape, and individual residential properties).

In **Chapter 3**, using focal, scan and ad libitum behavioural data, I determine seasonal and spatial variation in how the troop's activity patterns, and diet vary within the urban portion of their home range.

In **Chapter 4**, I use structured questionnaires to explore resident acceptance of baboons and to quantify changes in resident attitudes towards baboons over an 18-year period.

In **Chapter 5**, using ad libitum data, I investigate how the routine use of an urban landscape influences life history factors including troop size, age structure, sex ratio, reproduction, immigration, emigration and causes of mortality.

In **Chapter 6**, I synthesize the findings from Chapters 2-5, discuss the successes and limitations of sharing space in Rooiels, and the applicability of this approach to baboons and other wildlife in urban areas more generally.

Fig. 2.1. The Rooiels baboon troop crossing the Rooiels beach on their way out of the village. Image by Joselyn Mormile.

CHAPTER TWO

THE SPATIAL ECOLOGY AND URBAN SPACE USE OF AN UNMANAGED BABOON TROOP

ABSTRACT

The erosion of natural habitat is forcing many wildlife species to seek resources in rapidly expanding urban areas. Living within or adjacent to urban land uses can have profound impacts on the behavioural ecology of animals, altering their diet, social interactions, movement patterns and life history. In this chapter, I investigate the spatial ecology of the Rooiels baboon troop, unique amongst baboons in South Africa for having unfettered access to urban and natural land within its home range. Using GPS data, I analysed the troop's spatial ecology at three different scales using ecological covariates: home range, urban landscape, and individual residential properties. For the latter I also used social covariates derived from questionnaire responses on how residents behave towards baboons when they are on their property, how frequently the baboons had entered their houses and whether the residents live permanently or part-time on their property. Within their relatively small home range (5.78 km^2), the troop showed a strong preference for the village and low-lying land as well as areas closer to sleeping sites, consistent with other studies. Within the urban landscape, the troop showed a preference for developed properties and roads over undeveloped properties. Amongst developed properties, they preferred those with larger areas of grass, properties where residents did not deter them and one property where food was provisioned. Natural vegetation type did not significantly influence habitat use, nor did type of residency (i.e., permanent vs. part-time) or frequency of baboon entries into residents' houses. This study supports previous research in the Western Cape showing that baboons prefer to forage at low altitudes and in particular, urban areas. My findings challenge the perception that baboons only enter urban areas to access poorly managed waste, with private gardens and roads providing an abundance of both natural and exotic vegetation, proximity to water and only the occasional access to food from houses. Including social factors in spatial models improved my understanding of movement decisions in urban landscapes and highlights the need for an interdisciplinary approach to understanding wildlife in human-dominated landscapes.

2.1 INTRODUCTION

To ensure survival, wildlife must find suitable habitat which provides them with access to food, water and shelter (Davies et al., 2012). The primary goal of ecologists is to understand these various factors and how they drive the movement, presence, and abundance of wildlife species across landscapes. Historically, the ecology and behaviour of wildlife species within human-dominated landscapes was excluded from the study of ecology, which instead focused on wildlife in unaltered, natural environments (McDonnell, 2011). However, in the wake of widespread global land transformation, including urbanization, the need to understand the inclusion of human-dominated wildlife habitats has grown to become a well-accepted subset of ecological research known as urban ecology (McDonnell, 2011).

The destruction, fragmentation and transformation of natural habitat is the most significant threat to the survival of primate populations globally. Habitat loss often results in negative interactions between humans and primates over access to food and space (Estrada et al., 2017), particularly for primates belonging to the highly adaptable genera *Papio*, *Macaca* and *Chlorocebus* (Hill, 2017). Human-dominated landscapes present distinctively different ecological circumstances to those of natural habitats. Arguably the most important resource which impacts a primate's movement is the availability of food (Reyna-Hurtado et al., 2018). Within natural landscapes, food is often unevenly and widely distributed, the availability of which shifts in response to several factors including seasonality (Hanya et al., 2011), elevation (Grow et al., 2014) and landscape type (Tsuji et al., 2013). Many primate species thus travel large distances in natural habitat to meet their dietary requirements (Lewis & O'Riain, 2017).

An abundance of concentrated, low-fibre, highly palatable foods are often found within human-transformed landscapes. These include agricultural crops (Hill, 2005), fruiting trees and vegetation in gardens (Johnson et al., 2013), food waste from houses and rubbish bins (Sha et al., 2009) and intentional food provisioning (Zhao & Deng, 1992). Access to these foods, which typically have a higher caloric composition and reduced handling times, has been shown to alter primate spatial ecology. These changes manifest as decreased home range sizes (Altmann & Muruthi, 1988; Hoffman & O'Riain, 2012a) and disproportionate range use (Hoffman & O'Riain, 2011; Riley, 2008), shorter daily distances traveled (Brennan et al., 1985; Hoffman & O'Riain, 2012a) and selection of sleeping sites closer to, or within the transformed landscapes (Bracken et al., 2022a; Hoffman & O'Riain, 2011; Walton et al., 2021).

Nutritional benefits in urban and rural areas allow some primate species to thrive, showing increased fecundity and fitness (Strum, 2010), demonstrated by chacma baboons in South Africa (Hoffman &

O'Riain, 2011), macaques (*Macaca fascicularis*) in Indonesia (Fuentes et al., 2011), and Hanuman langurs in India (*Presbytis entellus*) (Mohnot et al., 1981). Additionally, fewer or no natural predators in human-dominated landscapes can allow local populations to exceed the density of those living in natural habitat (Malik et al., 1984), potentially increasing competition over space and food resources (Brennan et al., 1985). Given the attractiveness of human landscapes for primates, whether out of necessity (i.e., decreasing naturally available resources) or preference (i.e., higher caloric value of human foodstuff), understanding the spatial ecology of primates in developed landscapes has become essential for the management and conservation of various primate populations (Arrowood et al., 2003; Bracken et al., 2022a; Hoffman & O'Riain, 2012b).

There has been extensive research on the spatial ecology of the baboon troops that inhabit the urban landscapes in the Cape Peninsula (e.g., Bracken et al., 2022a; Fehlmann et al., 2017; Hoffman & O'Riain, 2011, 2012b, 2012c). These studies were foundational to the design of conservation and management plans for the baboon troops living on the urban edge, plans which are particularly vital given that the Cape Peninsula baboon population is geographically isolated from other populations due to extensive urban sprawl. To date, however, there has been no research on the spatial ecology of unmanaged urban baboon troops. Attempts to obtain such data are often confounded by management programs which aim to displace baboons from urban areas (Bracken et al., 2022b; van Doorn & O'Riain, 2020), fundamentally impacting how baboons utilize the landscape. The village of Rooiels has adopted a coexistence strategy that allows for the local baboon troop's spatial overlap with private and public property. The village implements no formal deterrent measures (e.g., baboon-proof fences, field rangers) and each property owner is expected to prevent the baboons from accessing human-derived foods (HDFs), defined as human foodstuff, vegetables from gardens, compost areas, and bins, both outside and inside their house. Importantly, the Rooiels troop exists in an open population within a biosphere reserve and has freedom of movement and choice in where they wish to forage, sleep, socialize and rest. Rooiels thus provides a unique opportunity to explore how an unmanaged, free-ranging baboon troop utilizes both natural and urban landscapes.

In this chapter, my first aim is to understand the spatial ecology of the Rooiels troop with the specific objectives of quantifying their home range size and how home range use is affected by altitude, distance to sleeping sites and broad scale habitat type (e.g., natural versus urban). Based on previous research for unmanaged troops living in natural habitat in the Cape Peninsula, I predict that the troop will show a preference for lower altitudes, areas closer to sleeping sites and urban land (Hoffman & O'Riain, 2012c; Lewis & O'Riain, 2017). My secondary aim is to investigate space use within urban areas with the main objectives of quantifying whether use varies with fine scale variation in habitat type within urban areas (e.g., roads, developed and undeveloped properties) and individual residential

properties. I predict baboons will show a preference for 1) areas closer to the property where they are food provisioned, 2) areas that were historically dominated by strandveld vegetation which is preferred for foraging by baboons in coastal areas (Lewis & O'Riain, 2017), and 3) developed properties over undeveloped properties as they offer a variety of novel benefits such as human foods, lawns and man-made shelter. At the level of individual developed property, I predict that the troop will 1) select for properties nearer to the food provisioning property, 2) properties with a larger area of lawn, which is a favoured food (Chapter 3), 3) properties where residents do not chase them away, 4) properties where baboons have entered the house more frequently which may represent hotspots for reliable access to human-derived foods and, 5) properties where residents reside full-time which increases the likelihood that baboons will gain entry into the house thereby increasing their potential access to human-derived foods.

2.2 METHODS

GPS data

Movement data for the troop were collected using two methods. To determine the troop's ranging patterns within the village, I recorded Global Positioning System (GPS) data points using handheld devices (Garmin eTrex 20x and Garmin eTrex 10x) operated by myself and one field assistant. GPS points were recorded from the approximate center of the troop every 30 minutes during scan sampling and within 5-10 meters of the focal animal at the start and end of focal data samples, which occurred throughout the day. Due to physical limitations of following the troop outside of the village through steep mountainous terrain, I deployed the use of GPS collars to aid in determining the troop's home range. The handheld GPS data points were used to supplement the GPS collar dataset for the period of time prior to the placement of the GPS collars (January-May 2017) and for dates when the GPS collars failed to capture data. Both methods assume that the GPS point is a suitable proxy for the troop (Fehlmann et al., 2017; Hoffman & O'Riain, 2011; Kaplan et al., 2011).

GPS collar specifications & data collection

The GPS collars were purchased from the South African-based company Human Wildlife Solutions (HWS), who design collars specifically for use on baboons. The GPS collar operates as part of the Sensorian Telemetry Mesh System, which includes a network gateway (placed at my residence in the Rooiels village) and multiple relay systems (placed in the mountains surrounding the village). Through line of sight, the relays bounce the collar signal to the gateway system which converts the data to GSM and then sends the data via the GSM network to a cloud database for online access. GPS locations of the collared animals were available in near real time through a secure website. Collars were set to take readings every 30 minutes throughout the day for the duration of the collar battery's life or until the

collar was removed. The collars weighed 0.25 kg, accounting for 1.6% of the collared adult female's weight (16 kg) and 0.8% of the collared adult male's weight (30 kg). This is well below the acceptable weight (≤5 % of body weight) for a transmitter that can be added to an animal without causing impediment to behavior, survival or well-being (White & Garrott, 1990).

GPS collaring procedure

GPS collars were fitted to two individuals, alpha male (CL) in May 2017 and alpha female (RE) in December 2017 (**Fig. 2.2**). The baboons were cage captured, and anaethetized by a qualified veterinarian through the use of a single intramuscular dose of Ketamine and Medetomidine. Once sedated, I fitted the collars with the assistance of HWS employees trained in the placement of their company's collars. Once the collar was secured, the veterinarian administered an injection of Atipamezole to reverse the effects of the Medetomidine anaesthetic. The baboon was placed in a holding cage to allow for complete recovery from anesthesia. Once fully recovered, the baboon was returned to the immediate vicinity of the troop (**Fig. 2.3**). I remained with the collared animal for a minimum of one-hour post-release to monitor their adjustment to the collar. I was able to regularly monitor the collared baboons for any issues related to the collar for the duration of their placement. Both collars were removed by the end of the study period using the same protocol described above. The use of GPS collars for research and protocols for baboon capture and immobilization were approved by the University of Cape Town Science Animal Ethics Committee (*approval number: 2017/v3/JOR*) and CapeNature (*permit number: 0056-AAA007-00208*) prior to the commencement of the collaring process.

Figure 2.2. Placing a collar on alpha female (RE) while under sedation. Image by Kaelin DeLong.

Figure 2.3. Alpha male baboon (CL) post-collaring in Rooiels. Image by Joselyn Mormile.

Spatial data: processing

As baboons are a diurnal species, the GPS data were truncated to data points recorded exclusively during daylight hours (i.e., one hour after sunrise until one hour before sunset), controlling for seasonal variation. To analyze troop spatial use at different scales (i.e., home range, use of the urban area and use of individual properties), datasets for each model were subsetted differently (see below). Datasets were cataloged in Excel and subsequently exported to QGIS 3.6 for covariate calculation. All models were run in R statistical software.

Home range use

To assess the troop's spatial movement at the home range level, I used data from the GPS collars exclusively (n = 3948 points). Following Hoffman and O'Riain (2011), I used the grid cell method (which utilizes cells as sampling units), to investigate the factors impacting the frequency of use of different areas of the home range. A cell size of 0.01 km2 (100m x 100m) was selected as this would subsume the area over which a troop would typically be dispersed when foraging (Hoffman & O'Riain, 2011). The grid was then superimposed over the GPS data points with cells retained only when they a) contained at least one GPS point, b) were bordered on three sides or two opposite sides by used cells, c) were bordered on all sides by used cells and the coast, or d) were completely enclosed by any of the abovementioned cells (Lewis & O'Riain, 2017). The grid was subsequently clipped to the coastline in order to exclude the portion of grid cells extending into the bay. The number of GPS points per grid cell was then calculated and utilized as the measure of intensity of use per area.

Thereafter, I quantified select physical and biological characteristics of each cell following methods in Hoffman and O'Riain (2011) and Lewis and O'Riain (2017). I calculated mean altitude (m) of each cell using a 30m digital elevation model from the Shuttle Radar Topography Mission (USGS, 2019). I used a shapefile outlining the urban area as demarcated by the Overstrand Municipality to indicate the dominant land-type (>50% 'natural' or 'urban') of each grid cell (Overstrand Municipality, 2017). I calculated the Euclidean distance from the nearest sleeping site (m) to the centroid of every cell, with the location of sleeping sites based on post-sunset GPS cluster points. Vegetation type was excluded from this model as one of the vegetation types was only found within the urban space. I tested for collinearity between the two continuous predictor variables by performing Pearson correlations (Dormann et al., 2013). I considered two variables to be collinear if the absolute value of the Pearson correlation coefficient (|r|) exceeded 0.7 (Dormann et al., 2013). No significant collinearity was found and both continuous predictor variables were standardized prior to running models (Zuur et al., 2009).

Sparse spatial generalized linear mixed models (SGLMMs) were used to examine the relationship between frequency of cell use within the troop's home range and the predictor variables (Lewis & O'Riain, 2017). Sparse SGLMMs were utilized as they incorporate the spatial structure of the data into the model. They also alleviate the issue of spatial autocorrelation (SAC) through the inclusion of random effects in the form of Moran eigenvectors (Hughes & Haran, 2013). I fitted the sparse SGLMM using the ngspatial package (Hughes & Cui, 2013). I tested for overdispersion of the response variable relative to a Poisson distribution by calculating the variance-to-mean ratio. Overdispersion was present in the response variable. The distribution was then tested and found to follow a negative binomial distribution. The model does not provide a default theta hyperparameter for negative binomial distributions, so this was calculated for subsequent use. To control for the variation in cell size due to the clipping of coastal cells, an offset for cell area was written into the model. I used the default number of Moran eigenvectors (q = 50) in the initial run of this model (Hughes, 2014). I tested for SAC in the residuals using the Moran's I test, which showed no significant SAC and therefore did not require an increase in eigenvectors. The models were run until the estimate-to-Monte-Carlo standard error ratios for each predictor variable showed convergence of the Markov chains (Jones et al., 2006). The model reached convergence with a burn-in of 1E + 05 with 1E + 06 iterations. I did not remove predictor variables from the model as none of the highest posterior density intervals generated by the model included 0, therefore all three proposed predictor variables were included in the final sparse SGLMM. Fitted values from the model were calculated and divided by the size of each grid cell for mapping.

Use of urban space

To assess the troop's use of the urban space, I examined movement data collected from the GPS collars and handheld GPS units (n = 2638). I cropped the dataset to include only points within the urban space,

as demarcated by the Overstrand Municipality (Overstrand Municipality, 2017). To understand the troop's differential use of space within the urban landscape, individual erven were used as sampling units (whereby the number of GPS points per erven was utilized as the measure of intensity of use per area), as opposed to grid cells (see home range use above). I quantified the topographical and biological characteristics of each erf. Firstly, I divided the roads running through the village into 100 polygons of approximately the same size as the mean size of all the other erven (~0.0014 km2). I then identified the land-use type of each erven using high resolution satellite imagery (Overstrand Municipality, 2017). Erven that were made up of road were classified as 'road', those that contained no houses (i.e., natural reserves and empty plots) during the study period were classified as 'undeveloped' and those that contained houses were classified as 'developed'. Pilot observations revealed that a single resident was routinely setting out food for wildlife (e.g., bird seed, fruit) which the baboons were regularly consuming. It was clear that this reliable source of food was a great attractant to the baboons, and I thus included this provisioning property as a covariate influencing the use of erven within the urban space. To measure the effect of this attractant, I calculated the Euclidean distance (m) from the centroid of each property to the centroid of the provisioning property. Finally, I determined the predominant (>50%) historical vegetation type (Kogelberg Sandstone Fynbos or Overberg Dune Strandveld) of each property using the South African National Biodiversity Institute's national vegetation layer (SANBI, 2018). Much of the historical vegetation has been modified by property owners through landscaping and planting of both other indigenous and exotic plants. However, the large bushes and mature vegetation on roadsides and individual properties are still recognizable as part of historical vegetation types prior to development.

I ran a Chi-square test to explore the relationship amongst all predictor variables, none of which were significant and thus all three were included in furthering modelling. Sparse SGLMMs were run to examine the relationship between frequency of erven use within the urban landscape and the predictor variables. Following the same procedure as the previous sparse SGLMMs, the response variable followed a negative binomial distribution and the appropriate theta hyperparameter for use in the model was calculated. To control for the variation in erven size, an offset for erven area was written into the model. I ran repeated models until the Moran's I test revealed no significant SAC (q = 50) and the estimate-to-Monte Carlo standard error ratios for each predictor variable showed convergence of the Markov chains with a burn-in of 1E + 05 with 1.5E + 06 iterations (Jones et al., 2006). Vegetation type showed the highest posterior density interval which included 0. The Deviance Information Criterion value was found to be higher when vegetation type was excluded so it was thus retained in the final model. Fitted values from the model were calculated and divided by the size of each erven for mapping.

Use of individual developed properties

For this analysis, the urban-use GPS dataset was restricted to developed erven where property owners had completed the questionnaire on Rooiels baboons (Chapter 4). The data set included a total of 130 erven and 716 data points. GPS counts per property were then used as a measure of intensity of use per area. Given the high intensity of use of the 'provisioning property' (n = 190 GPS points), I included it as a covariate in the model by estimating the Euclidean distance from the centroid of this property (m) to the centroid of all other developed erven in the sample. Lawn featured prominently in the diet of the troop when in town (Chapter 3) and given its close link with individual properties, I used a high-resolution satellite photograph of the village to quantify the area (h) of lawn on each developed property (Overstrand Municipality, 2017). I found no significant collinearity between these two covariates using Pearson's correlation (Dormann et al., 2013) and thus both were included in the models. The distance to the provisioning property was log transformed and both variables were standardized prior to running models (Zuur et al., 2009).

Each property was coded according to whether the residents were full-time or part-time (i.e., a holiday property). To assess whether houses that baboons frequently gained access to were more likely to be visited by baboons, residents were asked how many times baboons had entered their homes in the last 12 months (2017 - 2018). Where there was a discrepancy between residents of the same household, the number of times access was gained was averaged. To determine whether actively deterring the troop from a property resulted in fewer visits, properties were coded as either 'deter' or 'do not deter' based on resident responses to the open-ended question: "What do you do when the baboons come to your property?". When residents within the same household gave different responses to the question, their property was excluded from the analysis.

An interaction term between the number of times baboons had been inside a house on a property and residential status was included under the premise that baboons typically gain access to houses that are occupied. An interaction term between deterring and residential status was also included under the assumption that the impact of deterrence would differ between properties where residents are always present and properties where residents are present on an intermittent basis. Using Chi-square tests, I found no significant collinearity between categorical variables and thus all variables were retained.

Sparse SGLMMs were not used for this modeling exercise as they rely on matrices of connected polygons. The use of developed properties was therefore assessed through hypothesis driven generalized linear models (GLMs) using the package lme4 (Bates et al., 2014). Similar to the sparse SGLMMs, I tested for overdispersion of the response variable by calculating the VAR and determined that a negative binomial distribution with a log link was most appropriate. To control for the variation

in property size, an offset for property area was written into the model. The most parsimonious model was selected based on Akaike's Information Criterion. Due to the spatial nature of the dataset, Moran's I tests using distance were done for each final model to assess for SAC, and no SAC was found. Model fit was evaluated through the use of Q-Q plots. Fitted values from the top model were calculated and divided by the size of each property for mapping.

2.3 RESULTS

Home range model

All three variables used in the sparse spatial generalized linear mixed model (SGLMM) (**Fig. 2.4**) were significant predictors of the troop's home-range use (**Table 2.1**). The troop's home range over the study period covered an area of 5.78 km^2 (**Fig. 2.5**) with an average density of 4.1 baboons/km^2. Cell use varied from 0-269 GPS points (mean = 6.77 $\pm$ 15.17; n = 3948); most cells contained fewer than 5 GPS points (67.6%) with 140 cells containing zero GPS points.

Table 2.1. Results of the home range sparse spatial GLMM.

Predictor	Estimate	Lower	Upper	MCSE
Distance to sleeping site	-0.62	-0.75	-0.48	0.001215
Urban land type[1]	2.17	1.73	2.59	0.004829
Altitude	-0.40	-0.56	-0.23	0.00167

MCSE = Monte Carlo standard error. [1]The reference category was natural land type.

The troop selected strongly for urban space, with 51.2% of all diurnal GPS points being in the urban landscape despite this comprising only 16.8% of their total home range area (**Fig. 2.5**). Distance to sleeping sites was the second strongest predictor of cell use and increased with decreasing distance from sleeping sites. Cell use was also significantly affected by altitude, increasing at lower altitudes. Overall, the troop selected for the low-lying, urban landscape close to sleeping sites. This model accounted for 13% of the variation in baboon movement within their range (r^2 = 0.13).

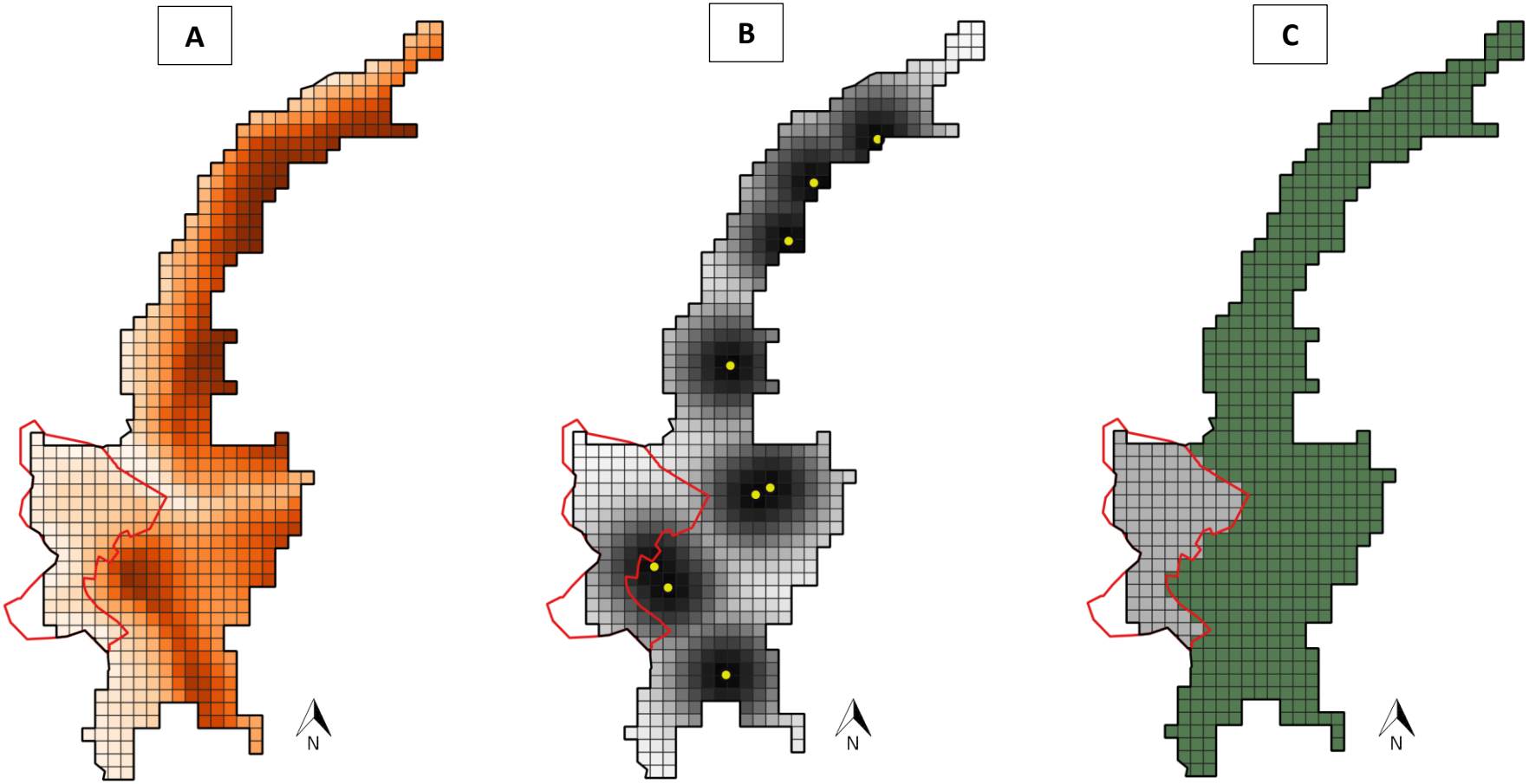


Figure 2.4. Grid cells showing the extent of the Rooiels troop's home range in relation to select covariates used in the home range sparse spatial GLMM. **(A)** illustrates altitude of each cell throughout the home range, with higher mean altitudes shown in darker orange. **(B)** illustrates the location of the nine sleeping sites as yellow dots, with darker gray indicating proximity to the sleeping sites. **(C)** illustrates the two land use types within the home range (green = natural, gray = urban). Red polygon demarcates the urban edge, as defined by the Overstrand Municipality.

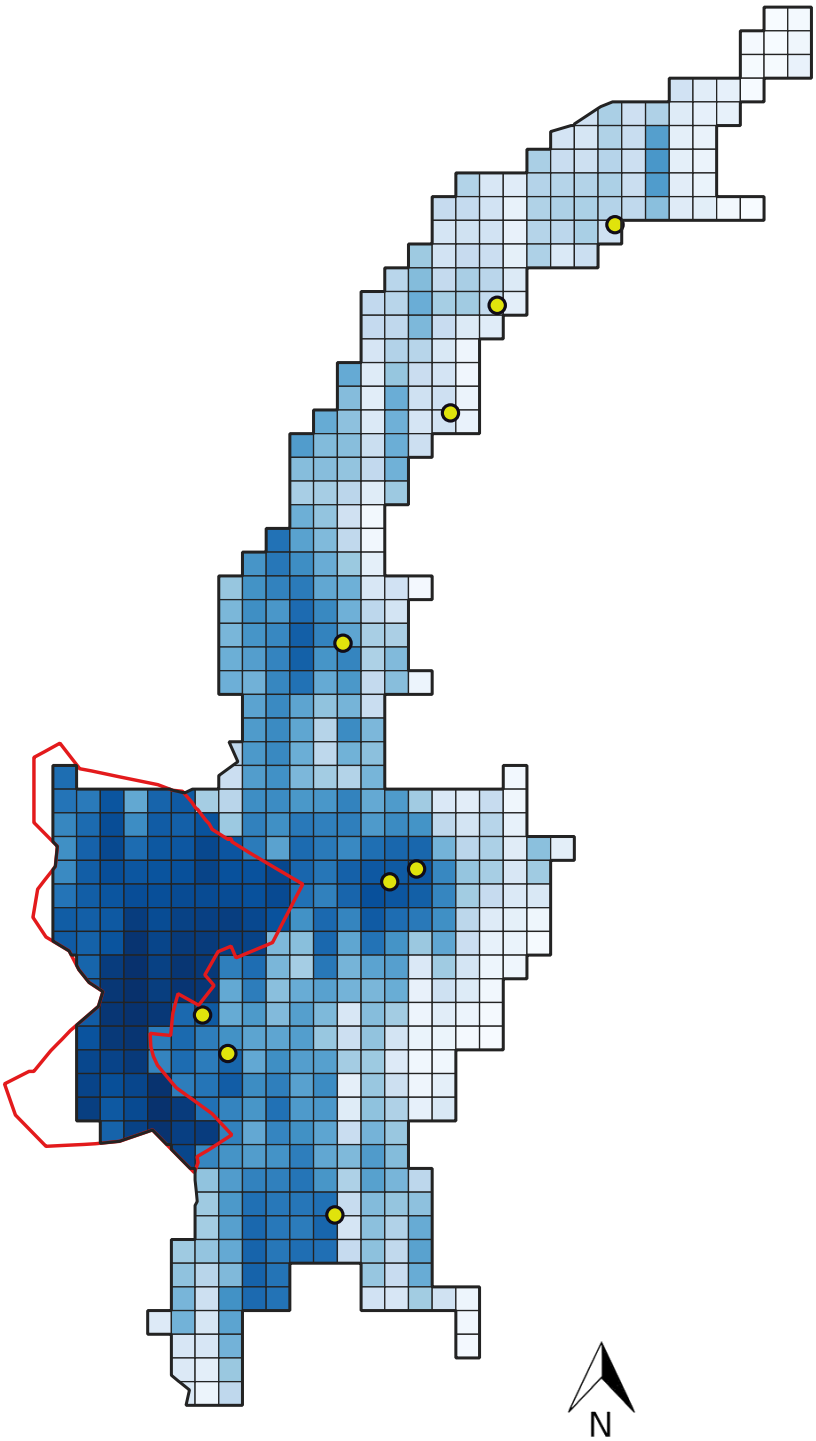


Figure 2.5. Grid cells showing the extent of the Rooiels troop's home range, and the frequency of cell use as predicted by the sparse spatial GLMM. Darker blue indicates higher predicted frequency of use based on the combined variables in Fig. 2.3. Red polygon demarcates the urban edge. Yellow dots indicate the location of sleeping sites.

Urban model

Most of the land use within the 0.836 km^2 of the demarcated urban space comprises developed erven (0.385 km^2), followed by undeveloped erven (0.28 km^2) and road (0.171 km^2). Results from the sparse SGLMM reveal that within this matrix, two of the three covariates used in the model (**Fig. 2.6**) were significant. The troop was more likely to use erven in proximity to the provisioning property and more likely to use developed rather than undeveloped erven and roads over developed erven. The vegetation type estimate crossed zero, therefore no significant selection for or against Overberg Dune Strandveld vegetation compared to Kogelberg Sandstone Fynbos could be determined by the model (**Table 2.2**). The model accounted for 78.5% of the variation in baboon movement within the urban space (r^2 = 0.785) (**Fig. 2.7**).

Table 2.2. Results of the urban sparse spatial GLMM

Predictor	Estimate	Lower	Upper	MCSE
Distance to provisioning property	-0.32	-0.44	-0.21	0.0014
Road erven[1]	0.42	0.23	0.60	0.0012
Undeveloped erven[1]	-0.53	-0.71	-0.34	0.0011
Overberg Dune Strandveld[2]	0.10	-0.16	0.36	0.0034

MCSE = Monte Carlo standard error. [1]The reference category was developed erven.
[2]The reference category was Kogelberg Sandstone Fynbos.

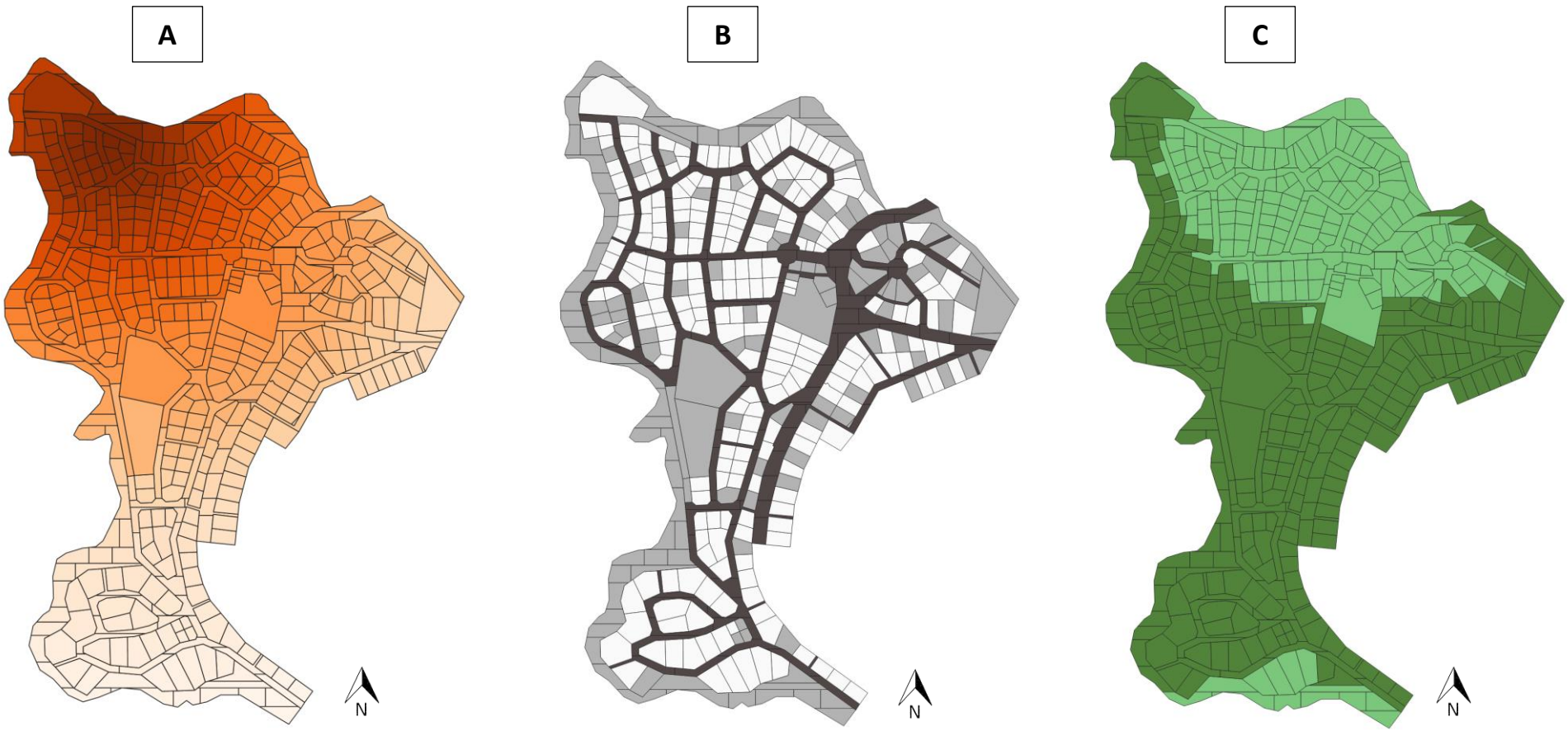


Figure 2.6. Maps showing the urban area of Rooiels in relation to select covariates used in the urban sparse spatial GLMM. (**A)** illustrates distance to 'provisioning property' with darker orange indicating greater proximity, **(B)** urban habitat type where white is developed erven, light gray undeveloped erven and dark gray indicates roads**, (C)** the two different types of historic fynbos in the village where light green is Overberg Dune Strandveld and dark green is Kogelberg Sandstone Fynbos, which was not significant in the model.

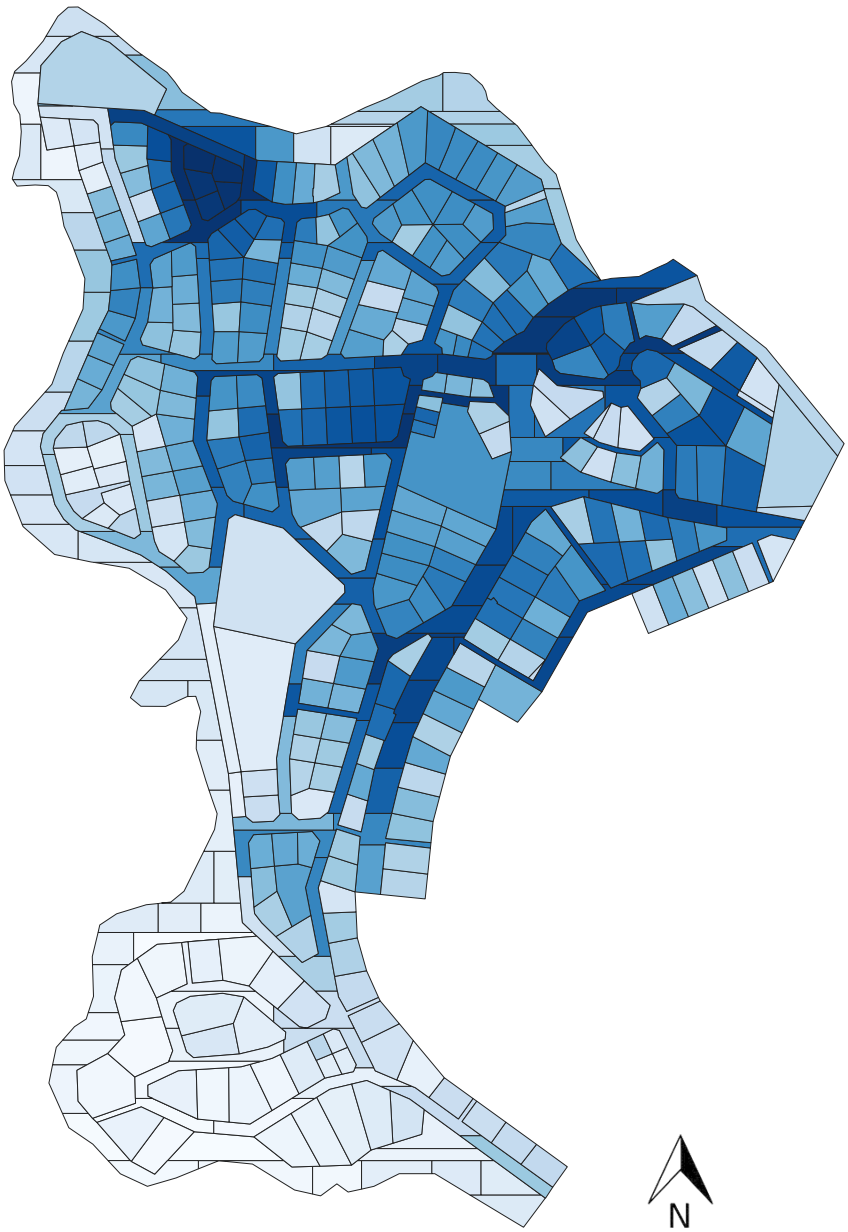


Figure 2.7. Map showing use of the urban area as predicted by the sparse spatial GLMM. Darker blue indicates higher predicted frequency of use based on combined variables in Fig. 2.5.

Developed property models

The most parsimonious model retained three of the five covariates (**Fig. 2.8**) as predictors of the troop's use of developed erven. The troop selected for erven with a larger area of lawn, that were in closer proximity to the provisioning property, and where residents do not deter them (**Table 2.3**). These three variables were retained and remained significant in all models within two delta AIC. Baboons were also more likely to visit properties with houses they had entered more frequently, as

well as properties with full-time residents, though neither of these variables were significant in the models. The top three socioecological models outperformed both exclusively ecological and exclusively social models.

Table 2.3. Top socioecological GLMs ranked by Akaike's Information Criterion (AIC). Covariates include distance (m) to the property where provisioning occurred, the area (h) of lawn on property, whether or not the occupants of the property actively deter baboons on their property, the total number of times baboons gained access to the house within a 12-month period and whether the residents occupy the property on a part-time or full-time basis. See methods section for further detail.

Model	Lawn area (h)	Distance to provisioning property (m)	Residents Deter[1]	No. house entries	Resident status (Part-time)[2]	AIC	ΔAIC
GLM1	0.18760*	-0.40987***	-0.57550**	-	-	647.31	0.00
GLM2	0.17626*	-0.41341***	-0.55736**	0.02841	-	648.72	1.41
GLM3	0.18816*	-0.40617***	-0.58577**	-	-0.11521	648.81	1.50
ECO	0.18420*	-0.41643***	-	0.04023	-	653.94	6.63
SOCIAL	-	-	-0.9621***	-	-0.7287***	722.67	75.36
NULL	-	-	-	-	-	742.14	94.83

*** indicates significance at $p < 0.0001$, **indicates significance at $p < 0.001$, *indicates significance at $p < 0.05$. [1] Reference category was not deterring. [2]Reference category was full-time residency.

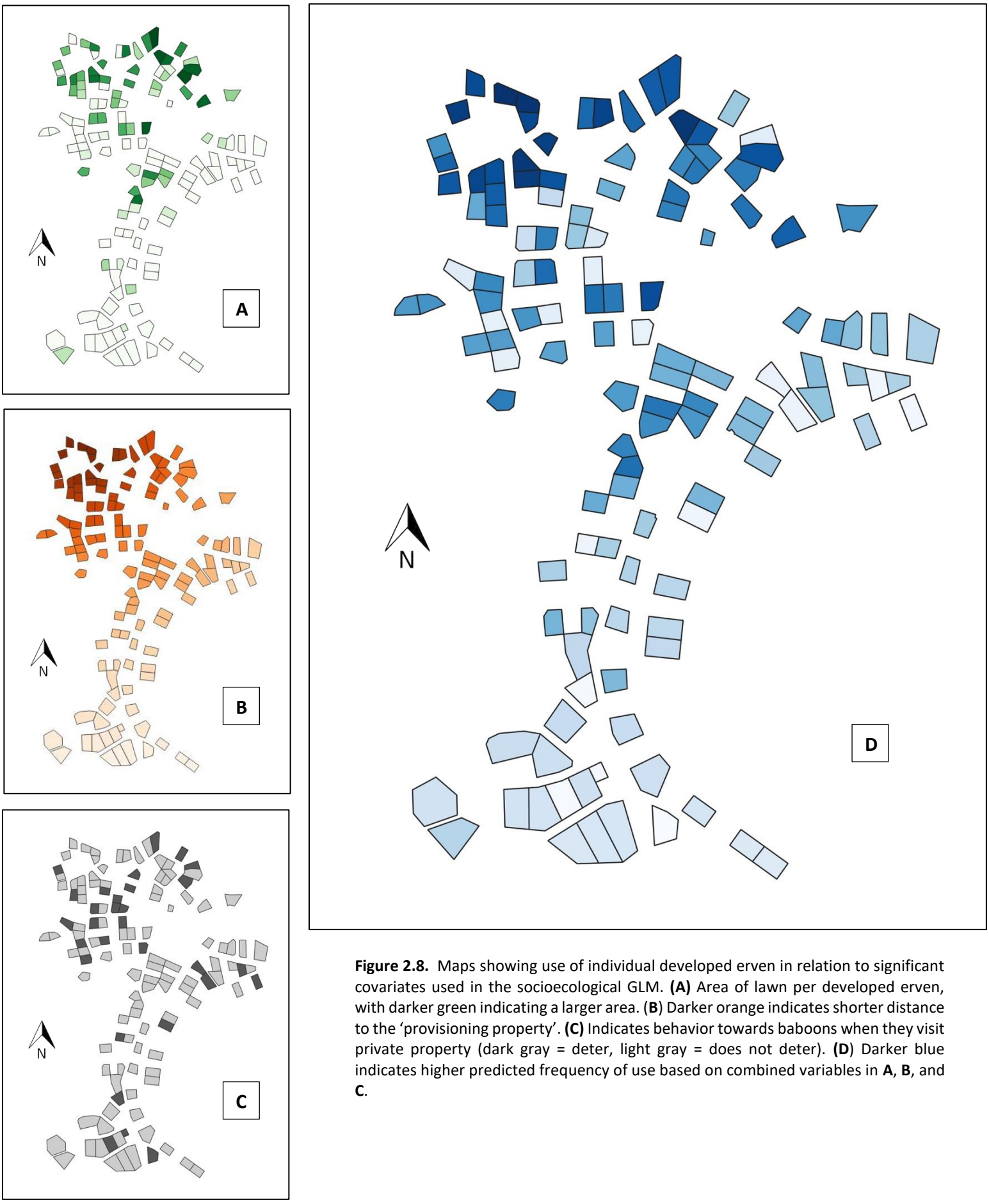


Figure 2.8. Maps showing use of individual developed erven in relation to significant covariates used in the socioecological GLM. **(A)** Area of lawn per developed erven, with darker green indicating a larger area. (**B**) Darker orange indicates shorter distance to the 'provisioning property'. **(C)** Indicates behavior towards baboons when they visit private property (dark gray = deter, light gray = does not deter). **(D**) Darker blue indicates higher predicted frequency of use based on combined variables in **A**, **B**, and **C**.

2.4 DISCUSSION

Few mammal species can adapt to urban environments, and still fewer may thrive in such transformed habitats (Lowry et al. 2012). Species whose traits allow them to successfully exploit resources in urban areas may be classified as urban adapters or exploiters (Rodewald & Gert, 2014) within the urban tolerance hypothesis (Sol et al., 2014). Such species are often generalists with a broad dietary niche capable of living across a wide range of environmental conditions (Fehlmann et al., 2020). The results of this chapter strongly suggest that the baboons in the Rooiels troop are urban adaptors, readily exploiting resources in the village of Rooiels.

Strict feeding hierarchies amongst troop members require that ranging area must increase with group size to prevent intragroup competition and ensure individuals obtain enough food (Wrangham et al., 1993). Primates whose home range overlaps with human-dominated landscapes often gain access to concentrated and predictable food sources and have smaller home ranges, shorter daily travel distances and spend less time feeding (Altmann & Muruthi, 1988; Hoffman & O'Riain, 2012a; Saj et al., 1999; Strum, 2010) than conspecifics living in more natural habitats (Lewis & O'Riain, 2017; Li & Rogers, 2004). At 5.78 km^2, the home range of the Rooiels troop falls on the low end of the range reported for chacma baboon troops in the Cape Peninsula (1.5 km^2 to 37.7 km^2, Hoffman & O'Riain, 2012a), but is similar to the home range of a neighbouring troop that also utilizes the urban area (Parsons, 2021).

The density of baboons was 4.1 baboons/km^2 which is significantly lower than natural foraging troops in fertile habitats (Okavango Delta, 16.8 baboons/km^2, Hamilton et al., 1976) and higher than naturally foraging troops in less productive habitats (Drakensberg mountains, 0.95 and 1.87 baboons/km^2, Whiten et al., 1987) but comparable to the average density of baboon troops on the Cape Peninsula (4.7 ± 2.5 baboons/km^2, Hoffman & O'Riain, 2012a). Interestingly, the Cape Peninsula baboon troops exist in a landscape bounded by extensive urban sprawl, with access to abundant human-derived foods throughout most of their ranging areas and an absence of natural predators. The Rooiels troop by contrast lives in an open population with natural predators and limited access to human-derived foods within their ranging area. The similarity in troop densities may be attributed to the findings of Hoffman (2011) who reported that 1 km^2 of human-modified space can support approximately five times the number of baboons as 1 km^2 of natural space.

The Rooiels village, which serves as the core of the troop's range, offers concentrated nutritional benefits greater than those available within the natural space. Though the village is approximately 1 km^2 in size and only accounts for an estimated 16% of their range, the benefits found within this area have allowed the troop to exist at a density higher than troops feeding exclusively in unmodified

natural landscapes (1.3 baboons/km^2, Hoffman & O'Riain, 2011) but still significantly lower than troops feeding in highly human-modified agricultural landscapes such as the Tokai troop in the Cape Peninsula (12.1 baboons/km^2, Hoffman & O'Riain, 2011). The density of the Rooiels troop is similar to a troop in the Cape Peninsula with a home range composition consisting of approximately 20% human-modified landscape and 80% natural landscape (4.0 baboons/km^2, Hoffman & O'Riain, 2011), a proportion which is remarkably similar to Rooiels.

In a previous study on the Rooiels troop, their home range size was found to be larger (8.76 km^2) and their density lower (3.77 baboon/km^2) than in this study (van Beuningen, 2011). Broadly, these differences may be due to different methods use for home range estimation, or season (van Beuningen's study took place exclusively in the winter season). The larger home range and lower density may also reflect the reduced time the troop was in the village (ca. 15%) in 2011, compared to over 50% in this study. Primates with access to predictable high-quality foods characteristically exhibit smaller home ranges and larger group sizes, and thus higher densities (Brennan et al., 1985; Fuentes et al., 2005; Hoffman & O'Riain, 2011). There are likely several factors which could have precipitated an increase in the troop's use of the village over several years. Most notably these include fires in the natural habitat that occur frequently in the area, reducing the potential long-term productivity of the fynbos (Rebelo et al., 2006) and thus its nutritional value to baboons. Additionally, the increase in the human population of the village, in particular the number of residents who may inadvertently provide increased opportunities for access to lush vegetation in watered gardens, shelter and the occasional access to human-derived foods, has led to an increase in attractants for the troop.

At the home range level, the Rooiels troop selected for low altitude land, aligning with previous studies both in the Western Cape (Hoffman & O'Riain, 2011) and elsewhere (Zinner et al., 2001). Preference for low lying land is in part due to higher plant biomass at lower altitudes, particularly within the fynbos biome (Hoffman & O'Riain, 2012c) with Lewis and O'Riain (2017) showing that baboons prefer to forage on coastal plains characterized by more nutritious strandveld vegetation. Rooiels, like many urban developments in the Western Cape, is situated on the coastal plain in an otherwise mountainous area (Richardson et al., 1996). Low lying flat land and urban development are thus somewhat confounded from a baboon preference perspective, but it is important to note that there is considerable undeveloped low-lying land to both the north and south of Rooiels which the troop seldom used.

Overall, the home range model explained only 13% of the variation in the troop's movement. Additional factors such as the movement of natural predators (i.e. leopard (*Panthera pardus*)), which have been shown to shape the movement patterns of primate species (Willems & Hill, 2009), and

detailed information on vegetation composition would be beneficial to include in future modelling exercises to further understand the troop's use of their home range.

Vegetation type did not emerge as an important predictor of use in the urban space despite the troop's fynbos diet being comprised almost entirely of species from the Overberg Dune Strandveld classification (Appendix 2). It seems likely that transformation of much of this historical strandveld vegetation for development has masked the influence of this vegetation type on habitat use at this scale. The urban model showed that the troop selected against undeveloped erven, thus largely avoiding areas containing Kogelberg Sandstone Fynbos which dominates the southern undeveloped erven of Rooiels including the small nature reserve. Fynbos requires burning every 15-25 years to increase productivity (Rebelo et al., 2006) but because fires within the village pose a serious risk to people and property, the nature reserve and undeveloped erven have not burned for over 40 years (G. Scholtz, pers. comm., 2019). Consequently, the vegetation on these properties is mostly senescent with reduced nutritional value which may explain why the baboons circumvent it despite offering lower disturbance from people, vehicles, and dogs. Additionally, as Kogelberg Sandstone Fynbos is abundant throughout the troop's range, they may be less inclined to consume it in a habitat that offers alternative exclusive and/or highly prized foods.

The high overlap between the troop's core home range and urban land use supports previous findings that baboons show a preference for human-modified landscapes (Fehlmann et al., 2017; Hoffman & O'Riain 2012a, 2012c; Kaplan et al. 2011) where access to nutrient rich human-derived foods (HDFs) such as vegetable gardens, garbage and food from houses serve as significant attractants. HDFs are generally palatable and high in calories (Fehlmann et al., 2017; Johnson et al., 2013) requiring less processing time for a higher reward, especially compared to fynbos, which is typically low in calories and high in both fiber and secondary compounds (Lewis & O'Riain, 2017). HDFs only comprised approximately 3% of the troop's annual diet (Chapter 3) and thus represent a rare and unpredictable dietary item in Rooiels, which may explain why there was no significant relationship between the use of erven and their recent history of access to HDFs from individual properties. Similarly, the troop showed a preference for properties where respondents resided full-time, which could increase their chances of accessing HDFs through an open window or door, however this relationship was not significant. Such opportunities presented by residents leaving a door or window open were observed to be exceptions and not the norm.

By contrast, the routine provisioning of crushed, dried corn and bird seed scattered across the lawn on one property was a significant predictor of the troop's use of space within the village (**Fig. 2.9**). Primates remember food quality and its location and, through the use of mental maps, exhibit goal-

oriented paths towards spatially permanent resources (Trapanese et al., 2019). Baboons revisit areas where they accessed high-calorie food (Fehlmann et al., 2017; Kaplan et al., 2011; King et al., 2008), showing a concomitant reduction in the length of daily ranging and decreased home range size (Hoffman & O'Riain, 2011; Kaplan et al., 2011; Strum, 2010). The food on this property was largely monopolized by the alpha male and alpha female baboons (Chapter 3). High ranking individuals, in particular alpha males, strongly influence troop movement (Bracken et al., 2022b; King et al., 2008; Stueckle & Zinner, 2008) with troop members remaining in proximity to high-ranking individuals for the purposes of protection from potential threats (King et al., 2011; Rhine, 1985) and obtaining important social information (King & Cowlishaw, 2009). Provisioning on this property thus influenced the movement of the entire troop, which visited this property and neighbouring properties more frequently than properties farther from the provisioning. This spatial pattern of routine visits to this property in response to provisioning has been observed in the troop for over a decade prior to this study and is well-ingrained into the troop's behaviour (Guyette, 2006; van Beuningen, 2011).

Figure 2.9. The troop on the provisioning property. Alpha male (CL) eats provisioned crushed corn (top left), baboons climbing on house (top right), baboons on roof (bottom left), baboons foraging for provisioned food (bottom right). Images by Joselyn Mormile (top left & right, bottom right) and Kaelin DeLong (bottom left).

Despite minimal access to HDFs, troop members still preferred the use of developed properties over undeveloped ones, with a significant preference for those with larger lawns. While grasses are available throughout the troop's range, grass in the form of lawn is highly concentrated, which facilitates efficient foraging (**Fig. 2.10**). Lawns are also mowed, resulting in shorter, younger shoots, which are likely easier to handle, and digest (McDonald et al., 2011). Grasses are an important component of baboon diets and are considered an important fallback food, which is available throughout the year when other foods may not be available (Altmann, 2009). The Rooiels troop spent more time foraging on lawns than any other food type during the winter months (Chapter 3) when indigenous fruiting vegetation is typically less available (Johnson, 1993).

Figure 2.10. Baboons foraging on grass on a resident's property. Image by Joselyn Mormile.

The troop also showed a preference for roads in the urban space, which are mostly unpaved gravel and dirt along which vehicles move at slow speeds (<30 km/h) (**Fig. 2.11**). Chapter 3 reveals that while on roads, the baboons spent most of their time traveling, followed by small and fairly equal amounts of feeding, resting, and socializing. The roads within the village have verges comprised of a mix of mowed lawns and both exotic and indigenous plants, most of which is readily consumed by the baboons (Chapter 3). The troop was also observed occasionally consuming clay along the road (**Fig.**

2.12). This clay is added to the materials used to resurface the road, which improves binding and stability (P. Kruger, pers. comm., 2017). Clay geophagy, in baboons (Pebsworth et al., 2012) and other primates (Krishnamani & Mahaney, 2000; Pebsworth et al., 2018) provides various potential benefits including relieving gastrointestinal distress, detoxifying dietary toxins, supplying micronutrients, and even providing antibiotic benefits (Young et al., 2011).

Figure 2.11. The troop moving along the village roads in Rooiels. Image by Joselyn Mormile.

When moving to preferred areas within the urban space (e.g., to a feeding patch, sleeping site, water source), animals are expected to minimize needless travel by following a direct path, thus maximizing their energy balance (Chapman & Chapman, 2000). A preference for roads in facilitating movement along flatter surfaces without dense barriers such as vegetation has been documented for baboons and other species of wildlife (Brown et al., 2006; Whittington et al., 2005). Baboons in fact showed a stronger preference for travel along roads compared to many other species of wildlife (Mann et al., 2015). Travelling along roads also enables baboons to maintain better visual contact which allows for improved social cohesion (Harel et al., 2021). Furthermore, movement along the road likely results in fewer negative interactions with residents and dogs given it is public open space.

The troop's movements on developed properties were influenced by the behaviour of people on the property, with the troop showing a preference for properties where residents did not chase them away. Though perhaps unsurprising, this finding is useful in that it reveals that the deterrent efforts of residents indeed impact the frequency of baboon visits to their properties. This information may be valuable for residents who wish to modify their level of interaction with baboons on their properties. Importantly, models that utilised only ecological factors ranked much lower than those that also included social variables. Arriving at more parsimonious models following the inclusion of social factors highlights the complexity of urban space use by baboons and supports the finding of Behr et al. (2017) that in the wake of increasing human-wildlife overlap, the exclusion of social components from modeling activities will result in a "misrepresentation of the observed process".

Figure 2.12. Baboon digging for clay on a village road in Rooiels. Image by Joselyn Mormile.

This chapter has provided novel data on how an unmanaged baboon troop existing in an open population includes urban habitat within their home range and is the first of its kind to model detailed urban space use. The troop not only adapted their spatial ecology to include the use of the village but in fact showed a significant preference for it. Perhaps most importantly from a human-baboon conflict and coexistence perspective, the troop showed a strong selection for developed properties, despite

minimal access to garbage or other HDFs on these properties. Selection for individual properties was based on both ecological and social factors which offered a higher chance of reward (e.g., larger lawns) and lower risk (i.e., being chased away).

Figure 2.13. Rooiels baboons drinking from various sources within the village. Images by Joselyn Mormile.

Given the complexity of the urban landscape from both an ecological and human dimension, an exhaustive list of factors which shape the troop's movement throughout the Rooiels village is far from complete. Other potentially important variables were noted during the course of the study including temperature, humidity, wind speed and direction, all of which occur at fine spatial scales within urban areas and which baboons may exploit to enhance their thermoregulation (Hill et al., 2004). Thermoregulation acts as a constraint on baboon behavioural decision-making (Hill, 2006) and likely

plays a role in the troop's use of urban space. The baboons routinely sought shelter from rain, wind, and sun by using both natural and man-made structures within the village such as large trees, covered verandas, balconies, and car ports (Chapter 3). Access to drinking water is also important for thermoregulation and baboons typically consume water every day (Barton et al., 1992). Access to water within the village was plentiful with baboons drinking water from streams, ponds, puddles in the road and swimming pools (**Fig. 2.13**). As many of these water sources were not permanent, their potential value as a predictor of space use when within the village could not be measured, but due to its overall abundance was likely negligible, as was found in the Cape Peninsula (Hoffman & O'Riain, 2011). Qualifying and quantifying all property attributes which may provide these benefits was beyond the scope of this study's feasibility and remain a challenge for future research on this troop.

CHAPTER THREE

URBAN HABITAT USE, DIET AND ACTIVITY BUDGETS OF AN UNMANAGED BABOON TROOP

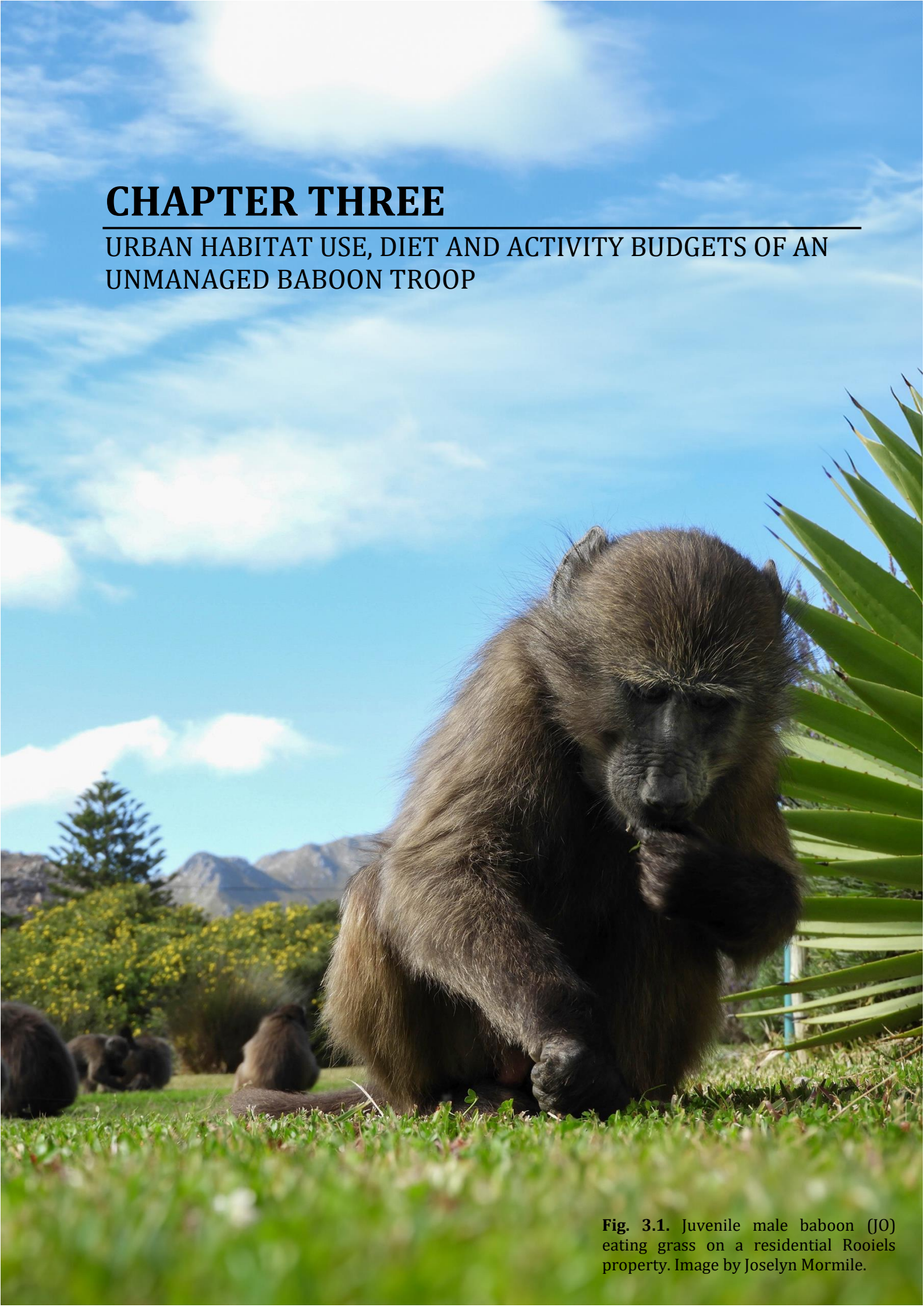


Fig. 3.1. Juvenile male baboon (JO) eating grass on a residential Rooiels property. Image by Joselyn Mormile.

ABSTRACT

Baboons, known for their dietary and behavioural flexibility, readily adapt to living in urban areas. As baboons are typically deterred from using these landscapes, little is known about how they utilise different habitats within urban areas to meet their nutritional and social needs. This study investigates the influence of habitat type, social dynamics and seasonality on the diet and activity budgets of an unmanaged baboon troop that regularly spends time in the village of Rooiels in South Africa's Western Cape. Most of their time in the village was spent moving, closely followed by resting, then socialising and feeding. Troop members spent more time feeding and moving and less time socialising in spring when fruiting and flowering fynbos vegetation was abundant and a minimal amount of time feeding and moving, with an increase in socialising during winter when they mostly consumed grass on properties and used built structures to avoid wind and rain. Troop members spent significantly more time resting on developed properties, foraging on undeveloped properties, and traveling on roads. The troop spent an annual average of 18.5% of their time feeding in the village with an annual diet consisting of predominantly fynbos vegetation and grasses and <4% human-derived foods from houses, vehicles, and bins. Despite the small contribution of human-derived foods to the troop's diet, their overall activity budget mirrored that of provisioned primates suggesting there are nutritional and social benefits to routinely visiting the urban space.

3.1 INTRODUCTION

With limited time available in a day, primates must determine how to most efficiently allocate their activities to meet their core requirements, from nutritional needs to social activities (Dunbar et al., 2009). The abundance, quality, and distribution of food in both time and space, is considered to be the main driver of activity budgets and landscape use in most primate species (Hill & Dunbar, 2002). Many primate species exhibit wide dietary breadth and flexibility (Chapman & Chapman, 1990) and thus can readily adjust foraging efforts (Yiming, 2006) and expand ranging areas in response to changes in food availability (Barton et al., 1992; Riley 2008; Zhou et al., 2007), which are strongly linked to seasonal plant phenology (Wrangham et al., 1998) as well as factors such as drought and fire (Berenstain, 1986; Herzog et al., 2016). As naturally occurring food patches are typically small and widely distributed, natural foraging primates spend most of their time feeding and traveling in search of food, with less time available for resting and socialising (Li & Rogers 2004; Masi et al., 2009; Post et al., 1980).

Baboons are dietary generalists, which when combined with their intelligence and opportunistic nature, means they are adept at exploiting novel food items in human-dominated landscapes (Hoffman & O'Riain, 2011; Ibrahim et al., 2023; Strum, 2010; van Doorn et al., 2010). The inclusion of human-derived foods (HDFs), which are of a higher caloric content than naturally occurring foods, have been linked to dramatic shifts in their behavioural ecology (Fehlmann et al., 2017). Compared to naturally foraging troops, baboons that feed on HDFs have been shown to spend significantly more time resting and socialising than feeding and traveling, have much smaller ranging areas, travel shorter daily distances and travel at a slower pace (Altmann & Muruthi, 1988; Hoffman & O'Riain 2012a; Strum, 2010; van Doorn & O'Riain, 2020). Access to HDFs allows baboons to grow and reproduce at rates faster than their naturally foraging counterparts, thus creating the potential for increased lifetime reproductive fitness (Strum, 2010). In response to these exceptional benefits, baboons routinely favour foraging in agricultural and urban areas over natural spaces, adjusting their movement patterns and activity budgets accordingly (Bracken et al., 2022a; Hoffman & O'Riain, 2012b; Strum, 2010; van Doorn et al., 2010).

On an individual level, primate activity budgets have been shown to vary significantly with age/sex class (Jaman & Huffman, 2008; Li et al., 2015), reproductive status (King & Cowlishaw, 2009), and social status of individuals (Isbell & Young, 1993). Baboons possess social hierarchies where high-ranking individuals enjoy increased access to higher quality foods (Kaplan et al., 2011), better access to grooming partners (Sambrook et al., 1995), and preferential access to mating partners (Gesquiere et al., 2011). When high-caloric food becomes predictable in space and time (e.g., a large fruiting tree or a provisioned food patch in the urban area) a change in activity budgets for troop members may

become apparent (Altmann & Muruthi, 1988), particularly for high-ranking individuals who successfully monopolize such resources (Kaplan et al. 2011; Post et al., 1980; Whitten, 1983). As high-ranking individuals hold critical positions in the troop social structure, they are readily followed by other baboons, and may thus lead the troop into urban space (Bracken et al., 2022b; King et al., 2011). Once an urban foraging strategy is adopted, dramatic shifts in activity budgets and movement patterns occur at both the troop (Fehlmann et al. 2017; Strum, 2010), and individual level (Bracken et al., 2022a).

Given the growing use of urban areas by baboons throughout South Africa, it is important to understand how this may influence their diet, activity budget and key life history factors. Baboon presence in these settings is, however, seldom tolerated and humans invariably resort to a combination of lethal and non-lethal methods to deter them (Beamish & O'Riain, 2014; van Doorn & O'Riain, 2020). It is thus difficult to obtain a clear understanding of the influence of foraging in transformed landscapes without the confounding effects of a range of baboon deterrents (Bracken et al., 2022a; Fehlmann et al., 2017; van Doorn & O'Riain, 2020). The Rooiels study troop which has unfettered access to the urban area and most of the private properties therein (Chapter 2), provides a unique opportunity to explore how living and foraging in an urban area influences the activity budget and diet of free-ranging baboons. Additionally, the presence of a provisioning site within the urban matrix allows for an understanding of how a predictable high-quality food patch within a transformed landscape may influence the movement patterns, diet, and activity of baboons. In this chapter, I test the hypothesis that foraging in an urban environment will influence the diet and activity budget of free-ranging baboons. I predict that 1) the activity budget and diet will vary seasonally given the distinct differences in rainfall and temperature in the study area which strongly influences the phenology of both indigenous and exotic plants (van Doorn et al., 2010), 2) higher quality food associated with gardens, houses, bins and vehicles will result in baboons spending less time traveling and feeding and more time resting and socialising than troops living within natural habitat (Altmann & Muruthi, 1988), 3) that the markedly different micro-habitat types within urban areas (roads, developed erven and undeveloped erven) will influence the behaviour of individuals (Klegarth et al., 2017), 4) the diet will include a higher proportion of exotic plants and anthropogenic food sources associated with urban environments (van Doorn et al., 2010), and 5) that more dominant individuals will monopolise access to and consumption of limited high quality food patches within urban areas (Kaplan et al. 2011).

3.2 METHODS

DATA COLLECTION

Behavioural observations

Behavioural data collection took place from January 2nd, 2017 until February 28th, 2018. At the start of the study, the troop consisted of 24 individuals. The troop's habitual use of the Rooiels village meant all individuals were already habituated to close human presence and observations. To facilitate detailed behavioural data collection, all individuals were identified based on natural features and given a two-letter code. Data were collected following an ethogram developed by the principal investigator (Appendix 3) and recorded on printed data sheets. Behavioural data collection began from the time the troop was first located in the urban area and concluded when the troop exited the village on the same day. Data were not collected outside of the village boundaries because of the challenging topography (i.e., steep mountains with loose rock) and subsequent poor success of observations outside of the village (van Beuningen, 2011).

Scan data

Scan data were collected every 30 minutes for a two-minute sampling period on all visible adult and subadult individuals in the troop (Bateson & Martin, 2007). Scan samples were not conducted if less than three individuals were seen within two minutes of onset of the scan. At the start of each scan, coordinates of the approximate center of the troop were recorded using a handheld GPS (Hoffman & O'Riain, 2012a). Thereafter, the behaviour of each visible individual was recorded. Modifiers of social and feeding behaviours were also collected (e.g., interaction partner or food type). Scan data were collected by the principal investigator from January 2017 until August 2017 and by a research assistant between August 2017 and February 2018. To ensure inter-observer reliability, scan samples were collected simultaneously by the principal investigator and research assistant and compared for consistency in the identification of, and number of individuals observed, as well as the behaviours they were engaged in. Reliability was established after two weeks, at which point the research assistant became solely responsible for collecting scan data.

Focal data

Instantaneous focal data samples were collected to gain more detailed behavioural data on individual baboons. Focal sampling was conducted solely by the principal investigator. Focal data were collected on all adults and subadults. Data were recorded at 1-minute intervals with the use of an interval timer over a 10-minute focal sampling period. At the start of the focal sample, the individual ID code, date, time, and reproductive status (e.g., pregnant, oestrus) was recorded. The focal animal's behaviour, including modifiers for social and feeding behaviours (e.g., interaction partner and food type) and

habitat (e.g., road or developed property) were recorded. If the focal animal was out of sight for more than two consecutive minutes, the focal sample was abandoned, and the data discarded. Focals were excluded from analysis if there were less than five data points per 10-minute sampling period. The observer aimed to collect a minimum of one focal sample per individual per day. Individuals were not sampled more than twice a day and never more than once within the same time block on a given day (Morning 1: 6h00-9h00, Morning 2: 9h00 – 12h00, Afternoon 1: 12h00-15h00, Afternoon 2: 15h00-18h00). A total of 1,760 focal samples were collected over a period of 176 days.

Ad libitum data

Rare or unusual behaviours (e.g., entering houses, births) as well as dominance behaviours (e.g., displacements) were recorded *ad libitum*.

DATA ANALYSIS

Time in the village

The duration of time from the first scan of the day to the last scan of the day was calculated and averaged across all research days to determine the average amount of time the troop spent in the village.

Activity budget data

All behaviours were grouped into one of five exclusive categories viz., feed, move, rest, social, and other. Scan data were sorted by season (Spring: September, October, November; Summer: December, January, February; Autumn: March, April May; Winter: June, July, August) (South African Weather Service, 2022) and the proportion of scans that each individual engaged in each behaviour was calculated for each baboon in each season. A mean of these values was then calculated to represent the troop's average seasonal activity budget. For habitat-specific activity budgets, scan data were divided by habitat type (i.e., developed erven, undeveloped erven, road) and the proportion of scans where the individual was engaged in each behaviour was calculated for each baboon in each habitat. A mean of these values was then calculated to represent the troop's average habitat-specific activity budget for the study period. Seasonal and habitat-specific data were tested for normality using the Shapiro-Wilks test and were not found to be normal and Kruskal-Wallis tests were thus used. Where Kruskal-Wallis tests were significant, paired Dunn's tests (Cliffe et al., 2023; Dinno, 2015) with a Holm correction (Haynes, 2013) were used to determine which variables were significantly different. Finally, Chapter 2 revealed that the troop spent a significant amount of time on a property where food was routinely put out for wildlife. To understand how the troop utilised this property, I extracted scans for this location and also recorded the rate of feeding on provisioned food for each troop member.

Annual diet

Focal data were used to analyse the diet of individual troop members and to derive a troop average of food consumed. For this portion of the analysis, HDFs were split into two categories, one as food obtained from houses and vehicles (e.g., typically fresh foods), the other as food obtained from bins (e.g., leftover food scraps) and analysed separately. The proportion of all food consumed in each category was estimated for each troop member. Seasonal differences in food consumed were estimated at the level of the troop by averaging the individual diets of all troop members in each season. The dataset was tested for normality and was not found to be normal thus Kruskal-Wallis tests were used. Where Kruskal-Wallis tests were significant, paired Dunn's tests (Cliffe, 2023; Dinno, 2015) with Holm correction (Haynes, 2013) were used to determine which variables accounted for the significant differences.

Dominance hierarchy

The adult female dominance hierarchy order was derived from aggressive interactions and displacements between all dyadic combinations that were recorded *ab libitum* (n = 328, mean = 72.9, range = 37 – 107) throughout the study period (March 1st, 2017 – February 28th, 2019) (Beehner et al., 2005). Rank order, stability, steepness, and transitivity of the hierarchy were calculated using the EloRating package in R (Neumann & Kulik, 2020). The troop had only one adult male, who was dominant to all troop members (King et al., 2011) and thus no analysis was done on the male dominance hierarchy.

Access to human-derived food

All instances in which individuals were observed obtaining food from houses, bins, and vehicles were recorded. The daily rate of acquisition was based on the number of instances divided by the number of hours of observation for the day. An average rate of consumption of these foods for different seasons and the school holiday period (December 7th, 2017 – January 16th, 2018, Western Cape Education Department, 2018) was then calculated. The school holiday season corresponded with the influx of baboon-naïve visitors to Rooiels who are assumed to be less adept at securing their waste, vehicles, and houses from opportunistic access by baboons. Where baboon(s) were seen consuming HDF items, but the origin of the food item could not be determined (e.g., from bin, from house), the data were excluded. As such, the number of times individuals accessed human-derived foods is likely underestimated. To further investigate different sources of HDF access, food obtained from houses, bins and vehicles were analysed separately. As data were not found to be normal, a Kruskal-Wallis test was used to determine whether there was a significant difference between the rate of obtaining HDFs from these sources during different seasons and the school holiday period. I also used Kruskal-Wallis tests to determine if there was a significant difference between the source of human-derived foods

(i.e., bin, house, vehicle) and season. Where Kruskal-Wallis tests were significant, I used Dunn's tests (Cliffe, 2023; Dinno, 2015) with Holm correction (Haynes, 2013) to determine which comparisons accounted for the significant differences. All analyses were conducted in Excel and R.

3.3 RESULTS

Time in the village and activity budgets

The troop spent an average of 3 hours per day in the village across all seasons (range: 0.5 – 7.5hrs). They spent an average of 2.2 hours per day in the village in autumn (range: 0.5 – 4.5), 2.9 hours per day in winter (range: 0.5 – 6.5), 3.5 hours per day in summer (range: 0.5 – 7.5), and 3.6 hours per day in spring (range: 0.5 – 6).

On average over the whole year, the troop spent the most time moving (29.4%) followed by resting (28.7%), socialising (22.1%), feeding (18.5%) and other behaviours (1.5%) (**Fig. 3.2**). There were significant differences in the percentage of time spent feeding between seasons (X^2 = 16.409, df = 3, p<0.001) (**Fig 3.2**) with the troop spending significantly more time feeding in spring than in autumn, winter (p<0.01 in both cases) and summer (p <0.05). There was also a significant seasonal difference in time spent moving (X^2 = 19.263, df = 3, p<0.001) (**Fig. 3.2**), which was lower in winter than in both spring (p<0.01) and summer (p<0.001). Time engaged in social behaviours also differed significantly (X^2 = 19.261, df = 3, p<0.001) (**Fig. 3.2**) with less time spent socialising in spring than in winter (p<0.001) or autumn (p<0.05), as well as less time in summer than in winter (p<0.05). No significant seasonal differences were found for resting or 'other' behaviours.

Significant differences in feeding were evident between habitat types (X^2 = 27.038, df = 2, p<0.001). The troop spent significantly more time feeding on undeveloped erven than on roads or developed erven and significantly less time feeding on roads than on developed erven (p<0.001 in all cases). There was a significant difference in time spent moving between habitat types (X^2 = 33.523, df = 2, p<0.001) (**Fig. 3.3**). The troop spent significantly more time moving on roads than developed or undeveloped erven and less time moving on developed erven than undeveloped erven (p<0.001 in all cases). A significant difference between habitats was also found for time spent resting (X^2 = 24.574, df = 2, p<0.001) (**Fig. 3.3**). The troop spent significantly more time resting on developed erven than on undeveloped erven or roads (p<0.001 in all cases). A significant difference between time spent engaged in social behaviours was found between habitats (X^2 = 12.953, df = 2, p<0.01) (**Fig. 3.3**). The troop spent significantly more time socialising on developed properties than on roads (p<0.01). There were no differences in time spent engaged in other behaviours between habitat types.

Annual diet

The troop consumed foods from eleven major food categories (**Fig. 3.4**). Natural foods, such as fynbos and exotic grasses in lawns, accounted for most of the troop's diet (36% ± 10.69 and 30.6% ± 12.31, respectively). Provisioned food, defined as food intentionally left out for wildlife including baboons, accounted for 10.4% ± 4.47 of their diet, followed by exotic plant species at 8.9% ± 5.68. Subterranean plant items accounted for 2.7% ± 1.52 of their diet. Foods exploited opportunistically from houses or cars, accounted for an average of 2.1% ± 1.21 of the troop's diet followed closely by clay from the surface of the unpaved village roads at 1.7% ± 1.45. Garbage from unsecured waste bins accounted for 0.96% ± 1.03 of their diet and marine invertebrates accounted for only 0.21% ± 0.19. Unknown food items accounted for 4.3% ± 2.24 and finally other food items such as bark, accounted for 1.7% ± 0.78.

I found significant seasonal differences in time spent eating fynbos ($X^2 = 20.453$, df = 3, $p<0.001$), exotic and indigenous grasses ($X^2 = 22.072$, df = 3, $p<0.001$), exotic shrubs and trees ($X^2 = 10.132$, df = 3, $p<0.05$) and subterranean items ($X^2 = 10.947$, df = 3, $p<0.05$) (**Fig 3.5**). The troop fed on fynbos significantly more in spring than in any other season ($p<0.001$ in all cases) and were least likely to feed on fynbos in the winter months ($p<0.001$ in all cases). Individuals spent significantly more time feeding on grass in the winter months than in any other season ($p<0.001$ in all cases) and the least amount of time feeding on grass in summer ($p<0.001$ in all cases). Troop members consumed significantly more exotic plants in summer than winter ($p<0.05$) and significantly more subterranean items in spring than autumn or summer ($p<0.05$). There were no significant seasonal differences in time spent feeding on foods from the remaining food categories.

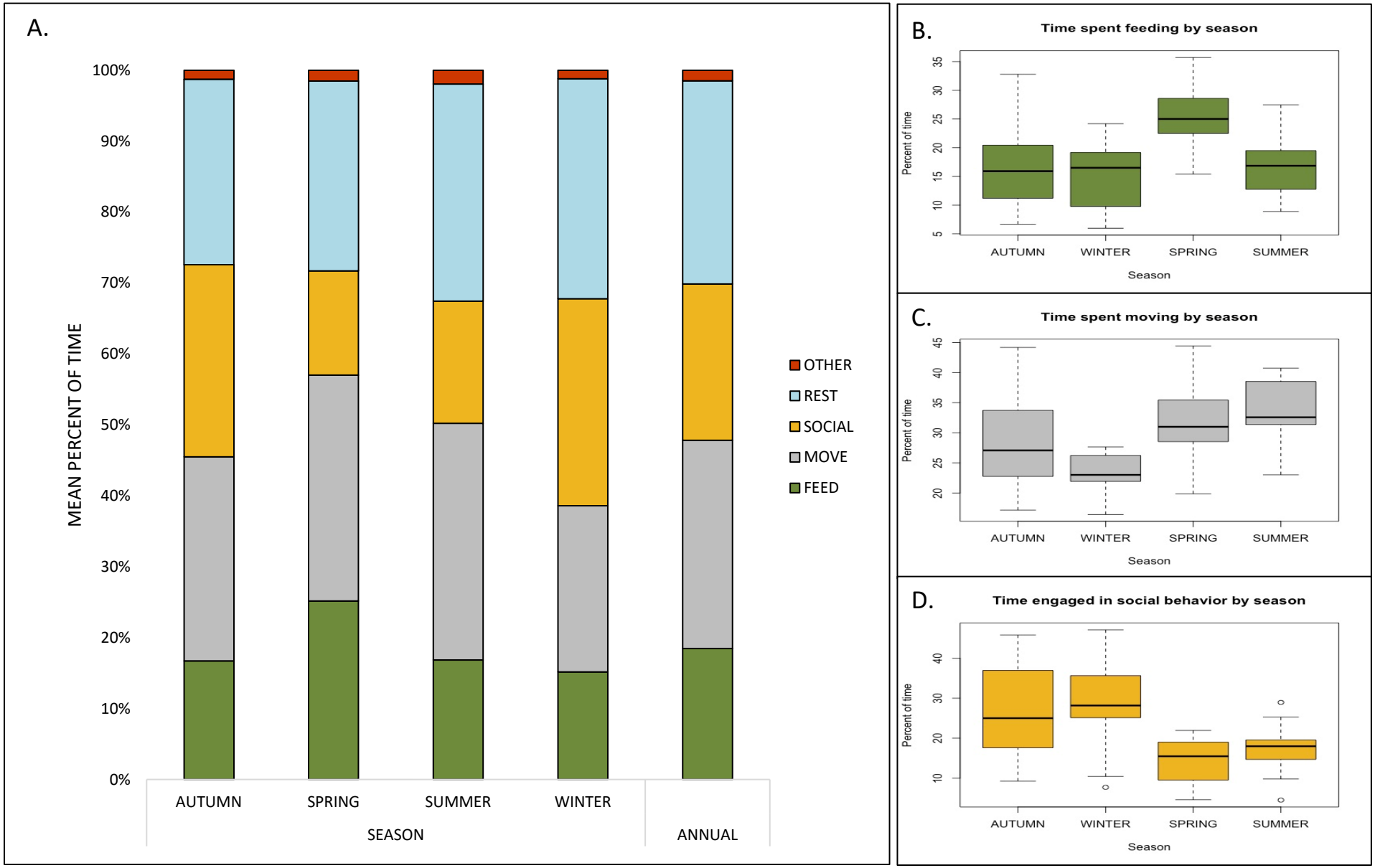


Figure 3.2. Panel A illustrates the mean percentage of time the troop members engaged in each of the five behavioural categories during the course of the study. In panels B-D, boxplots showing the median (bold black line), range (coloured box), standard deviation (whiskers) and outliers (circles) illustrate the three behaviours that differed significantly between seasons.

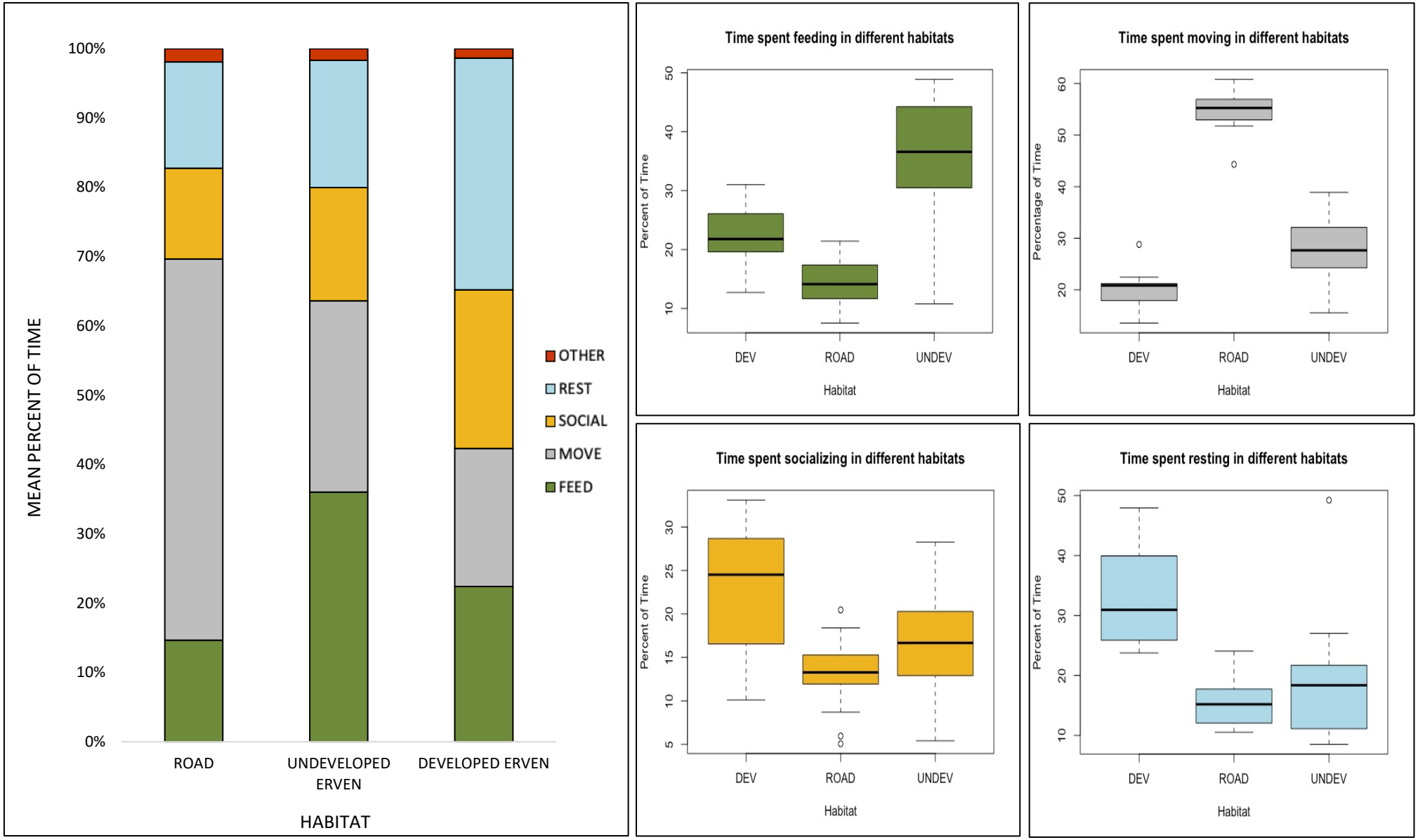


Figure 3.3. Panel A illustrates the proportion of time allocated to the five main behavioural categories in each of the three main habitat types in the urban area of the study area. In panels B-E, boxplots showing the median (bold black line), range (coloured box), standard deviation (whiskers) and outliers (circles) illustrate for the percentage of time that troop members engaged in the four main behaviours (excluding 'other' from panel A) within the three main habitat types (Dev – developed erven, Undev- undeveloped erven and road) present in the urban portion of the troops home range.

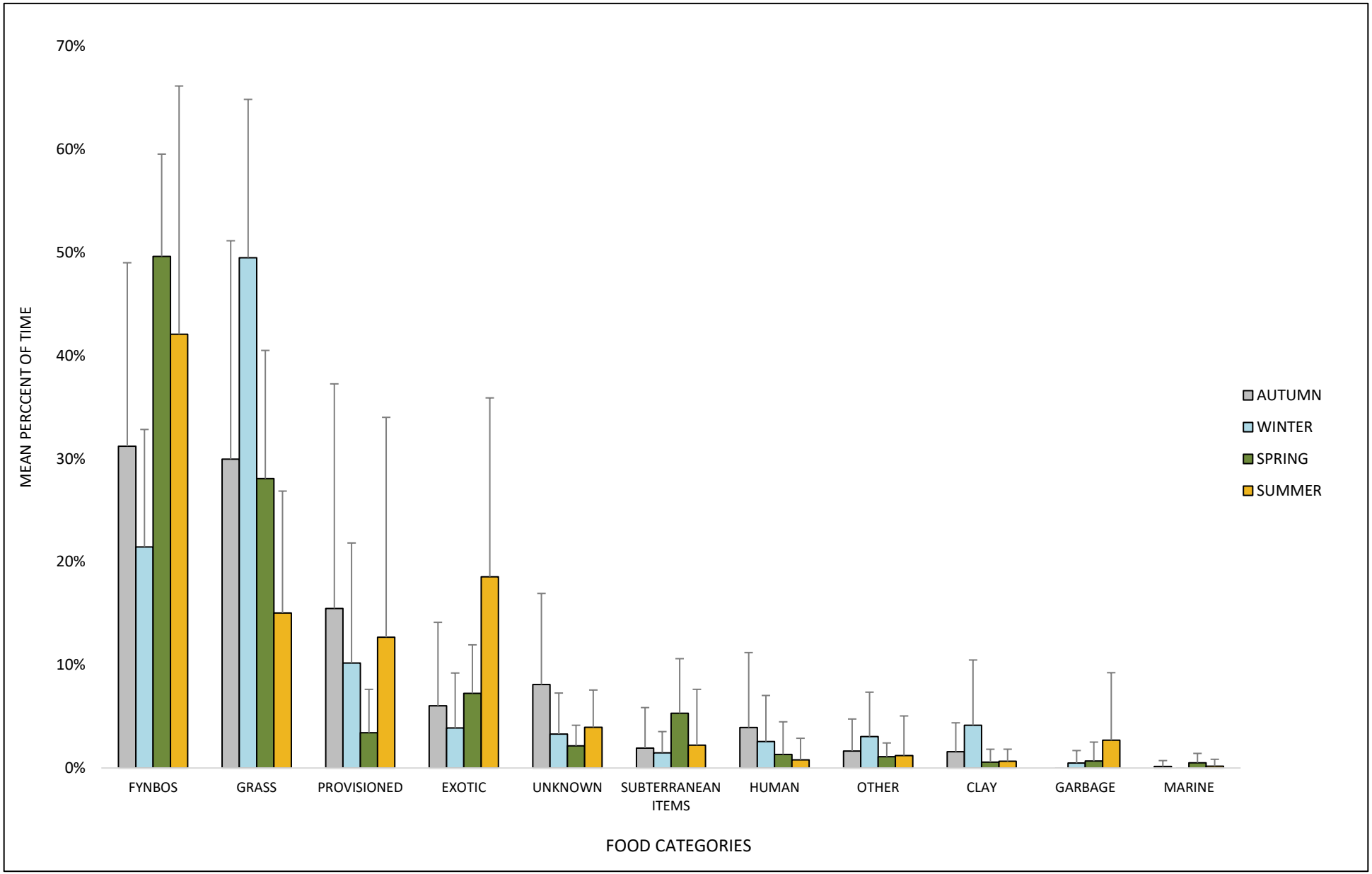


Figure 3.4. Mean (± SD) percentage of time the troop spent consuming different foods by season. Species of fynbos consumed in Appendix 2.

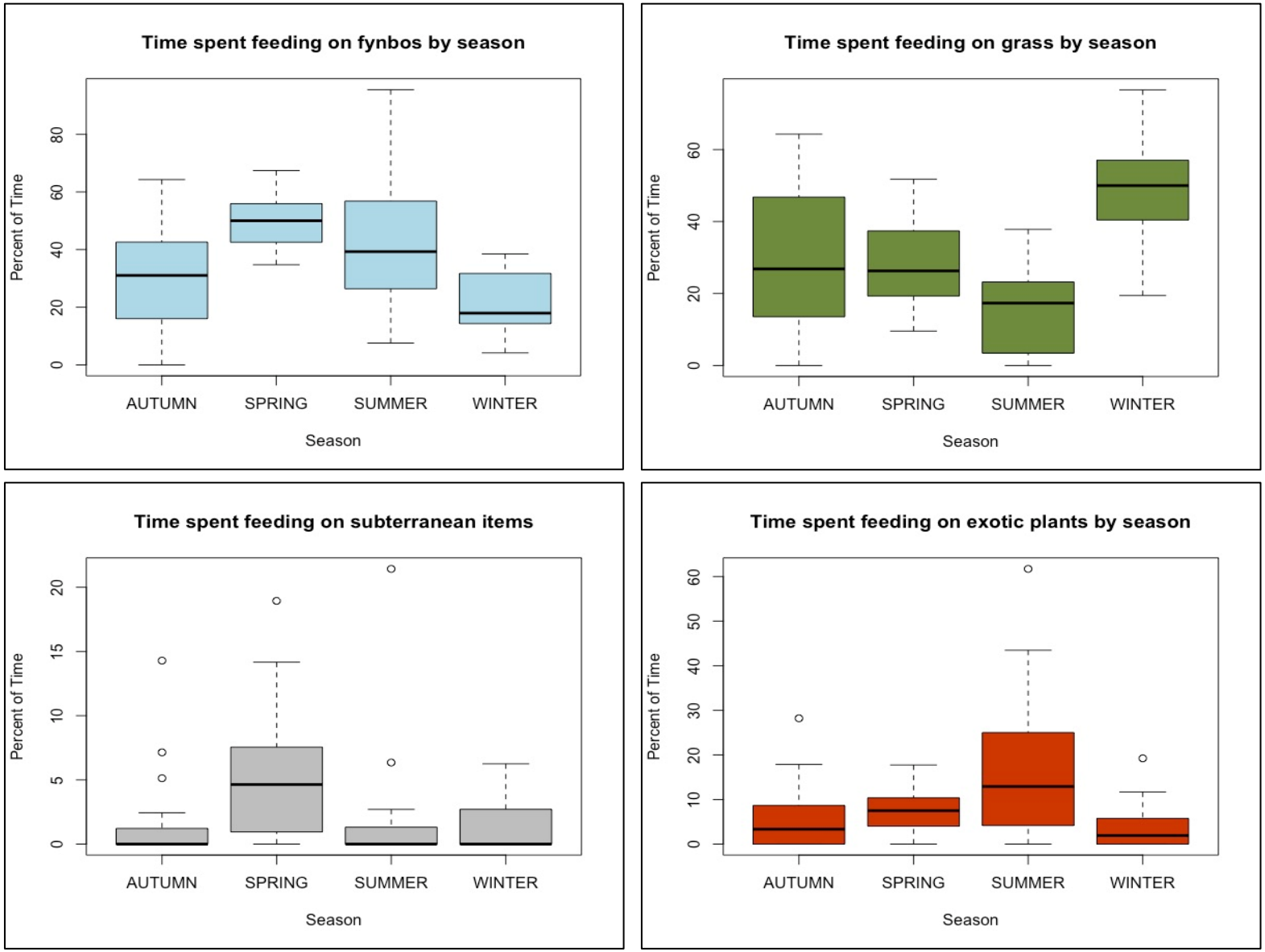


Figure 3.5. Boxplots show the median (bold black line), range (coloured box), standard deviation (whiskers) and outliers(circles), illustrating the variation in the consumption of individual foods by season.

Dominance hierarchy and feeding on provisioning property

The adult female dominance hierarchy was found to be highly linear and transitive (TTri = 1, $p<0.001$), very steep (score: 0.82, $p = 0.01$) and highly stable (score: 0.996) (**Fig. 3.6**).

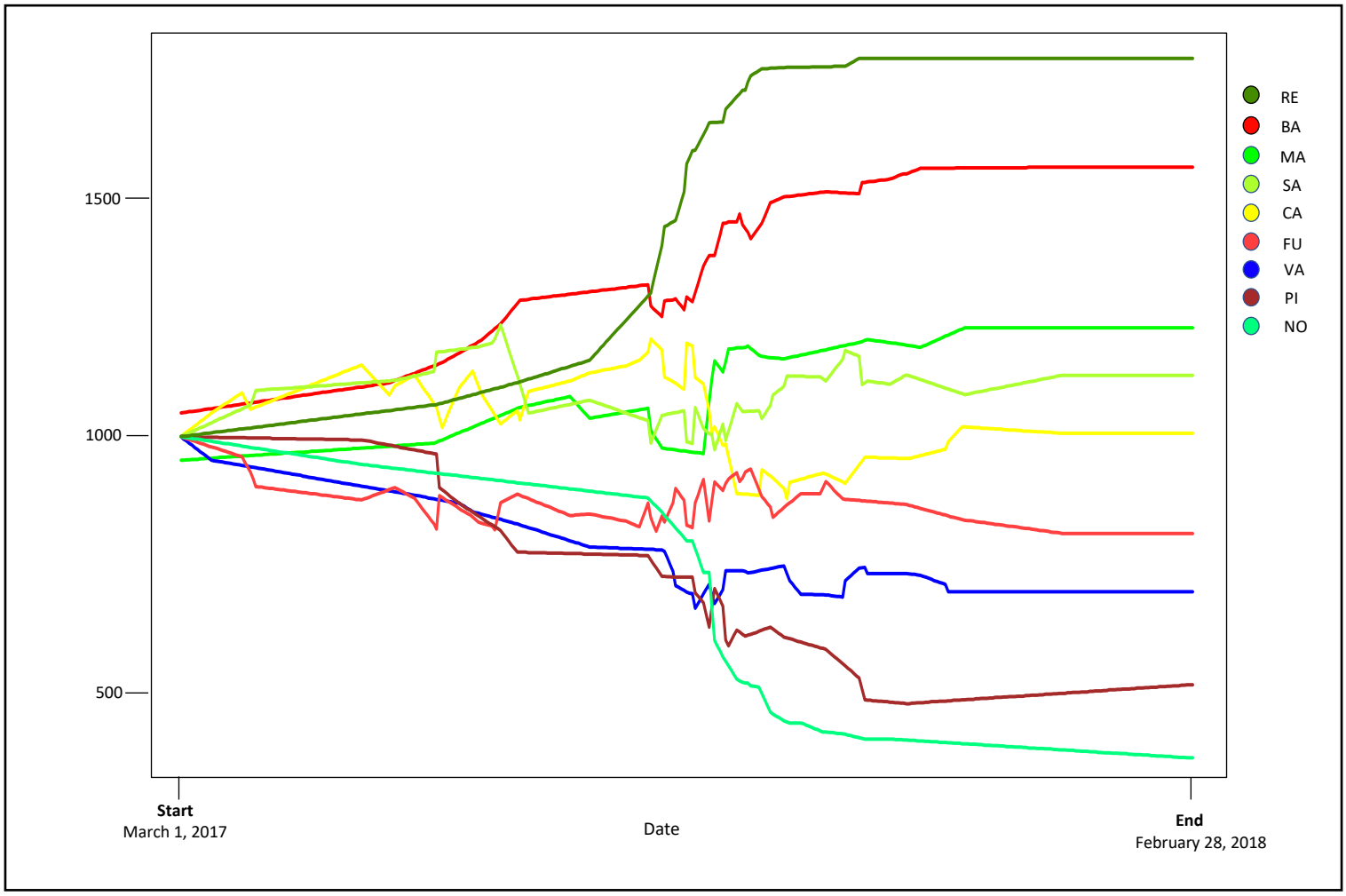


Figure 3.6. Elo-rating of the adult female dominance hierarchy in order from highest ranked (top) to lowest ranked (bottom). Individual AM is not listed as she had not reached adulthood during the behavioural observation study period.

The troop visited the property where crushed dried corn or bird seed was provided on 58% of all days (n = 176). The troop spent more of their time resting (mean ± SD = 44.3% ± 10.9) and socialising (32.7% ± 12.4%) when at this property. This was followed by moving (14.3% ± 6), feeding (7.4% ± 6) and other behaviours (1.4% ± 1.5). The alpha male (CL), alpha female (RE) and the older juvenile son of the alpha female (JA), spent an average of 18.6% ± 1.9 feeding when on this property, compared to an average of 4.6% ± 2.4% for the rest of the individuals. The most consumed food item on the property was provisioned food (48.1% ± 32) with the alpha male (CL) and the alpha female (RE), responsible for 51.5% of all provisioned food consumption (**Fig. 3.7**), while JA was the third highest consumer of this food (21.6%). The remaining 12 troop members consumed 27.3% of the provisioned food (range: 0-6.8%).

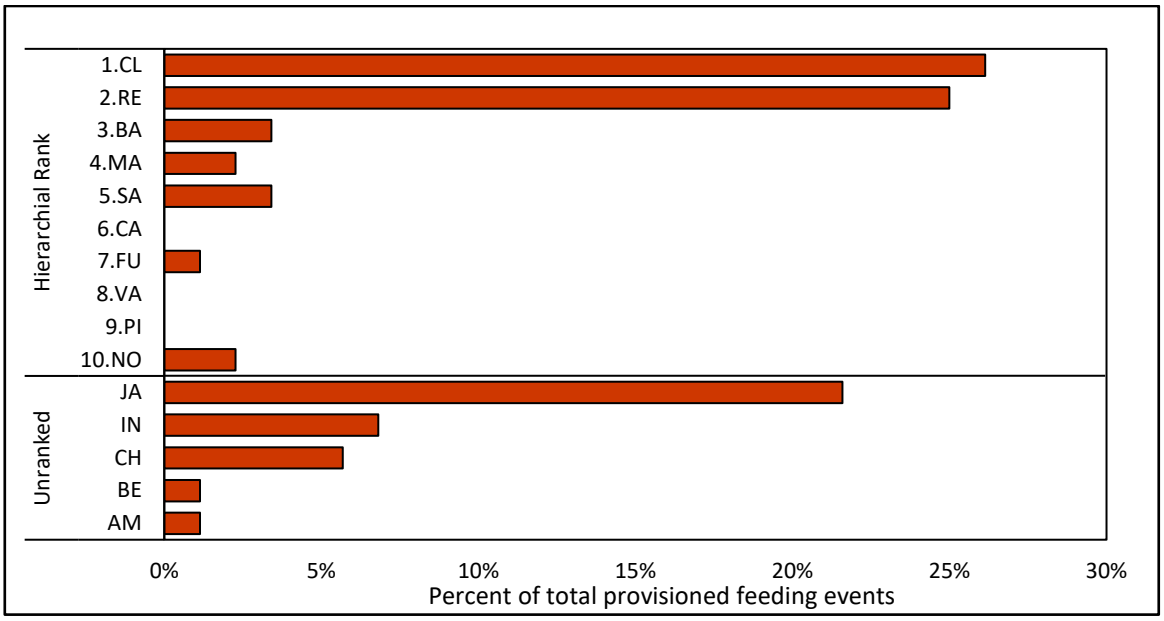


Figure 3.7. Individual proportions of the provisioned food source consumed relative to the troop dominance hierarchy (lowest number is the highest hierarchical position). Immature individuals were not ranked. "JA" is the older juvenile son of alpha female "RE".

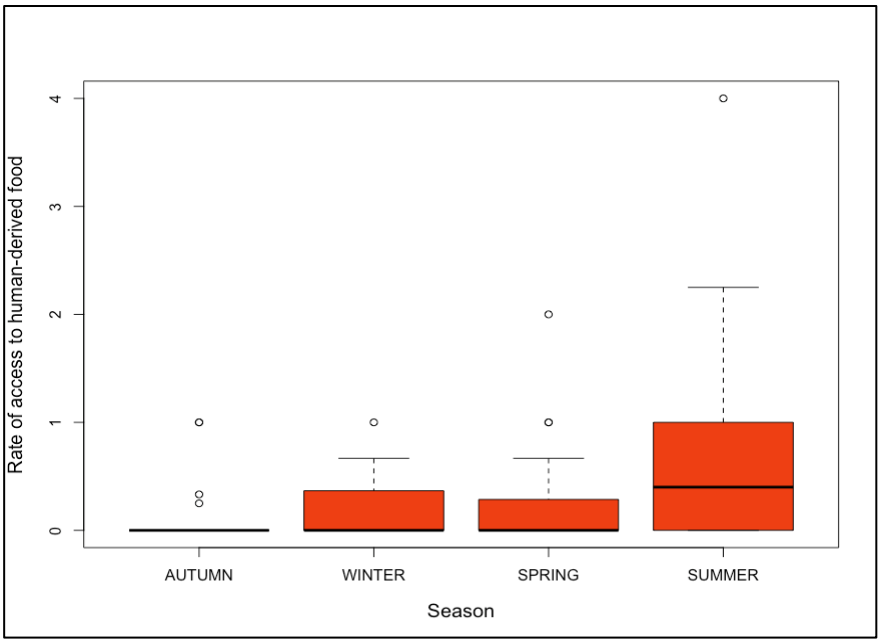


Figure 3.8. The average frequency (± S.D.) with which troop members obtained human-derived Food from houses, bins, and vehicles in each season. Open circles indicate outliers.

Exploitation of human-derived food sources from houses, bins, and vehicles

A total of 89 incidents of baboons obtaining food from houses, bins and vehicles were recorded during the study period. The average rate at which the troop obtained these foods varied significantly across

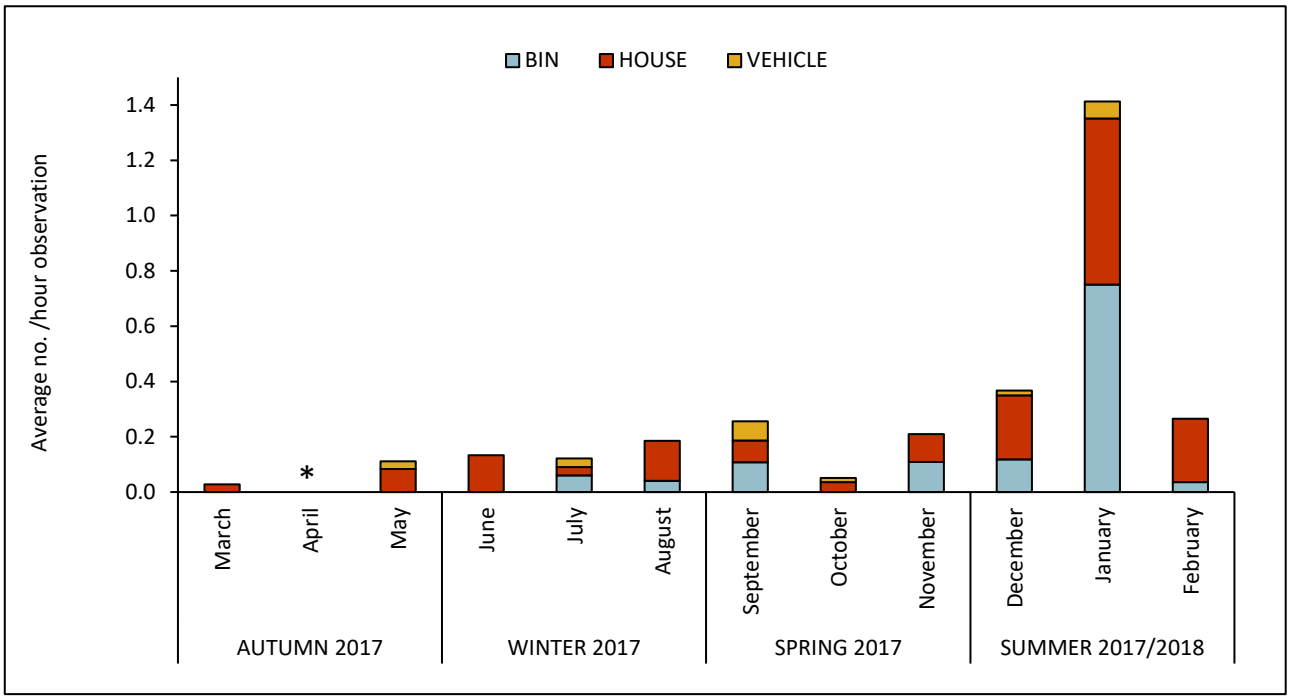


Figure 3.9. Average number of times per hour that troop members obtained human-derived foods from houses, bins, and vehicles in each month of the year and grouped by season. *No data were collected for the month of April.

seasons (X^2 = 26.105, df = 3, p<0.05) (**Fig. 3.8**) and was significantly higher in summer (0.49 ± 0.76 instances per hour of observation) than in winter, autumn or spring (0.14 ± 0.31 instances per hour of observation (p<0.05 in all cases). Food from houses specifically was obtained more often in summer than in winter, autumn and spring (p<0.05 in all cases). There were no seasonal differences in the rate of obtaining food from bins or vehicles. Obtaining food from houses, bins and vehicles peaked in the month of January (**Fig. 3.9**) and was significantly higher (mean = 0.67 ± 0.96) during the 5-week school holiday period in December and January (X^2 = 20.567, df = 1, p<0.05) relative to the rest of the year (0.16 ± 0.32). The number of instances during this holiday period accounted for 39% of total annual amount (n = 89).

3.4 DISCUSSION

The Rooiels troop's activity budget varied significantly with season, consistent with previous studies of baboons in South Africa's Western Cape (Hall, 1962; Hoffman & O'Riain 2011; Lewis & O'Riain 2017; van Doorn et al. 2010) and elsewhere in South Africa (e.g., Hill et al., 2004; Whiten et al., 1987). Variation in baboon activity budgets has been linked to both food availability and quality (Lewis & O'Riain, 2017) with sparsely distributed and poor-quality forage resulting in increased time traveling and feeding with concomitant reductions in both socialising and resting (Hoffman & O'Riain, 2012b).

In this study, feeding was significantly higher in spring when most plants, including fynbos, are flowering or fruiting (Manning, 2018) resulting in more high-quality food available (**Fig. 3.10**). Fynbos, which was the main food item consumed by the troop during this season, requires considerable handling and processing time and is typically spatially dispersed, thus requiring considerable time spent traveling to obtain it (van Doorn et al., 2010). While the troop spent the most time feeding during the spring season, this was not matched by a significant increase in time spent traveling relative to other seasons, as is the typical trade-off reported by other studies in the region (Hoffman & O'Riain, 2011; Lewis & O'Riain, 2017; van Doorn et al., 2010). The village falls within a low altitude, coastal region, which is known to offer more productive fynbos vegetation (Lewis & O'Riain, 2017) and thus the limited amount of time traveling may be a result of the densely concentrated fynbos in the village area.

The troop spent the least amount of time feeding in the winter months and fed predominantly on grass from lawns on developed properties. Grass served as a staple fallback food for the troop during this time when fruiting and flowering fynbos vegetation was less available (Marshall & Wrangham, 2007). Dependence on fallback foods during times of lower food availability has been reported for other primate species (Constantino & Wright, 2009; Lambert & Rothman, 2015). Fallback foods are typically nutritionally poor and require an increase in foraging time at the expense of other activities such as resting and socialising (Altmann, 2009; van Doorn et al., 2010).

Contrary to this however, the Rooiels troop spent the least amount of time both feeding and moving during the winter season and the highest amount of time socialising. Compared to fynbos, which is notoriously time consuming to process, grass requires less handling and processing time, thus resulting in relatively low feeding time. This was evidenced by their consumption of grass by way of rapidly alternating the use of hands to pluck and transfer grass blades to their mouth without manual or oral separation of plant components. Similar processing has been reported for other easily obtainable resources (Altmann, 2009) and differs from other vegetation types including fynbos which typically requires the separation of flowers and fruits from stems (Whiten et al., 1991) (**Fig. 3.11**). The fact that traveling time was also low in winter may be because of the large, uniform concentration of grass from lawns on many properties in the village. In fact, Chapter 2 revealed that the troop preferentially selected for properties with larger areas of lawn, which would increase the efficiency of grass foraging. Alternatively, Weingrill et al. (2004) found that baboons in the nearby De Hoop Nature Reserve exhibited elevated cortisol levels during the winter season, suggesting that low temperatures cause metabolic stress linked to thermoregulation. The troop may thus opt to reduce their time spent moving to conserve energy and maintain thermoregulation during colder months when preferred food availability is low, as demonstrated in other primate species (Hanya, 2004).

Figure 3.10. Juvenile baboon consuming a *Leucodendron* sp. cone (top left). Juvenile baboon consuming *Leucospermum* sp. flower (top right). Juvenile baboon foraging in coastal vegetation (middle right). Adult male consuming *Salvia africana-lutea* flowers (bottom right). Juvenile baboon eating *Osteospermum moniliferum* berries (bottom left) (image by Kaelin DeLong). All other images by Joselyn Mormile.

Resting time is a resource from which to draw on when feeding and traveling times increase in response to food availability (Dunbar et al., 2009). Despite significant seasonal differences in time spent feeding and moving however, the troop exhibited no significant seasonal differences in time spent resting (**Fig. 3.12**). The lack of seasonal difference in time allocated to resting was also observed in a troop in the nearby Cape Peninsula, however this finding was linked to the troop's increased access to high-return human-derived supplemental food during the winter months, which offset the time cost of searching for less available natural foods (van Doorn et al., 2010). Instead of compromising on the amount of time spent resting to account for increased feeding and traveling, the study troop showed significant seasonal fluctuations in time spent engaged in social behaviours. This is contrary to other

studies where the amount of time engaged in social behaviours was unaffected by season change (Alberts et al., 2005; van Doorn et al., 2010) which may be attributed to the fact that social behaviour, in particular grooming, is a biologically important activity requiring adequate time investment to maintain social troop cohesion (Dunbar, 1992). That the troop drew from social time over resting time within the village suggests that the troop prioritised resting when in the village. The village likely offers more benefits for resting including protection from environmental elements or natural predators (i.e., leopards (*Panthera pardus*)) which are less likely to enter the village (Bateman & Fleming, 2012). When engaged in resting and socialising, animals prefer micro-habitats with a lower risk of predation, (e.g., baboons (Cowlishaw, 1997), Cape fur seals (*Arctocephalus pusillus*) (De Vos et al., 2015), various herbivores (Palmer et al. 2017)), and thermoregulatory benefits (e.g., baboons (Hill, 2006), elephants (*Elephas maximus*) (Ramakrishnan et al., 2014)). The unexpected differences in resting and socialising tradeoffs may be attributed to the fact that this study did not include full-day observations of the troop and thus cannot account for time spent on activities outside of the village.

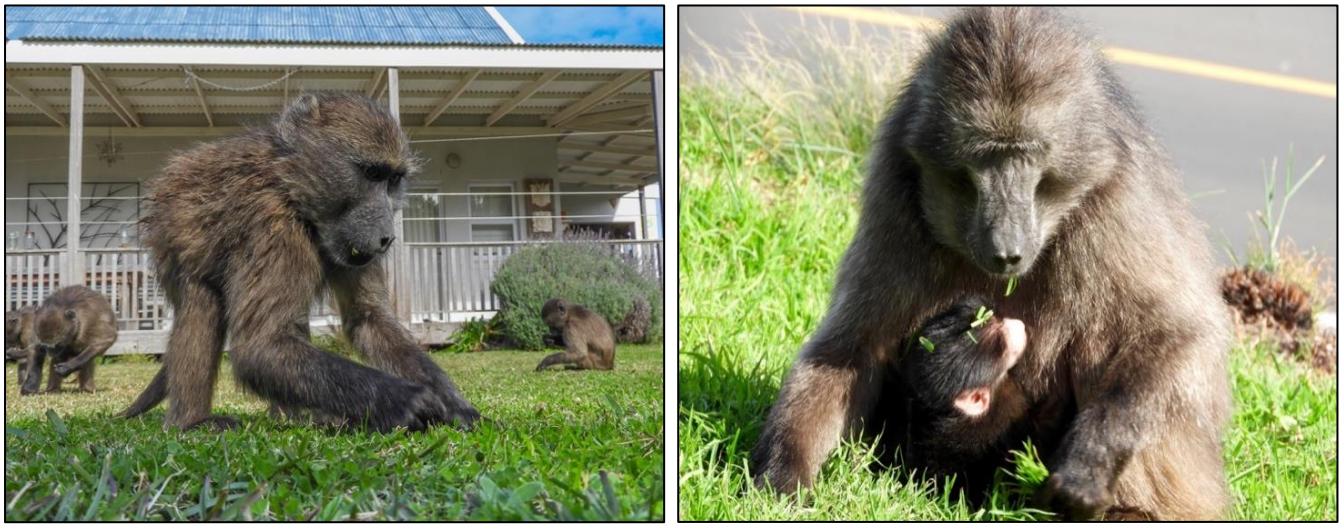


Figure 3.11. Juvenile baboons foraging on grass on residential property by way of rapidly alternating hands to pluck and transfer grass blades to their mouth (left). Adult female grabs and consumes grass blades (right). Images by Joselyn Mormile.

Importantly, the troop's activity budget, with less time spent feeding than resting, suggests that the troop does not suffer from food shortages and more than adequately meets their nutritional needs, even in winter. This relationship between time spent feeding and resting in fact appears closer to that of a troop which regularly consumes high-calorie HDFs (Altmann & Muruthi, 1988). However, HDFs and provisioned foods accounted for a minimal amount of their annual diet, suggesting rather that the various natural foods (e.g., fynbos, grass) present within the village are abundant and readily available year-round, thus buffering the troop against the effects of seasonality.

Figure 3.12. Baboons resting and socialising on a residential property. Image by Joselyn Mormile.

Chapter 2 revealed that the troop does not use the village landscape evenly and their activity budgets differ depending on habitat type within the village. They spent significantly more time feeding on undeveloped erven than either roads or developed erven. Undeveloped erven represent larger patches of natural vegetation given there are no hard structures (e.g., buildings) and are thus more suitable for foraging. Buildings in turn provide suitable shelter for baboons to exploit including covered areas to avoid getting wet on rainy days, for shade on hot days and for wind shadows on windy days (**Fig. 3.13**). Thus, it was not surprising that baboons both rested and socialised more on developed erven relative to roads and undeveloped erven.

The troop also selected for developed properties with larger areas of lawn (Chapter 2). This may not only be because grass is a staple food for the troop, but also because lawns provide a safe location to rest with good visibility and in proximity to refugia (e.g., rooftops). Houses also provide vantage points for sentinels and are often the focal point for protracted playing behaviour by juveniles, offering diverse substrates and infrastructure to improve locomotory and social skills (Palagi, 2018) (**Fig. 3.14**). Chapter 2 also showed that the troop members preferred to travel on roads within the village matrix and spent most of their time moving when in this habitat type. Wildlife often utilise roads and pathways for traveling as they allow for lower costs of movement and improved speeds (Brown et al., 2006; Mann et al. 2015; Whittington et al., 2005). Additionally, particularly for a social species, roads allow for better visual coordination of movement (Harel et al., 2021) between spatially discrete resources (e.g., sleeping site and provisioning site) and improved vigilance for potential threats.

Figure 3.13. Baboons using urban infrastructure in Rooiels for protection from rain and wind (left & top right) and sunlight (middle and bottom right). Images by Joselyn Mormile.

Within developed erven, the troop showed a strong preference for a property that provisioned dried crushed corn on a near daily basis (Chapter 2). When on this property most of the troop spent their time resting and socialising with most of the provisioned food consumed by the highest-ranking male and female as well as this female's oldest offspring, aligning with previous similar findings (Kaplan et al. 2011). While few nutritional benefits were accrued by other troop members from visiting this property, high ranking individuals, particularly the alpha male, strongly influence troop movement (Bracken et al., 2022b; King et al., 2008; Stueckle et al., 2008). Though the provisioned food only accounted for an average of about 10% of the troop's average annual diet, the nutritional benefits provided by this food likely impacted the troop's activity budget, which more closely resembled that

of a troop which consumes HDFs, specifically with regards to the percent of time spent feeding and resting (Altmann & Muruthi, 1988). The exact degree to which this small proportion of provisioned food in the diet would have impacted their activity budgets is unknown. Importantly, the troop did not consume more of this high-calorie food during winter when naturally available foods are scarce, a trend which has been previously reported in other areas (Hoffman & O'Riain, 2011; van Doorn et al., 2010). While the property owner in this study supplied food regularly, it was not necessarily provided every day and was in far smaller quantities than for troops accessing agricultural products that are detailed in the aforementioned studies. The natural vegetation, fynbos, is a highly fibrous, nutrient-poor vegetation with secondary compounds (Coetzee et al., 1997; Cowling et al., 1996). Consequently, when provided with opportunities to supplement their diet with more palatable and nutrient dense exotic plants or human-derived foods, baboons readily do so (Chowdhury et al., 2021; Ellwanger, 2020; Hoffman & O'Riain 2011; van Doorn et al. 2010). Frequent visits to the property where higher-nutrient food was supplied was thus predicted. While it is illegal to provision wildlife in the Western Cape (CapeNature Ordinance 19 of 1974) and the owner was issued repeated warnings and fines (J. Yates, pers. comms., 2017), they nevertheless persisted, highlighting the difficulty of altering human behaviour through legislation alone.

Figure 3.14. Alpha male (CL) acts as a sentinel from a resident's roof (top). Juveniles play on a resident's roof (bottom). Images by Joselyn Mormile.

By contrast, most residents within Rooiels are careful to secure their houses, vehicles, and waste bins to limit access to HDFs on their property (Chapter 6). Consequently, food from these sources accounted for a very small fraction of the troop's overall diet. Importantly however, the troop accessed significantly more of these foods in the summer season, which corresponds with the annual influx of holidaymakers. In addition to an increase in the number of opportunities to access human-derived foods as a result of more occupied properties, visitors are often less aware of the importance of keeping windows and doors closed to prevent baboons from accessing houses and vehicles.

Figure 3.15. Baboons entering an unoccupied house where visitors had left a window open (top left) and some of the resulting damage from the baboons (top right). Baboons accessing waste from an overfilled public bin (bottom left). This bin was being used to deposit large quantities of household waste by visitors and was eventually removed by the community to prevent such use and access to waste by baboons. An adult female baboon looks through an open window into a house (bottom right). This window could not be opened further due to baboon-proof latches. Images by Joselyn Mormile.

Additionally, high summer temperatures compel visitors and residents alike to open windows and doors, which provides baboons with increased opportunities to enter buildings. These combined circumstances resulted in a significant spike (4x the annual average) in food obtained from houses during the summer months (**Fig. 3.15**). An increase in foraging on HDFs during summer months is contrary to other studies in the region (van Doorn et al., 2010), that found that baboons are more likely to seek out residential properties during times of food scarcity (i.e., winter months) when they are more reliant on fallback vegetation, such as grasses which are often found in low-lying areas where houses are present (Hoffman & O'Riain, 2011). These increased visits to residential properties led to higher rates of opportunistic exploitation of human food (van Doorn et al., 2010). A similar finding in Rooiels illustrates the opportunistic nature of baboons and their ability to exploit high quality resources. The higher rate of feeding on human food sources in the summer months further highlights the success of most permanent residents in restricting access to these foods through education, awareness, vigilance, and baboon-proofing of individual properties, throughout the rest of the year. However, the annual summer spike also highlights a weak point in the success of the coexistence model in Rooiels, namely the difficulty of educating visitors who have limited experience in living with an agile, dexterous, and innovative primate. When primates learn to associate people and houses with food, the risks of negative interactions between both parties increase, which has negative implications for the welfare of the troop (Chapter 5).

CHAPTER FOUR

FACTORS INFLUENCING RESIDENT ACCEPTANCE OF URBAN BABOONS: INSIGHTS FROM THE ROOIELS COMMUNITY

Fig. 4.1. People and baboons walking in Rooiels.
Image by Joselyn Mormile.

ABSTRACT

People's willingness to share space with wildlife plays a pivotal role in the latter's ability to persist and utilise resources in developed landscapes. Factors that promote such willingness are poorly understood and thus difficult to promote where coexistence is favoured. Given their behavioural and dietary flexibility, baboons readily adapt to and exploit human-dominated landscapes including residential areas. However, baboons are seldom tolerated in urban areas because of damage to property, safety concerns for family members and pets and competition over food. The exception to this rule is the Rooiels community which has opted to share their village with the local baboon troop. The community boasts of harmonious coexistence with the troop by relying on resident baboon-proofing and vigilance to prevent or limit negative interactions with baboons. I used structured questionnaires to assess resident demographics, and social and psychological factors that might have promoted this unique attitude towards baboons. Partial least squares structural equation modelling revealed that acceptance of baboons was influenced by respondent wildlife value orientation, attitudes towards baboons, and emotions evoked by baboons. Psychological acceptance of baboons was also linked to acceptance of physical overlap with baboons. Most respondents held a mutualistic wildlife value orientation, positive attitudes towards baboons and low levels of fear regarding baboons. Compared to results of a questionnaire 18 years prior, community acceptance had increased significantly indicating a shift in the community's perception and boundaries of human-wildlife relationships. Most respondents reported that their attitudes towards baboons had become more positive over time, citing education on how to live with baboons as a predominant contributing factor. The study highlights the positive role that an informal resident-led baboon education and awareness campaign can have on changing attitudes towards baboons. As urban areas expand and wildlife adapt, further research is needed to fully understand the factors that foster acceptance and coexistence, particularly for often maligned and challenging species with which to share space.

4.1 INTRODUCTION

As the human population expands into natural habitat, increasing overlap with wildlife is inevitable, leading to a wide range of responses by, and outcomes for, wildlife and people. The study of the human dimension of these interactions only came to the fore around the 1980s (Manfredo et al., 1995), but today human attitudes and behaviours are now considered to be as important to the persistence of wildlife as those of direct ecological variables, such as available habitat (Brenner & Metcalf, 2020). The field of human dimensions of wildlife can be defined as seeking to understand "human thought and action regarding wildlife using concepts and methods of social science." (Manfredo et al., 1995).

Human dimensions research has shown that living with wildlife comes with costs and benefits impacting people's tolerance (Kansky et al., 2016) and that negative interactions increase the likelihood of retaliatory behaviour (Treves et al., 2009). Research further illuminated reasons why residents support or oppose wildlife management approaches such as the re-introduction of species (Campbell & Alvarado, 2011) or lethal removal (Manfredo et al., 2020), and a better understanding of public support for conservation initiatives (Bennet & Dearden, 2014). In understanding human relationships with wildlife, human dimensions research considers the influence and importance of a wide variety of variables such as wildlife value orientations and attitudes (Manfredo et al., 1995), emotions (Jacobs, 2012) and demographics such as age, gender, and educational level (Kimmig et al., 2020).

Wildlife value orientations

Wildlife value orientations (WVOs) are a growing area of focus within human dimensions of wildlife research. These orientations are defined as "patterns of basic beliefs that give meaning and direction to fundamental values in the context of human-wildlife relationships." (Fulton et al., 1996). Two predominant WVOs are widely recognized and commonly studied, 'utilitarian' and 'mutualistic' (Bruskotter et al., 2019; Jacobs et al., 2014; Manfredo, 2008). Individuals with a utilitarian WVO prioritize human well-being over that of wildlife and believe that wildlife should be managed for human benefit. Individuals with a mutualist WVO believe that animals should have rights similar to humans. Two additional orientations are discussed in the literature, though they are studied to a lesser degree (Keener-Eck et al., 2020). 'Pluralism' is defined as holding both mutualistic and utilitarian beliefs, and a 'distanced' WVO is defined as having low mutualistic and low utilitarian beliefs (Teel & Manfredo, 2010). WVOs, as patterns of basic beliefs, are one of the foundational constructs of the cognitive hierarchy theory, second only to the most fundamental construct of values (Fulton et al., 1996). According to the theory, these orientations, which are both few in number and slow to change, form the basis for attitudes, behavioural intentions, and behaviours (Fulton et al., 1996). As such,

utilizing WVOs as a framework to assess, and predict, the perception towards wildlife and wildlife management approaches is particularly valuable and robust (Jacobs et al., 2014).

Attitudes towards wildlife

Attitudes are a frequently investigated psychological construct in the study of human dimensions of wildlife. An attitude is defined as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly & Chaiken, 1993). It is theorized to consist of three components; affect, cognition and behaviour, though some propose that attitude is rather an evaluative summary of information arising from these components (Fabrigar et al., 2018) with each component contributing in varying degrees to the final summary (Pooley & O'Connor, 2000). Attitudes towards wildlife play a key role in tolerance of wildlife (Kansky et al., 2016), behaviour towards wildlife (Bagchi & Mishra, 2006), responses to increasing wildlife populations (Ostermann-Miyashita et al., 2023), risk perceptions (Hartel et al., 2015) and support for conservation (Mormile & Hill, 2017). Despite the fundamental link between WVOs and attitudes as ordered constructs within the cognitive hierarchy (Fulton et al., 1996), variation in attitudes towards wildlife cannot be entirely explained by WVOs (Jacobs et al., 2014; Hartel et al., 2015). Compared to basic beliefs, attitudes are abundant and quicker to change (Fulton et al., 1996). As such, investigating attitudes in addition to WVOs may provide a greater understanding of the complexity of human dimensions of wildlife.

Emotions towards wildlife

The emotions evoked by wildlife and their potential role in perceptions of wildlife, wildlife management and conservation initiatives have received only minor attention in human dimensions literature to date (Jacobs & Vaske, 2019). There is currently no consensual definition of emotion amongst scientists, however, emotion is largely considered to consist of physiological and expressive reactions, behavioural tendencies, and experiential components (Jacobs & Vaske, 2019). In this study, as for most studies that investigate human emotion towards wildlife (Jacobs et al., 2014), I focus on the experiential component. Part of this component consists of what are considered to be six basic and discreet human emotions: fear, disgust, anger, sadness, joy, and surprise (Ekman, 1992). Of these six emotions, fear has been the most studied in the context of wildlife (Jacobs & Vaske, 2019), likely due to its importance as an adaptive defense mechanism against potentially dangerous animals (Castillo-Huitron et al., 2020). Although the inclusion of emotions in wildlife research is in its infancy, studies have already revealed the significance of emotions in understanding the human dimension of wildlife. For example, research has shown that disgust felt towards wolves predicted the acceptability of lethal control (Jacobs et al., 2014), and fear reduced support for wolf reintroductions (Slagle et al., 2012), as well as willingness to contribute towards management and conservation of large carnivores (Johansson et al., 2012). Few studies have combined the study of emotion with other psychological

constructs such as attitudes and wildlife value orientations. Findings thus far reveal that emotions can add additional explanatory power to the investigation of these variables (Abidin & Jacobs, 2019; Straka et al., 2020; 2021) and recent research has recommended a combined exploration of these constructs (Abidin & Jacobs 2019).

Human dimensions research on primates

An extensive body of research exists on the ecology and biology of primate species within various human-dominated landscapes (McLennan et al., 2017). However, despite the emergence of the study of primates in anthropogenic landscapes in the 2000s, a focus on the human factors which impact primates in these landscapes is lacking (McLennan et al., 2017). As an estimated 75% of the world's primate species are now estimated to be in decline as a result of human activities (Estrada et al., 2017), the need to understand interactions between primates and humans in shared space is increasingly important, particularly with regards to their conservation (Bersacola et al., 2023). Given this statistic, some researchers advise that "one cannot engage in the study of primate ecology and behaviour scientifically, ethically, or morally without including the relations between humans and other primates", further stressing that "these relations, and their resultant ecologies are mutually co-constructive, dynamic, conflictual, complex and central to primate lives." (Fuentes, 2023).

In a review of existing primatology literature published between 1970 and 2016, only 21% of publications included an assessment of human dimensions (McLennan et al. 2017). The majority of these studies were however published towards the end of the period in review (2010-2016), suggesting a recent increase in effort to understand human dimensions in primatology (McLennan et al., 2017). While encouraging, gaps within subsets of knowledge on human-primate interactions in anthropogenic landscapes remain. In the same review, nearly 65% of research on primates in human-dominated landscapes occurred within agricultural or rural contexts, with only 15% taking place in urban settings. Additionally, most of these articles focused on conflicts with primates, emphasizing negative aspects such as crop damage and pest status, with less than ten percent describing neutral or positive interactions (McLennan et al., 2017).

Defining tolerance, acceptance, and coexistence

Though conflict between wildlife and people has been the focus of most research on human-wildlife interactions (Frank, 2016), researchers have recommended a shift towards understanding the diversity of interactions, including tolerance, acceptance, and coexistence with wildlife (Glikman et al., 2021). This has given rise to the conflict-to-coexistence continuum concept (Frank, 2016) with the inclusion of neutral-to-positive interactions allowing for a more holistic evaluation of the context and extent of potential or existing challenges. While in search of solutions to these challenges, focusing on the

mechanisms of coexistence may provide a positive opportunity to move beyond simply mitigating conflicts (Frank & Glickman, 2019). Despite the call for this more holistic approach, the very ideals which are being sought, i.e., tolerance, acceptance, and coexistence, remain poorly defined in the literature (Brenner & Metcalf, 2020), often leaving interpretation up to the reader and thus limiting the ability to compare studies or build upon previous research (Glikman et al., 2021). While formal definitions for these terms have not been established, the existing literature has examined various factors thought to predict tolerance, acceptance and coexistence, including demographics, location, length of exposure or experience, associated costs and benefits, and psychological constructs such as wildlife value orientations and attitudes (Bruskotter & Wilson, 2014; Kansky et al., 2016; Kimmig et al., 2020; Lischka et al., 2019; Merz et al., 2021; Treves et al., 2013).

In this study, tolerance for wildlife is defined following Kansky et al., (2016) viz., "the ability of an individual to absorb the potential or actual costs of living with wildlife" and consider this as a lower bar than acceptance and coexistence, in line with Glikman et al., (2021). This study applies an original interpretation of acceptance of wildlife whereby I defined "acceptance of sharing space" as: "beyond a willingness to endure the potential costs of living with wildlife; embracing the sharing of space." For added clarity, this terminology is further operationalized into two categories, "psychological acceptance", which is defined as "embracing of sharing space from a mental perspective", i.e., welcoming of sharing space in theory, and "spatial acceptance", which is defined as "embracing of sharing space from a physical overlap perspective", i.e., welcoming of sharing space in practice. Finally, I consider "coexistence" as an overarching state of being that takes place "when a compromise which satisfies the interests of humans and wildlife is negotiated, allowing the existence and persistence of both humans and wildlife in the same space", a definition adapted from Frank (2016).

Acceptance of baboons

As a result of their dietary flexibility and behavioural plasticity, baboons readily exploit various anthropogenic landscapes (Fehlmann et al. 2017; Hill, 2005; Katsvanga et al., 2006). Despite their adaptable nature and ubiquitous range, few studies have examined how people experience living in overlap with them, with most taking place in agricultural contexts and very few within urban settings. The findings of this limited research reveal their reputation as "pests" on farms due to their penchant for crop foraging (Hill, 2005; Kifle, 2021), while in urban areas they incite fear and negative attitudes (Kansky et al., 2016; Mormile & Hill, 2017), highlighting a significant concern for both baboon conservation and the well-being of the people with whom they share space.

Given these perceptions, the typical approach used by both agricultural and urban communities living near baboons involves their exclusion from human-dominated spaces. Contrary to this, for decades

the village of Rooiels has espoused a coexistence strategy with baboons that allows for the local baboon troop's spatial overlap with private and public property. The village implements no formal deterrent measures (e.g., baboon-proof fences, field rangers), instead encouraging residents to prevent the baboons from accessing human-derived foods both inside and outside of their houses in an effort to prevent negative or unwanted interactions. Given this long-term coexistence approach, I predicted that the community will be highly accepting of sharing space with baboons. I further predicted that resident demographics, length of residency in Rooiels, WVOs, and attitude and emotions evoked by the baboons would contribute to psychological acceptance of sharing space, which will subsequently influence spatial acceptance of sharing space.

This study aims to fill gaps in existing knowledge on the human dimension of human-baboon relationships. It not only contributes to a better understanding of the human perceptions of baboons in an urban setting, but also explores the highly unique scenario of acceptance of sharing space with a much-maligned species and aims to illuminate the human dimensions that enable it.

4.2 METHODS

Questionnaire design and distribution

A questionnaire for residents of Rooiels was developed to assess their acceptance of living alongside baboons. The questionnaire included fifty-three multiple choice and open-ended questions based on recurrent themes identified during informal interviews, interactions with residents and reviews of village publications at the beginning of the study (Newing, 2010). To compare resident attitudes over time, the questionnaire repeated five questions from a previous anonymous questionnaire developed by resident Dr. Jenny Stark, which was conducted in the village in 2000 as part of a baboon education and awareness program. I trialed a pilot questionnaire with six individuals from the target audience during questionnaire development to test the clarity and accuracy of the questions, question type and question order (Newing, 2010). Small changes, including rewording and reordering were made to the questionnaire based on this pilot survey before the final questionnaire survey was initiated (Newing, 2010). The questionnaire was directed to all residents, whether they rent or own property in the village and regardless of whether they reside in Rooiels part-time or full-time. Visitors were not included in the questionnaire process as the survey was aimed at understanding residents. Name and property number were requested of the respondents to enable spatial mapping of various questionnaire responses (e.g., behaviour towards baboons) for Chapter 2 but were not mandatory. The final questionnaire (Appendix 4) was developed in Google Forms. At the time of the study, the village had 240 houses. Of these, approximately 125 were permanently occupied, with the remainer being holiday or weekend houses. Resident email addresses were obtained with permission from the Rooiels

Security Association's database of resident contact details. A link to the questionnaire was emailed to 392 residents on March 13th, 2018. A message encouraging resident participation was also posted on the resident-only WhatsApp group by the Rooiels Ratepayer's committee chairperson on March 15th, 2018. This message was repeated on March 28th, 2018, in the March 2018 Rooiels Ratepayer's newsletter email sent to all residents. I posted a reminder to participate on the resident-only WhatsApp group on March 21st and 31st, and April 21st, 2018. Residents were asked to contact me for a copy of the questionnaire if they had not received a copy in their email or were unable to access the online link. Physical printed copies were made available for collection in the village security office for residents that required a hard copy. Participants completing the paper form of the questionnaire were asked to seal their completed form inside the provided envelope and hand it to the security agent, who placed the envelopes in a locked safe. I collected all completed paper questionnaires on the same day they were submitted. The questionnaire link closed to responses on the May 1st, 2018.

Questionnaire analysis

One hundred and eighty-one responses were received. Four questionnaires that were completed by individuals not residing in the study area, and one duplicate questionnaire, were removed from the sample prior to analysis. The remaining 177 responses came from 130 households (54.2% household response rate). This resulted in a response rate of qualitative questions were separated by theme for quantitative analysis. Only respondents that answered all questions utilised in the final analysis were included (n = 104). Additionally, respondents who answered "unsure" for any of the questions used in analysis were excluded as the goal of the study was to determine causal relationships between variables. All responses were coded in Excel. Descriptive analyses were conducted in SPSS and Excel, and modeling exercises were conducted in R statistical software.

Acceptance and boundary modeling

I used Partial Least Squares Structural Equation Models (PLS-SEM) to understand the drivers of respondent psychological and physical acceptance of sharing space with baboons. I used the statistical package SEMinR, run in the statistical program R (Ray et al, 2021). The PLS method of SEM was utilised as it allows for the development and exploration of new theories whereas CB-SEM is primarily used to test hypotheses of existing theories (Hair & Alamer, 2022). PLS-SEM is also preferred when the focus of the research is to predict an outcome using many composite variables with complex relationships, when data do not meet the assumptions of normal distribution and when sample sizes are small (Hair & Alamer, 2022). Given that the modeling exercise is not based on established theory and serves to allow for the interpretation of causal relationships between variables, the inclusion of individual latent variables utilised in the PLS-SEM should be justified based on strong theoretical evidence (Kansky et al., 2016). This is particularly relevant as it is recommended not to reject PLS-SEM models based only

on model fit indices but rather weighing these indices alongside different structural model specifications based in theory and logic (Hair & Sarstedt, 2021). PLS-SEM path model diagrams are used to visualize the directionality and significance of latent variable relationships.

Acceptance variables

Seven latent variables were used to understand the variation in the degree to which respondents accept sharing space with baboons from a psychological perspective, which was termed "acceptance" in the structural model and was also a latent variable. The latent variables were made up of one to five manifest variables as shown in **Table 4.1**. Education level was merged from five categories into three – no undergraduate degree, undergraduate degree, postgraduate degree. Gender was collapsed from three to two categories as all respondents self-identified as either male or female.

Boundary variables

One latent variable, "acceptance", was used to understand the variation in respondents' physical acceptance of baboons. This variable was labelled "boundary" in the model and was also a latent variable made up of one manifest variable (**Table 4.1**).

Table 4.1. Development of latent variables used in the PLS SEM modeling of acceptance

Latent variable	# manifest variables	Question(s) that served as the manifest variable
Age	1	What is your age group?
Gender	1	What is your gender?
Education level	1	What is your highest level of education?
Length of residency	1	What year did you first move to Rooiels?
Attitude	1	How do you feel about the baboons in Rooiels?
Emotion	2	Generally speaking, how emotionally stressful is it for you to live with baboons in Rooiels?
		Are you afraid of the baboons in Rooiels?
Wildlife Value Orientation	4	Please respond to the following statement on a scale of strongly agree to strongly disagree:
		"If a baboon gets into a house in Rooiels, it is the resident's fault?"
		"Baboons have been coming to Rooiels long before people lived here."
		"Baboons have restricted how I would like to live my life in Rooiels."
		"I am concerned about the conservation of the baboons in Rooiels."
Acceptance	5	"Do you consider the baboons in Rooiels a problem?"
		"Do you consider the baboons in Rooiels a nuisance?"
		"Do you believe the baboons in Rooiels are dangerous?"
		"Do you consider the baboons in Rooiels an asset?"
		"Would you like the baboons to be removed from Rooiels?"
Boundary	1	"In an ideal world, you would prefer if the baboons DID NOT: A. Enter your house B. Climb on your house, car, or outside fixtures C. Come to your property D. Enter the Rooiels village E. None of the above"

Reliability and validity of measurement model

A convergent validity assessment using Average Variance Extracted revealed that all constructs utilised were acceptable (>0.5). Variance Inflation Factors (VIF) for manifest variables were calculated to assess for collinearity amongst them. While the meaningful cutoff value for VIF is debated (Thompson et al., 2017), Hair & Alamer (2022) suggest that with regards to PLS-SEM, values less than three indicate no collinearity and variables with values greater than five require further investigation (Hair & Alamer, 2022, Thompson et al., 2017). All predictor constructs in this study had a value of less than five. All indicator weights were significant, indicating they should be retained in the measurement model. Though not required because the indicator weights were found to be significant, indicator loadings were also assessed and found to be significant with loadings ≥ 0.5 in magnitude, confirming sufficient absolute contribution to the formation of the latent variable and thus empirically justifying their retention (Hair & Alamer, 2022).

Assessment of structural model

A bootstrapping routine with 5000 iterations was used to achieve stability in the results (Hair & Alamer, 2022). Latent variable VIF values were assessed to test for collinearity. The value for "wildlife value orientations" was slightly above the value of five cutoff recommended by Hair & Alamer (2022) (VIF = 5.037) and was thus retained. Based on the cognitive hierarchy theory, value orientations contribute in part to the foundation of attitudes but are indeed a distinct cognitive construct (Vaske & Donnelly, 1999). The fact that value orientations form the fundamental basis of much of cognition thus predict the potential for a degree of collinearity amongst related concepts. Additionally, Thompson et al. (2017) warn against viewing an acceptable VIF value as a dichotomy and suggests that values very close to the chosen cutoff value effectively stipulate the same implication. Thus, despite this VIF value falling at the high end of the spectrum, this latent variable was retained in the model. An assessment of the coefficient of determination, in this case the R^2 value, was used to determine the level of variance in the outcome explained by the latent variables and hypotheses. The adjusted R^2, a more conservative estimate, is reported in the results.

Acceptance scores & change over time

Psychological acceptance was a latent variable generated by the PLS SEM, which does not produce an output from which descriptive statistics can be calculated. To enable descriptive discussion of acceptance in the Rooiels community, I created an acceptance scale as a proxy to the latent acceptance variable. Scores were calculated for respondents of the 2000 and the 2018 questionnaire surveys by summing the coded binary answers to the five questions used for creating the latent variable of acceptance (**Table 4.1**), with a higher score indicating higher acceptance (scale: 0-5). After a Shapiro-Wilk test for normality determined that the data were not normally distributed, a Mann Whitney U

test was used to compare mean ranks in acceptance scores between the 2000 and 2018 surveys. For further descriptive investigation of the manifest variables which comprised psychological acceptance, percentages for answers to each of the five questions were calculated for the responses in both the 2000 and the 2018 questionnaire surveys and graphed for visualization. Respondent WVOs were categorized for general discussion based on an average of their scores (1-5). Broad categories included "utilitarian" (score: 1.0 – 2.0), "pluralistic" (score: 2.1 - 3.9) or "mutualistic" (score: 4.0-5.0). Only three of the four recognized wildlife value orientations were presented in this study. The fourth value orientation, "distanced", was not represented in the sample as this measurement would have relied on respondents selecting the option of "unsure" for wildlife value orientation questions, and these respondents were removed from analysis

Ethics statement

Ethical clearance from the University of Cape Town's Faculty of Science Research Ethics Committee (approval code: FSREC 85 – 2017) was received for this study prior to the start of the questionnaire data collection period.

4.3 RESULTS

MODEL DESCRIPTIVES

Demographics

The largest proportion of respondents had lived in Rooiels for more than 20 years (37.7%), followed by 1-5 years (30.7%), 11-25 years (25%), 6-10 years (5.7%) and less than one year (1%). Most reported moving to Rooiels for the nature (64.4%) (**Table 4.2**). Slightly more men (54.8%) completed the questionnaire than women (45.2%). Most respondents were older than 50 years (85.5%) and the most represented group was between 60-69 yrs (36.5%). The respondents were highly educated with 22.1% holding an undergraduate degree as their highest degree and 46.2% holding a postgraduate degree as their highest degree obtained.

Table 4.2. Common reasons residents for moving to Rooiels (n = 104).

Why did you choose to move to Rooiels?	**Count***	**Percent**
Nature	67	64.4%
Isolated location	36	34.6%
Other	15	14.4%
Convenient proximity to large city	14	13.5%
Unspecified	7	6.7%
Holiday home	6	5.8%
Community	4	3.8%

*Respondents could list unlimited reasons.

Attitude, emotions, wildlife value orientations and boundaries

The majority of respondents reporting that they liked baboons (70.2%), 18.2% disliked them, and a small percent had neutral feelings about them (11.5%) (**Fig. 4.2**). The majority of respondents held a mutualistic wildlife value orientation (64.4%), 22.1% held a pluralistic wildlife value orientation and 13.5% held a utilitarian wildlife value orientation (**Fig. 4.2**). Most (81.7%) respondents reported not being afraid of baboons while 75% did not consider living with them to be stressful and only 25% considered living with them to cause some degree of stress (**Fig. 4.2**). Most respondents reported that in an "ideal world", they would prefer that the baboons visit the village (84.6%) and their properties (79.8%), but only a small proportion wanted them to enter their houses (6.7%) (**Fig. 4.3**).

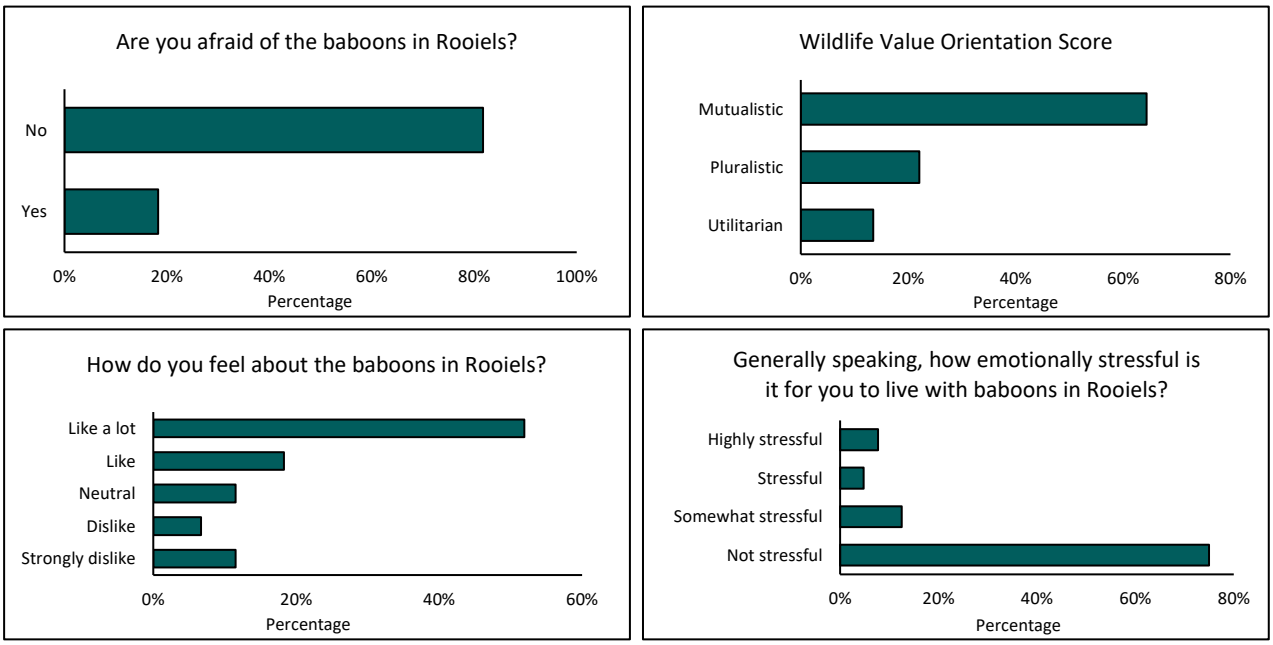


Figure 4.2. Responses to select questions used in the PLS SEM.

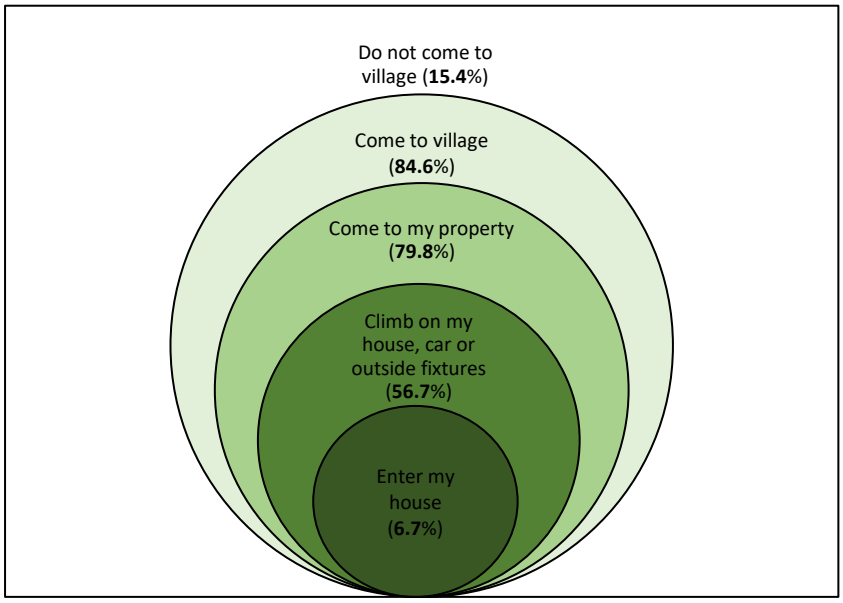


Figure 4.3. Boundaries respondents envisaged for Rooiels baboons in an "ideal world".

Community acceptance over time

A smaller percentage of respondents considered baboons a problem and a nuisance in 2018 than in 2000 (**Fig. 4.4**). A greater percentage of respondents considered baboons an asset and fewer supported their removal in 2018 compared to 2000. The percentage of respondents that considered baboons dangerous increased in 2018, however the 2018 wording of the question included the option of "sometimes", which was categorized as "yes". 13.5% of respondents in 2018 answered "yes" while 14.4% answered "sometimes". Acceptance scores from the community in 2018 were significantly higher than in 2000 ($z = -2.121$, $p < 0.05$, $n = 191$) (**Fig. 4.5**).

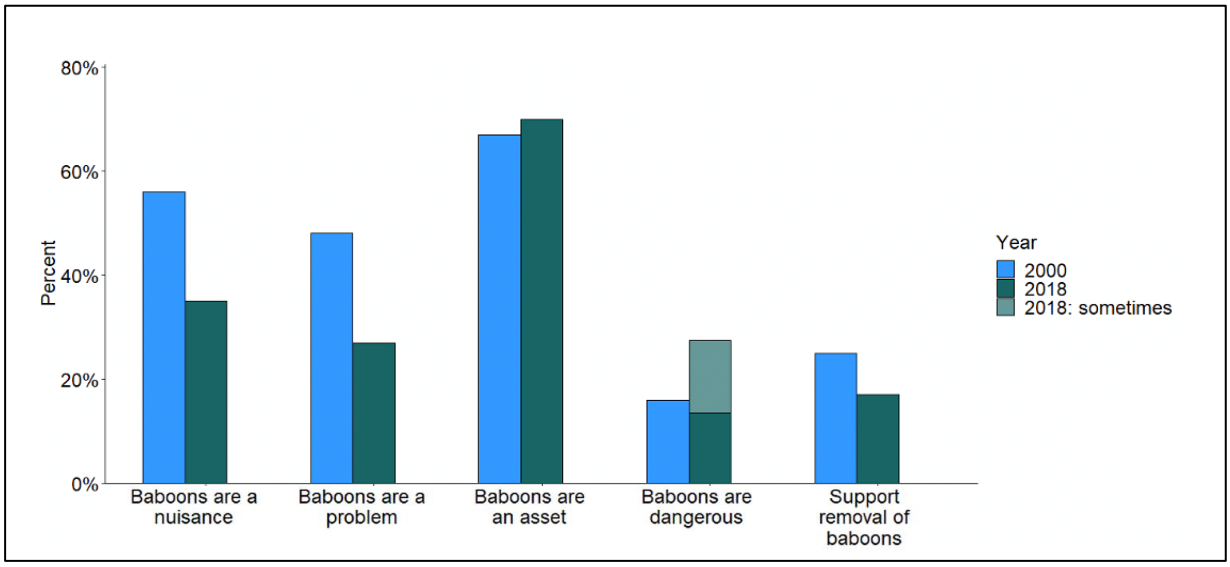


Figure 4.4. Comparison of responses to questions in the 2000 survey (n = 87) that were repeated in the 2018 survey (n = 104). Responses to these questions were used to create the Acceptance score.

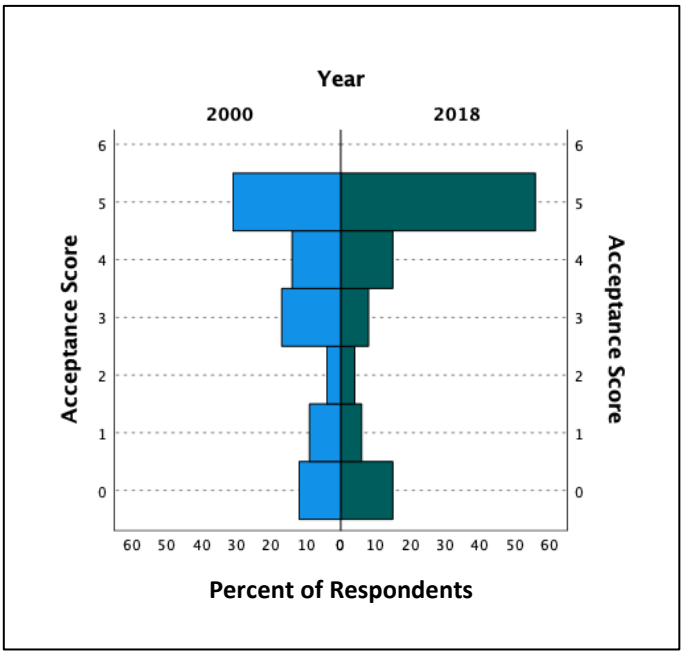


Figure 4.5. Acceptance scores from the 2000 (n = 87) and 2018 (n = 104) questionnaires.
A higher score indicates a higher degree of acceptance of sharing space with baboons.

Individual respondent attitude change over time

When asked whether their attitude towards baboons had changed over the course of living in Rooiels in the 2018 questionnaire, 58.7% said it had (n = 104). Of those who reported a change, 68.9% reported a positive change, 29.5% reported a negative change and 1.6% did not indicate a direction. The most reported reason for a positive change in attitude was education and hence a better understanding of baboons (72.1%). This was followed by enjoyment in watching them (34.9%), no longer being afraid of them (30.2%) and baboon-proofing (30.2%). The most common themes for negative attitude change were feeling that the baboons had become more aggressive or lost their fear of people (61.1%). This was followed by having to keep the house locked up to prevent baboons access (50%) and concerns about damage, or nuisance factors on their property (27.8%) (**Table 4.3**).

Table 4.3. Common themes for positive attitude change towards baboons over time (n = 43).

Why did your attitude towards baboons become more positive over time?	**Count***	**Percent**
Education/Understand them better	31	72.1%
Love watching them	15	34.9%
No longer afraid of them	13	30.2%
Learned to coexist/baboon-proofed house	13	30.2%
Other	11	25.6%
Unspecified	2	4.7%

*Respondents could list unlimited reasons.

Acceptance model

Results of the partial least squares structural equation model indicated that wildlife value orientations geared towards mutualistic, a more positive attitude and less negative emotions associated with baboons, resulted in a higher level of acceptance of sharing space with them (**Fig. 4.6**). All other variables were not significant, with small estimates. This model explained 84.4% of the variation in respondents' psychological acceptance of sharing space with baboons. Results also showed that a higher level of psychological acceptance of sharing space led to a significant increase in respondents' desire for a greater level of overlap between the baboons and themselves (spatial acceptance). The model explained 73.7% of the variation in where the boundary would be drawn by respondents in an "ideal world" (**Table 4.4**).

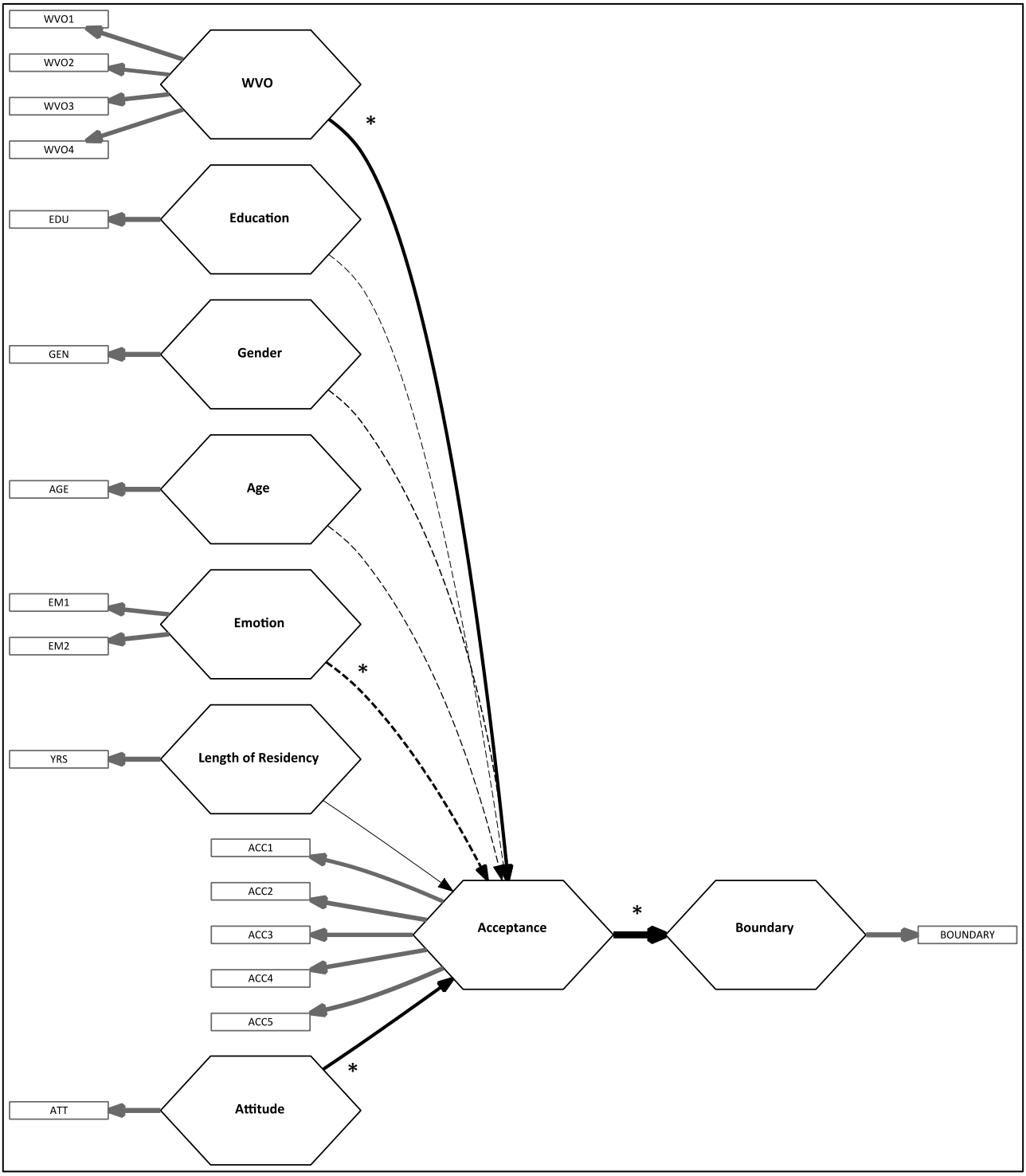


Figure 4.6. Partial least squares structural equation model of the predictors of respondent acceptance for sharing space with baboons and the degree of physical overlap that would be desired in an "ideal world". Solid lines indicate positive relationships, dashed lines represent negative relationships. Thicker black lines indicate larger variable estimates. * Indicates significant relationships at $p<0.01$. WVO = Wildlife Value Orientation.

Table 4.4. Partial Least Squares Structural Equation Model estimates (n = 104).

Variable	Acceptance	Boundary
R^2	0.855	0.740
Adjusted R^2	0.844	0.737
WVO	0.368*	-
Attitude	0.356*	-
Emotion	0.244*	-
Gender	-0.080	-
Age	-0.050	-
Length of residency	0.020	-
Education level	-0.008	-
Acceptance	-	0.859*

WVO = wildlife value orientation. Gender reference category was female.
*p<0.01.

4.4 DISCUSSION

Acceptance of baboons in Rooiels was found to be influenced by respondent wildlife value orientation, attitude towards baboons and emotions evoked by baboons. It is unsurprising that these three constructs influence resident acceptance of baboons as they represent interrelated psychological components. Attitudes build upon values within the cognitive hierarchy (Fulton et al., 1996) and, similarly, emotions comprise the affective component of attitudes (Eagly & Chaiken, 1993; Seitz et al., 2007). These three human dimension constructs and their links to acceptance of wildlife have been studied extensively (Hartel et al., 2015; Hermann et al., 2013; Jacobs et al., 2014; Jacobs & Vaske, 2019; Kansky et al., 2016; Keener-Eck et al., 2020).

Wildlife value orientations

WVOs are described as "patterns of basic beliefs that give meaning and direction to fundamental values in the context of human-wildlife relationships" (Jacobs et al., 2022). Individuals holding a utilitarian WVO believe that humans are superior to wildlife and that humans should maintain control over their environmental surroundings to their benefit (Dietsch et al., 2019). Contrary to this, individuals with a mutualist WVO believe that humans and wildlife are of relatively equal standing, wildlife should have rights similar to humans, that wildlife and humans can coexist, and hold beliefs that stress the significance of environmental education and wildlife protection for future generations (Dietsch et al., 2019; Jacobs et al., 2014). Individuals holding pluralistic orientations have views towards wildlife that fall between those of utilitarian and mutualist, with expression of one end of the spectrum or the other dependent on the situational context (Keener-Eck et al., 2020). Most respondents in the survey held mutualistic WVOs as captured by a respondent's statement:

> *"We are privileged to live in the fynbos conservation area. Baboons are part of the wildlife in this conservancy. Thus, we are visitors in baboon territory. If we choose to live in the Kogelberg Biosphere we as human beings have the responsibility to conserve it for future generations."* - resp. A

While WVOs in communities differ based on numerous factors (Jacobs et al., 2022), some geographic patterns associated with value orientations have emerged. For instance, rural residents in the USA are more likely to hold a utilitarian WVO and those in cities are more likely to hold a mutualistic WVO (Dietsch et al., 2019; Vaske et al., 2011). The residents of Rooiels, however, are neither strictly urban nor strictly rural. A comparable community in the USA was described by Keener-Eck et al. (2020) as comprising a small population of highly educated, long-term residents of older age, living in an exurban area surrounded by a large natural area. They exhibited a similar breakdown of WVOs to those found in this study with predominantly mutualist orientations, followed by pluralist and then utilitarian. The similarities between the two communities may stem from a shared desire to be closer to nature, as was reported by the majority of respondents in Rooiels, or that in general, people choose to live in areas where others hold values similar to their own (Dietsch et al., 2019). Thus peri-urban communities may emerge as a potential third generalizable geographic type characterized by mostly mutualistic and pluralist value orientations towards wildlife, though this requires further investigation.

Figure 4.7. Rooiels residents and baboons walking in the village. Image by Joselyn Mormile.

WVOs have been shown to predict acceptance of wildlife species (Lischka et al., 2019), as well as different wildlife management approaches (Jacobs et al., 2014; Manfredo et al., 2016). Most of the respondents in this study held a mutualistic orientation, reinforcing their stated desire for coexistence with wildlife and the sharing of urban space with baboons.

Attitudes and emotions

Whilst cognitive hierarchy theory predicts a link between WVOs and attitudes, variation in attitudes towards wildlife cannot be explained entirely by the more fundamental value orientation (Hartel et al., 2015; Jacobs et al., 2014). This is largely because there are only a few basic beliefs which are slow changing, while attitudes are abundant and quicker to change (Fulton et al., 1996). While a large portion of the Rooiels community's acceptance appears to be related to the broadly held mutualistic WVOs, attitude was also a significant variable influencing acceptance. Attitudes towards wildlife, which have been studied extensively (e.g., reptiles (Hartel et al., 2015; Keener-Eck et al., 2020), mammals (Kansky et al., 2014; Mkonyi et al., 2017), birds (Prokop et al., 2008; Sharma & Kreye, 2021)), are central to understanding acceptance of wildlife. Most respondents stated that they liked the baboons in Rooiels while in the larger town of Knysna, on the south coast of South Africa, respondents reported being angry or annoyed with the presence of baboons (Mormile & Hill, 2017). Similarly, a study conducted in the Cape Peninsula found that most suburban residents considered sharing space with baboons to be problematic (Kansky et al., 2016). These negative perceptions of sharing space with baboons in both previous studies were linked to respondent perception of risk or costs associated with baboon visits, such as concern for personal safety, safety of household pets and damage to property.

Though tolerance for sharing space with wildlife varies widely, it is typically low when human health and safety are believed to be at risk (Destefano & Deblinger, 2005), even when the actual risk is low (Riley & Decker, 2000). It was thus unsurprising to find that emotions, including fear of baboons and the degree of stress baboons cause respondents, significantly influenced respondent acceptance of baboons. Emotions toward wildlife have a significant impact on the perception and acceptance of wildlife (Jacobs & Vaske, 2019). Fear in particular is considered one of the most basic human emotions and is the most studied emotion in human-wildlife relationships to date (Hartel et al., 2015; Jacobs & Vaske, 2019). Sharing space with an animal that elicits fear is perceived as undesirable and results in negative perceptions of, or attitudes toward the animal, as has been shown for several species of wildlife (e.g., large carnivores (Kleiven et al., 2004), snakes (Vaughn et al., 2022), hornets (*Vespa* spp.) and wild boars (*Sus scrofa*) (Hosaka et al., 2017)). Risks to children are globally viewed as unacceptable and elicit some of the most significant concerns regarding interactions with wildlife (Curtis & Hadidian, 2010). Children are both smaller in size and less adept at accurately evaluating threats which places them at a greater risk during a wildlife interaction (Curtis & Hadidian, 2010). Notably however, given

the average age of Rooiels residents was over 50 years, the number of households with young children on a permanent basis in Rooiels is likely low. This may contribute to a higher level of acceptance of the baboons overall, as studies indicate that residents living with children at home express more concern about the risks of living with wildlife, than those without children living at home (Zinn & Pierce, 2002).

Living in a state of continuous fear can also lead to emotional stress, which is defined as "the feeling of psychological strain and uneasiness produced by situations of danger, threat and loss of personal security" (American Psychological Association, 2023). In the context of Rooiels, a resident may experience emotional stress when a baboon gains entry to their house and they attempt to get the baboon out amidst the worry over personal safety, the safety of household pets and potential property damage as described below:

> *"It is a constant fear. If I hear a sound downstairs, I have to run down and make sure the windows (even with baboon locks) are closed, that somebody did not accidentally forget to lock a door. I am scared of them defouling [sic] my house, like I have experienced in the past at other houses. I am scared of them hurting a visiting child, or the tiny dogs of visiting friends."* - resp. B

This stress could further manifest as chronic worry that such a situation could occur at any given time, the unpredictability of which may worsen emotional stress. A lack of control or predictability over encounters with wildlife, which have the potential to cause stress (Baum et al., 1986), can reduce the acceptability of sharing space with them (Bruskotter & Wilson, 2013; Gehrt et al., 2010; Kleiven et al., 2004).

While fear and stress negatively influenced acceptance scores, most respondents in Rooiels were not scared of the baboons and did not consider living alongside them to be stressful. The finding that fear and emotional stress have the potential to influence acceptance of baboons is important as it supports the findings of the few existing similar studies, which suggest that baboons are a fear-relevant species (Kansky et al., 2016; Mormile & Hill, 2017). The role of fear in relation to primates requires further research as numerous species of primates overlap with human-dominated landscapes (Hill & Webber, 2010; McLennan et al., 2017). Not only has human dimensions research highlighted the impacts of negative human-wildlife interactions, such as stress and worry, on human psychosocial wellbeing (Barua et al., 2013; Chowdhury et al., 2008), but fear may impede conservation goals through lack of concern for wildlife conservation (Mormile & Hill, 2017), indiscriminate killing (Musah et al., 2022), or disinterest in financial contribution towards conservation efforts (Johannson et al., 2012). A deeper investigation into the full range of emotions that baboons and other primates evoke is necessary as research suggests that positive emotions such as joy may be even stronger predictors of wildlife acceptability (Jacobs & Vaske, 2019).

Change in acceptance and attitudes of baboons over time

Prior studies have shown a lack of generalizable patterns regarding the impact of time on changes in community perceptions of wildlife, even for the same species. Some studies have revealed that attitudes and perceptions become more negative over time (e.g., large carnivores (Zimmerman et al., 2001)), while others have become more positive (e.g., sharks (Friedrich et al., 2014), coyotes (*Canis latrans*) (Jackman & Rutberg, 2015)), or remained the same (e.g., wolves (*Canis lupus*) (Bruskotter et al., 2007)). The acceptance of baboons by the Rooiels community increased significantly over eighteen years. In 2018, not only were fewer respondents in favour of the baboons' removal from the village, but the number of respondents who considered the baboons to be dangerous decreased, and those that considered the baboons an asset increased. Nearly 70% of individual respondents stated that their attitudes towards baboons had become more positive over the course of living in the village, citing education and a further understanding of baboons as the main cause of their attitude change. This supports the idea that attitudes, unlike values or value orientations, are more flexible to change, and may be particularly responsive to targeted education (Skupien et al., 2016; Walsh et al., 2023).

The role of education and awareness in changing perceptions

In 1999, a small group of Rooiels residents, concerned about the mistreatment of baboons in the community, initiated an informal resident-led baboon education and awareness campaign. Their stated goal was to promote tolerance and acceptance for the presence of baboons in the Rooiels village. The campaign, which lasted until 2010, was multifaceted, including articles in local publications, signage, community talks, events, and games (Appendix 5). Additionally, volunteer residents, serving as 'community champions', visited households where baboons had gained access, to calm fears and frustrations and to discuss how the situation transpired and how to best prevent future similar incidents (J. Stark, pers. comm., 2022). This campaign likely succeeded in changing attitudes and encouraging pro-environmental behaviour (e.g., baboon-proofing, not retaliating against baboons) in several ways. The approach of using 'community champions' can be one of the strongest approaches to influencing pro-environmental behaviours, by circulating information through a known social network (Abrahamse & Steg, 2013). Additionally, utilizing diverse channels of communication regarding environmental education strengthens the influence of the messages being shared (Abrahamse & Steg, 2013; Jacobson et al., 2016) and person-to-person dialogues can increase the social influence of a message and better elicit behaviour change (Abrahamse & Steg, 2013; van Heezik et al., 2012). This approach may have been particularly effective in the small, close-knit community of Rooiels.

Educational messages shared within the community sought to increase knowledge of baboon behavioural ecology to allow residents to better understand baboon behaviour during interactions

(e.g., baboons do not mean you harm and are only interested in your food) and adjust their expectations of these interactions to better match reality (e.g., baboons are likely to enter your house in search of food if the door is open (Appendix 5). This information likely influenced residents' attitudes towards baboons as knowledge of relevant information on the behaviour and conservation issues of species that may have negative interactions with people can positively shape people's attitudes towards them (Ericsson & Heberlein, 2003; Tan et al., 2020) and reduce fear (Espinosa & Jacobson, 2012). Messaging also focused on detailing practical measures to increase one's level of control over interactions with baboons through reducing human-derived food attractants and baboon-proofing of properties (Appendix 5).

Control, or lack thereof, over interactions with wildlife significantly impacts tolerance for wildlife species (Gore et al., 2007), and thus education or awareness efforts that focus on practical solutions to increase control and prevent negative interactions are likely to increase tolerance (Slagle et al., 2013). Formal conservation education programs have found that targeted education is an effective strategy for changing attitudes towards wildlife, particularly for potentially dangerous animals (e.g., alligators (*Alligator mississippiensis*) (Skupien et al., 2016), Andean bears (*Tremarctos ornatus*) (Espinosa & Jacobson, 2012), mountain lions (*Puma concolor*) (Riley & Decker, 2000)). Overall, the success of this informal campaign can be attributed to the community's inadvertent application of various principles utilised in formal conservation education programs.

The role of non-conflict exposure in changing perceptions

Sharing information on its own may not be enough to bring about changes in attitudes and perceptions (Heberlein, 2012). In fact, over a third of respondents listed their enjoyment in watching the baboons as the reason for a positive change in their attitudes. While observing wildlife is a well-known human interest (Curtain, 2009), sharing direct living space with wildlife has potential associated costs (Kansky et al., 2014; 2016). These costs, which exist at both tangible (e.g., damage to property) and intangible levels (e.g., emotional stress) (Pebsworth & Radhakrishna, 2021) may reduce potential interest in observing or being exposed to them. The education campaign in Rooiels likely aided in reducing potential costs associated with living near the baboons on both a tangible (i.e., fewer baboon entries into houses due to vigilance and baboon-proofing (Chapter 6) and intangible level (i.e., reduced fear through increased understanding of baboon behaviour). This prevention of negative interactions likely facilitated an increased degree of tolerance for baboon presence in the village and an increased opportunity for residents to observe baboons engaged in neutral or positive behaviours. When asked how they reacted when baboons come to their property, some respondents illustrated this coupling of preparedness and subsequent enjoyment in watching the baboons:

> *"Once we baboon-proofed the house, we were able to watch them and enjoy them. I love watching the baboons that act as nannies taking care of the babies, and the way the young ones play on and up and down houses."* - resp. C

Figure 4.8. Rooiels resident and grandchild observing baboons in the village. Shared with permission. Photo by Kaelin DeLong.

Continued observation of the baboons engaged in neutral behaviours in the village may thus have played an important role in fostering tolerance, and ultimately acceptance. Other studies have shown that acceptance of living with wildlife increases as familiarity through observation and exposure increases (Bjurlin & Cypher, 2005; Harrison, 1998; Kleiven et al., 2004; Skupien et al., 2016). Further to this, the enjoyment of watching wildlife and having nature nearby is often considered an intangible benefit of wildlife (Curtain, 2009). Intangible benefits drive acceptance of wildlife species, including primates (Kansky et al., 2016, Pebsworth & Radhakrishna, 2021). Enjoyment in watching the baboons contributed to residents considering the baboons an asset. For example, a respondent stated:

> *"It is a privilege to share an environment with baboons and other wildlife right on one's doorstep. There are not many places in the world that one is able to look out of one's window and share a special moment observing wildlife on a daily basis."* - resp. D

When the costs of living with primates are high and benefits are low, people tend to exhibit negative attitudes and lower tolerance towards them (Kansky et al., 2016; Pebsworth & Radahkrishna, 2021).

Though costs and benefits were not directly measured in this study, a few respondents considered the baboons dangerous or their presence to be a problem, which are some of the typical cost indicators (Kansky et al., 2016). Equally, respondents appear to perceive benefits associated with the baboons as the majority considered them an asset. A respondent illustrated their balance of costs and benefits by stating:

> *"Yes, they are a nuisance. Yes, they restrict our ability to open doors and windows, but they contribute to making Rooiels extraordinary. We would be so much poorer without them."* - resp. E

This perceived offset of costs relative to benefits, likely facilitated through education, awareness, and continued exposure to neutral or positive behaviours, contributed to the observed high acceptability of sharing space with baboons, which has increased with time.

Figure 4.9. Rooiels residents watching baboons on their property from indoors. Shared with permission. Photo by Kaelin DeLong.

Boundaries

Philo and Wilbert (2000) describe people's relationships with animals through "zones of human settlement" in which different types of animals "belong" in specific areas. Opinions on where wildlife "belong", or are 'allowed', varies widely and these human constructed boundaries have a direct impact on tolerance for the animal in question (Alexander & Draper, 2019). For instance, songbirds are generally accepted as "belonging" in resident gardens and their presence is often met with enthusiasm

and even encouragement (Larson et al., 2023). Comparatively, coyotes seen in urban areas may be considered “out of place”, with some residents believing they should be killed if they come within a certain distance of a house (Alexander & Lukasik, 2016).

Figure 4.10. Rooiels resident and friend sitting near a baboon resting on property. Shared with permission. Photo by Kaelin DeLong.

Given the historically high rate of negative interactions between baboons and residents, which were detrimental to both parties (Beamish, 2009; Kaplan et al., 2011; van Doorn et al., 2009), the baboon population in the Cape Peninsula has been actively managed for over a decade with the goal of keeping them out of urban areas (Kansky & Gaynor, 2000; van Doorn & O’Riain, 2020). This approach was supported by Kansky et al., (2016) after finding that local resident tolerance for baboons decreased as their exposure to baboons increased. Contrary to this, the Rooiels community was highly accepting of living in the village with baboons and did not consider them out of place. This psychological acceptance appears to have strongly influenced their spatial acceptance of baboons. Spatial acceptance in this area manifested as a preference for an extreme level of physical overlap with baboons with most respondents not only desiring that baboons come to the village, but also visit their properties. Preference for extreme overlap with baboons is highly unusual, particularly given the potential for

damage to properties, negative interactions with pets and unsafe interactions with baboons due to their size and proclivity to directly compete with people for human-derived food sources. Despite this, respondents appear to very much view baboons as co-habitants of the village, which are embraced as an integral component of Rooiels and their community culture.

Conclusion

The boundaries of human tolerance are now considered to be as significant as physical ecological limitations in predicting the presence and survival of wildlife (Brenner & Metcalf, 2020). This study illustrated the complex interplay of key human dimension concepts in human-wildlife relationships. Given the rapid expansion of urban areas and the adaptability of baboons, the need for further research and understanding of the origins, mechanisms, and limitations of human acceptance for this often-maligned species is required.

CHAPTER FIVE

ASSESSING THE IMPACTS OF AN URBAN INCLUSION MODEL ON THE DEMOGRAPHY AND LIFE HISTORY OF A BABOON TROOP

Fig. 5.1. Adult female (SA) and newborn infant (SQ) resting on a rooftop in Rooiels. Image by Joselyn Mormile.

ABSTRACT

Urban landscapes present both novel opportunities and threats to wildlife species, potentially altering the demography and life history of populations that use urban resources. The village of Rooiels has adopted an urban inclusion model allowing for the local troop's spatial overlap with public and private property. Rooiels thus provides a unique opportunity to explore how the routine use of an urban landscape influences life history factors including reproduction, troop composition, immigration and emigration rates, and survival. These data allow for an assessment of the costs and benefits of the Rooiels inclusion model from the baboons' perspective. Ad libitum data collected over 49 months revealed 24 births and 20 deaths and a relatively small average troop size of 24.8 ± 1.7. Direct causes of human-induced deaths (n = 1) were rare but indirect causes were high, with 75% of all deaths attributed to motor vehicle collisions with infants. With limited opportunities to learn the risks associated with roads and vehicles, infant mortality is predicted to remain high. Additionally, low immigration of unrelated adult males into habituated troops that frequent urban areas, may threaten the genetic health of the troop. High infant mortality and reduced genetic variation suggest that Rooiels, and other urban areas may function as evolutionary traps for baboons. This study highlights the complex interplay of costs and benefits associated with the urban mosaic and the importance of including detailed life history to accurately determine the impacts and potential sustainability of wildlife groups and populations using these spaces.

5.1 INTRODUCTION

With the ongoing transformation of natural habitats to urban, agricultural, and industrial land uses, wild animals are being forced to either move or adapt to living in shared landscapes (McCleery et al., 2014). Anthropogenically modified land includes both novel threats and novel opportunities that together may alter the demography and life history of local populations (Fleming & Bateman, 2018; Sol et al., 2013). Life history data is particularly important for understanding how novel human habitats may alter the interplay between extrinsic causes of mortality and constraints that impact growth, development, and reproduction (Fabian & Flatt, 2012). Understanding reproductive schedules, the rate of immigration recruitment, and the rate and patterns of mortality may help shed light on which species can adjust and survive the land modification associated with a rapidly expanding human population (Kim & Donohue, 2011). Many species demonstrate an ability to adapt their ecology and behaviour to anthropogenically modified landscapes (Flack et al., 2016; Sol et al., 2013) including white tailed deer (*Odocoileus virginianus*) (Duarte et al., 2015), black bears (*Ursus americanus*) (Zeller et al., 2019), leopards (*Panthera pardus*) (Bista et al., 2022), foxes (*Vulpes vulpes*) (Soulsbury et al., 2010), possums (*Trichosurus vulpecula*) (Carthew et al., 2015), and gulls (various spp.) (Spelt et al., 2021). Large carnivores, which are easily disturbed by human activity, reduce their activity during daylight hours to avoid anthropogenic disturbance (Van Cleave et al., 2018). The small, omnivorous raccoon (*Procyon lotor*) adjusts its feeding behaviour and occurs at higher densities in urban areas (Prange et al., 2004). In response to increased noise pollution in urban landscapes, some bird species have overcome communication challenges by singing at higher frequencies than their wild counterparts to maintain contact over typically low frequency urban noise (Slabbekoorn & Peet, 2003). As a result of these adaptations, many species show evidence of improved survival rates in urban landscapes compared to rural or naturally foraging conspecifics (Bateman & Fleming, 2012).

Within species and populations, differences in sex, age, experience, and personality may all influence the likelihood of individuals adapting, surviving, and reproducing in human-modified landscapes (Brooks et al.,2020; Camphuysen et al., 2015; Ducatez et al., 2017). Over time, these individual differences may result in distinct life history parameters relative to individuals living exclusively in natural habitats (Elfström et al., 2014; Gill et al., 2001), thus changing the selective environment and ultimately favouring the microevolution of novel phenotypes adapted to life in transformed habitats (Fehlmann et al., 2023; Rice & Emery, 2003).

However, despite existing in urban environments, many of these species or populations may be entering ecological or evolutionary traps (Dwernychuk & Boag, 1972; Gates & Gysel, 1978; Robertson & Hutto, 2006) where short-term gains (e.g., access to high caloric foods) are trumped by long-term costs (e.g., high anthropogenic causes of injury and death). Motor vehicle collisions globally are

responsible for high rates of mortality for a variety of mammals including black bears (Beckmann & Lackey, 2008), badgers (*Meles meles*), coyotes (*Canis latrans*), bobcats (*Lynx rufus*), and skunks (*Mephitis mephitis*) (Bateman & Fleming, 2012). Exposure to harmful chemicals associated with human activities such as pollutants and poisons are another leading cause of death for urban wildlife including caracals (*Caracal caracal*) (Leighton et al., 2022b), coyotes (Gehrt & Riley, 2010), bobcats (Riley et al., 2010), mountain lions (*Puma concolor*) (Benson et al., 2020), dolphins (*Tursiops truncatus*) (Lahvis et al., 1995), squirrels (*Sciurus carolinensis*), deer, and raptors (various spp.) (Stone et al., 1999). Electrocutions (Guil & Pérez-García, 2022) and domestic dog (*Canis lupus familiaris*) attacks (Holderness-Roddam & McQuillan, 2014; Young et al., 2011) are also common causes of mortality for urban wildlife.

Many primate species are highly adaptable and readily adjust their ecology and behaviour to utilise urban landscapes (e.g., New World primates: Black-tufted marmosets (*Callithrix penicillate*) (Dias et al., 2022), black howler monkeys (*Alouatta caraya*) (Duffy et al., 2022), robust capuchins (*Sapajus robustus*) (Gonçalves et al., 2022); Old World primates: rhesus macaques (*Macaca mulatta*) (Kaburu et al., 2019), long-tailed macaques (*Macaca fascicularis*) (Illham et al., 2017), and vervet monkeys (*Chlorocebus pygerythrus*) (Thatcher et al., 2019)). By altering lifestyle factors such as diets, foraging strategies, ranging areas, and sleeping sites, many primate species can persist in urban landscapes. Adapting to life in the urban landscape has obvious benefits, most notably the ability to survive despite shrinking natural habitats. Some other benefits include access to high calorie human-derived foods which equate to growth and reproductive advantages such as shorter interbirth intervals (Harcourt, 1989; Strum, 2010), buffering against natural disasters such as severe drought (Waite et al., 2007) and even potential protection against natural predators that are either averse to anthropogenic landscapes (Sinha & Vijayakrishnan, 2017) or less tolerated within them (Knopff et al., 2016; Lischka et al., 2019).

The use of urban environments by wildlife comes with novel risks to survival. In natural settings, primate mortality is most often associated with predation (Gursky & Nekaris, 2007), infanticide (van Schaik & Janson, 2000), and intra- and inter- group aggression (Itani, 1982; Wilson, 2007). For primates living in urban spaces, mortalities linked to anthropogenic causes increase, including electrocutions, motor vehicle collisions (Al-Razi et al., 2019; Cunneyworth & Slade, 2021; Linden et al., 2022) and domestic dog attacks (Riley et al., 2015). Mortality can also be the result of intentional killing by residents due to fear or frustration over competition for resources (Baker et al., 2014; Benzason et al., 2017; Gumert, 2011; Strum, 2010). Secondary anthropogenic impacts may also occur, such as an increased rate of adult aggression in response to human food provisioning, leading to an increased rate of infant mortality (Berman et al., 2007).

Baboons are one of the most adaptable primate species, inhabiting diverse landscapes from forests (Berman et al., 2007) and seasonal floodplains (Engh et al., 2006) to deserts (Cowlishaw, 1997) and coastal regions (Lewis & O'Riain, 2017). The demography and life history of baboons living in natural habitats across various landscapes has been investigated in several studies (Alberts, 2019; Altmann et al., 1985; Hamilton, 1985; Henzi & Lycett, 1995; McLean et al., 2019). Similar to other primates the most common causes of mortality in wild populations are predation and infanticide (Cheney et al., 2006; Cowlishaw, 1997; Swedell & Leigh, 2006). While life history data have been recorded in agricultural settings (Strum, 2010; Warren et al., 2011), there are currently no detailed studies focused on the demography and life history of baboon troops that frequent urban landscapes.

In South Africa's Cape Peninsula, Beamish and O'Riain (2014) explored how baboons living adjacent to urban areas suffered from high levels of permanent physical disabilities and how this impacted their behaviour and reproduction. Additionally, Beamish and O'Riain (in press) investigated causes of mortality in baboons living in a mixed-use landscape, revealing that time spent in urban areas increased levels of mortality linked to anthropogenic causes. As humans continue to expand into natural habitats, baboons are increasingly forced to move through or live in anthropogenically modified landscapes. How these changes in habitat use affect baboon behaviour have been investigated in recent years (Bracken et al., 2022a, Christensen et al., 2022; Fehlmann et al., 2017; van Doorn et al., 2010), but there are limited equivalent data on life history parameters. By contrast, there are a number of long-term field studies that have provided detailed life history data for baboons living in natural habitats (e.g., Altmann & Alberts, 2003; Bercovitch & Strum, 1993; Strum & Western, 1982).

Life history data, including age- and sex-specific survival, reproduction, and mortality rates, are often difficult to collect for long-lived species as this requires both extended study periods and fine scale sampling to quantify stochastic and short-lived events. There are limited data on how the key life history factors of reproduction and offspring survival are affected by living in urban environments and how these vary with age and social status of individual baboons. These data are often confounded by attempts to displace the study baboons from the urban area (Bracken et al., 2022a) given the generally low tolerance for baboons in residential suburbs (Mormile & Hill, 2017). Herding baboons alters their activity budgets and diet (van Doorn & O'Riain, 2020), which in turn may influence life history traits of reproduction and survival.

In this chapter, I investigate the life history and demography of the Rooiels troop by examining changes in troop size based on immigration and emigration, birth, and mortality. While Rooiels is a self-proclaimed area of human-baboon coexistence, where the community generally accepts the presence of baboons in the village, the consequences of the troop's urban-dwelling lifestyle on their survival and

fitness remains unknown and are hence the primary aim of this chapter. As a result of access to highly productive vegetation, the wide availability of important fallback foods, and the presence of provisioned food in the urban area (Chapter 3), I predict that 1) females will have shorter interbirth intervals compared to exclusively wild-foraging conspecifics, and 2) priority of access to provisioned food will translate into shorter interbirth intervals and higher offspring survival for higher ranking females compared to low-ranking females. Given the troop's preferential selection for the urban area (Chapter 2), I further predict that 3) causes of mortality will be predominantly due to anthropogenic factors and 4) that given the high level of resident tolerance for baboons, these deaths will stem from indirect human-induced causes (e.g., dog attacks) as opposed to direct human-induced causes (e.g., shooting).

5.2 METHODS

Data collection

Life history and demography data collection took place over a four-year period from the July 4th, 2016 until the July 31st, 2020. Data collection on dyadic female relationships took place between March 1st, 2017 and February 28th, 2018. Between July 4th, 2016, and May 31st, 2019, the troop was observed on an almost daily basis (see Chapter 3). From June 1st, 2019, when I moved out of the study site, life history data on births, injuries and deaths were reported to me by residents living in Rooiels. Resident reports included detailed photographs and videos that allowed me to confirm the identity of the baboon(s) involved.

At the start of the study, the troop consisted of 22 individually recognizable members that were all habituated to close (10m) observation. Individuals were identified based on natural features, with each troop member assigned a unique name and a two-letter code (Altmann, 2001). All infants born during the study period were named using the same first letter as their mother's name (Altmann, 2001). Infants were classified as juveniles at one year of age. Females were classified as subadult at the time of menarche and classified as adult after the birth of their first infant. Males were classified as subadult after surpassing adult female size and when their testicles fully descended and were enlarged. Males were classified as adult after reaching their maximum size (Altmann & Altmann, 1981). Births, injuries, mortalities, female reproductive status, immigrations, emigrations, social status, as well as infrequent or unusual behaviors (e.g., consortships, fights) were recorded on an *ad libitum* basis (Altmann, 2001).

Data analysis

Kruskal Wallis tests performed in R were used to test for a relationship between both female hierarchical rank and offspring survival rate, and cause of mortality. Troop size was calculated at the

end of each month and considered births, deaths, immigrations, and emigrations. All descriptive statistical analyses were done in Excel.

5.3 RESULTS

Troop size and composition

At the start of the study, the troop was comprised of 1 adult male, 9 adult females, 9 juveniles and 3 infants (n = 22). The troop had 1 immigration, 2 emigrations, 24 births and 20 deaths during the study. At the end of the study, the troop had 3 adult males, 7 adult females, 1 subadult female, 11 juveniles and 3 infants, having increased by a total of three baboons (n = 25). The troop averaged 24.8 ± 1.7 (range: 22 to 29) individuals over 49 months (**Fig. 5.2**). The troop had an average of 5 deaths and 6 births per year (**Fig. 5.3**). During the third year of the study period, the troop had more deaths (n = 6) than births (n = 4) and thus experienced their lowest annual troop size (n = 23 baboons). The troop had an adult sex ratio ranging between 1:9 (male: female) at the start of the study, to 1:2.3 at the conclusion, with an average of 1:4.5.

Injury and mortality

Of the 20 mortalities during the study period, 70% (n = 14) died of known causes, 20% (n =4) were assumed based on circumstantial evidence, and 10% (n = 2) could not be determined due to their disappearance. When an infant in previously good health was discovered to have died without any visible injuries associated with infanticide, dog attack or motor vehicle collision, the cause of death was presumed to be natural. Most deaths (75%, n = 15) were attributed to anthropogenic causes (**Fig. 5.4** & **Fig. 5.5**), with vehicle collisions the leading cause (55%, n = 11) (**Fig 5.6**) followed by dogs (15%, n = 3) (**Fig. 5.7**) and people (5%, n = 1). Natural causes were the second most common form of mortality (15%, n = 3) with three baboons dying of unknown causes. In addition to the two baboons killed directly by domestic dog attacks, a dog attack was also the proximate cause of death for one infant following the death of his mother when he was 3 months old, which is within the dependent stage of development. After the death of his mother, he was adopted by a high-ranking lactating female with her own infant of the same age. The female allowed the adopted infant to nurse and was regularly observed allowing him to ride on her dorsum and ventrum together with her own infant (**Fig. 5.8**). Despite this, the infant failed to thrive and four months after his biological mother's death, following a brief period of emaciation and weakness caused by the female's cessation of nursing for both infants, he disappeared. Four additional baboons (one subadult male, one adult male, and two adult females), were attacked by dogs on three separate occasions during the study period.

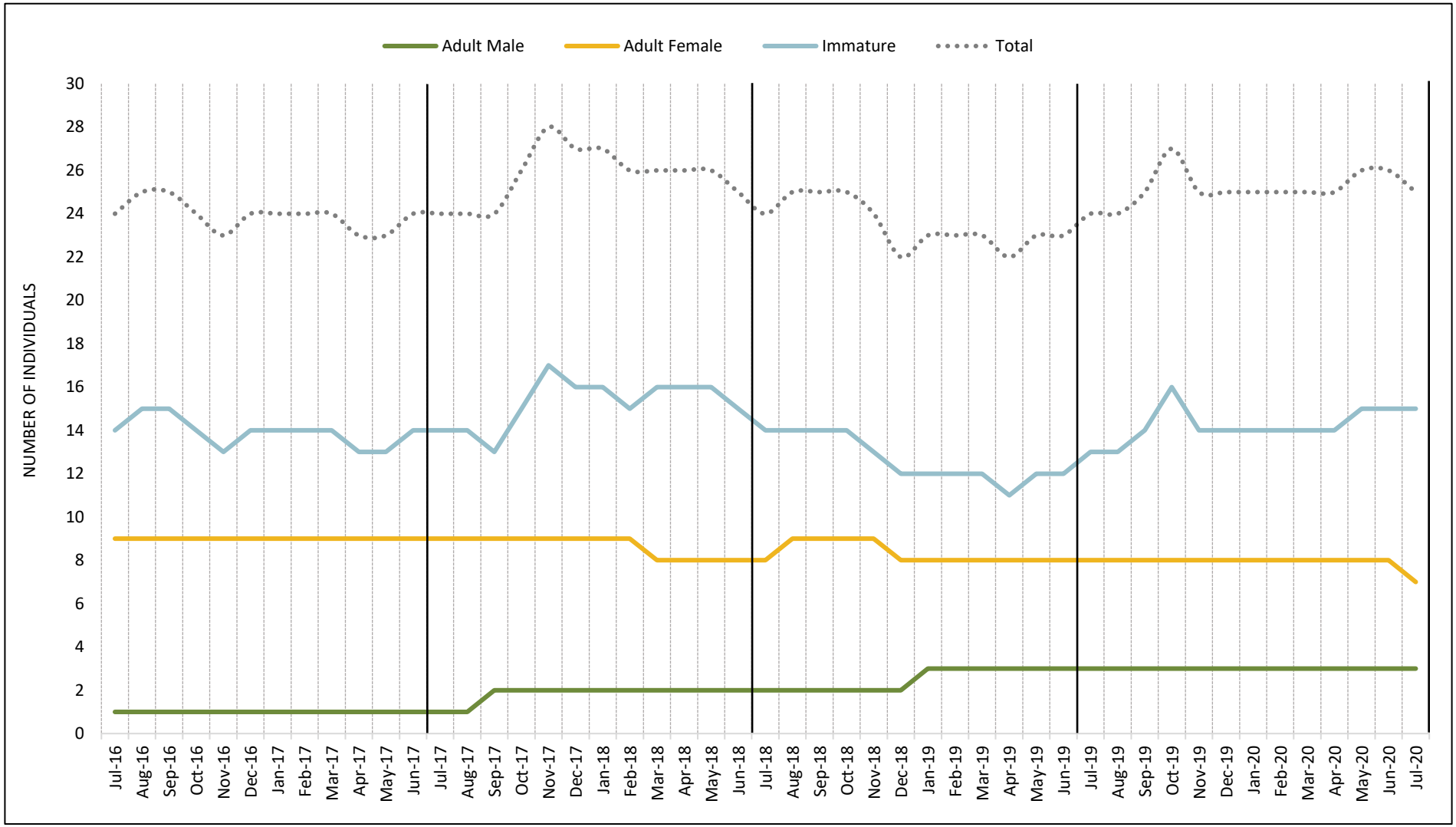


Figure 5.2. Changes in the composition of the Rooiels troop over 49 months. Infants, juveniles and subadults are classified as immatures. Immature females were reclassified as adult after their first birth. Two natal males were added to the adult male category as they remained in the troop after reaching sexual maturity. Bolded vertical lines represent study years.

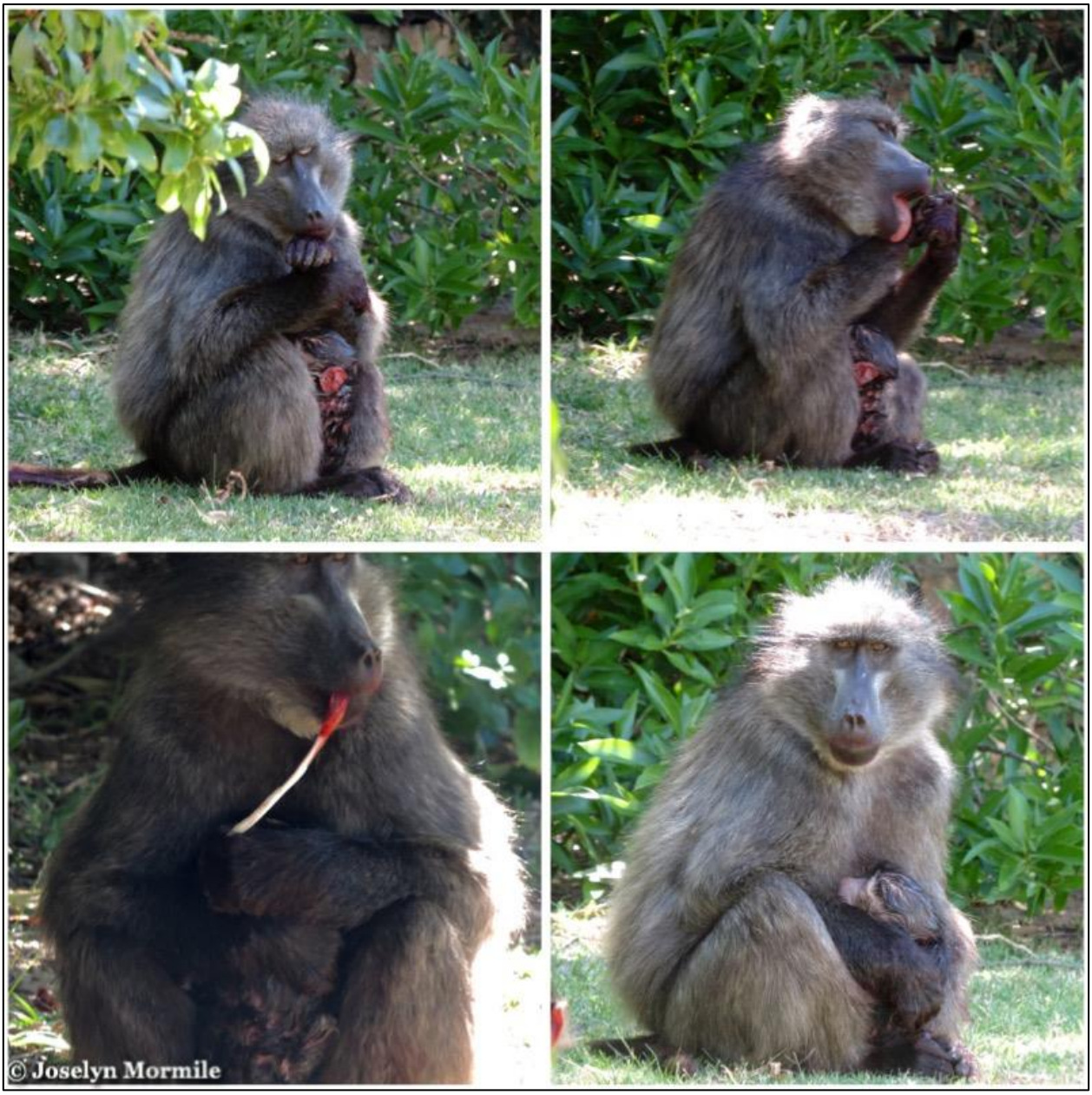


Figure 5.3. Adult female (BA) gave birth to infant (BO) in a resident's garden. Images by Joselyn Mormile.

Despite extensive injuries, they survived with no visible permanent disabilities. All incidents involving dogs in this study took place on just two properties (Property A = 1 mortality and 4 injuries; Property B = 1 mortality). One adult female, who was attempting to retrieve her juvenile offspring who was being attacked by a dog (Property B), was bludgeoned with a pole by a Rooiels resident. This female and her juvenile were subsequently euthanised due to their injuries. One elderly adult female (~20 years old) was euthanised after suffering a severely broken arm and leg, likely resulting from a motor vehicle collision, but as this could not be confirmed, her death was classified as unknown. One juvenile male in seemingly good health disappeared for unknown reasons.

Infant mortalities accounted for 75% of all deaths in the troop. The infant survival rate to one year of age was 44.4% (n = 27). The average age at death was 4.2 ± 2.9 months for those whose exact age was known (n = 14). Anthropogenic causes accounted for 80% of infant deaths (**Fig. 5.4**). The leading cause of infant mortality was road accidents on the R44. In addition to the recorded road deaths, three infants were involved in vehicle collisions but survived with no visible permanent disabilities. One surviving infant was subsequently killed in a vehicle collision a few months later. The average age of infants involved in vehicle collisions was 5.5 ± 2.6 months and the average age of infants killed in collisions was 5 ± 2.4 months.

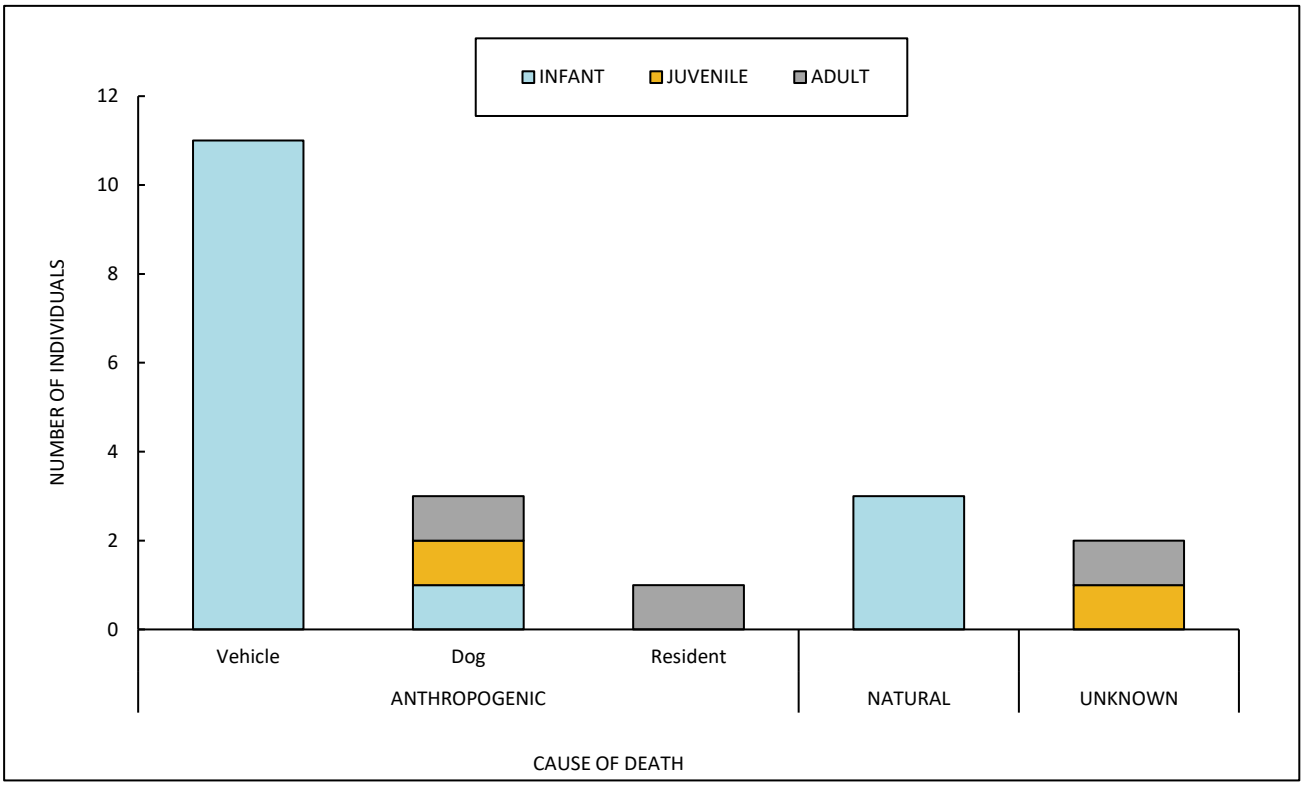


Figure 5.4. The total number of individuals that died and their cause of mortality over 49 months. Deaths were categorized into three groups, namely anthropogenic, natural, and other. Infants are defined as under one year of age.

Figure 5.5. Adult female (NO) with broken left arm after suspected motor vehicle accident (left), fracture of NO's radius and ulna visible on postmortem (middle top), adult female (VA) with infant (VM) after he was killed by a vehicle (top right), adult female (BA) after she was bludgeoned by a resident (middle bottom), adult female (MA) carrying infant (MW) several days after she was killed by a vehicle (bottom right). Images by Joselyn Mormile.

Figure 5.6. Baboons on the R44 highway (top left), adult female (CA) with infant (FL) killed by vehicle (top right), adult female (RE) with infant (RO) injured by vehicle (middle right), adult female (SA) with infant (SS) killed by vehicle (bottom right), adult female (SA) with infant (SQ) killed by vehicle (middle bottom), adult female (MA) carrying infant (MC) in her mouth several days after he was killed by vehicle (bottom left). Images by Joselyn Mormile.

Figure 5.7. Adult female (FU) with infant (FR) shortly after dog attack in March 2019 where she suffered a broken arm (top left), visibly stressed FR sitting with his resting mother shortly after dog attack (top middle), FU attempting to clean her broken arm weeks after the attack while her infant watched (top right), FU walking along the boundary wall of the R44 with her infant riding dorsally, with no use of her broken arm (bottom left), after FU was euthanised in April 2019 (bottom middle), closer inspection of the broken arm post-euthanasia revealed a fully broken humerus and necrotic tissue (bottom right). Following FU's euthanasia, FR was adopted by BA (see Fig. 5.8). Images by Joselyn Mormile.

Figure 5.8. Adult female (BA) with biological infant (BO) and surrogate infant (FR). After a four-month long surrogacy, FR disappeared after appearing emaciated and weak for a brief period of time following BA weaning him from nursing. BA was eventually killed by a resident and BO was killed by a dog during the same incident. Images by Joselyn Mormile.

Female reproductive success

Eight of the ten adult females lost at least one of their offspring during the study period (range: 0-4 infants). There was no significant relationship between female rank and offspring survival ($H_{(14)}$ = 8, p = 0.08177), but females of lower rank had slightly more surviving offspring (**Fig. 5.9**).

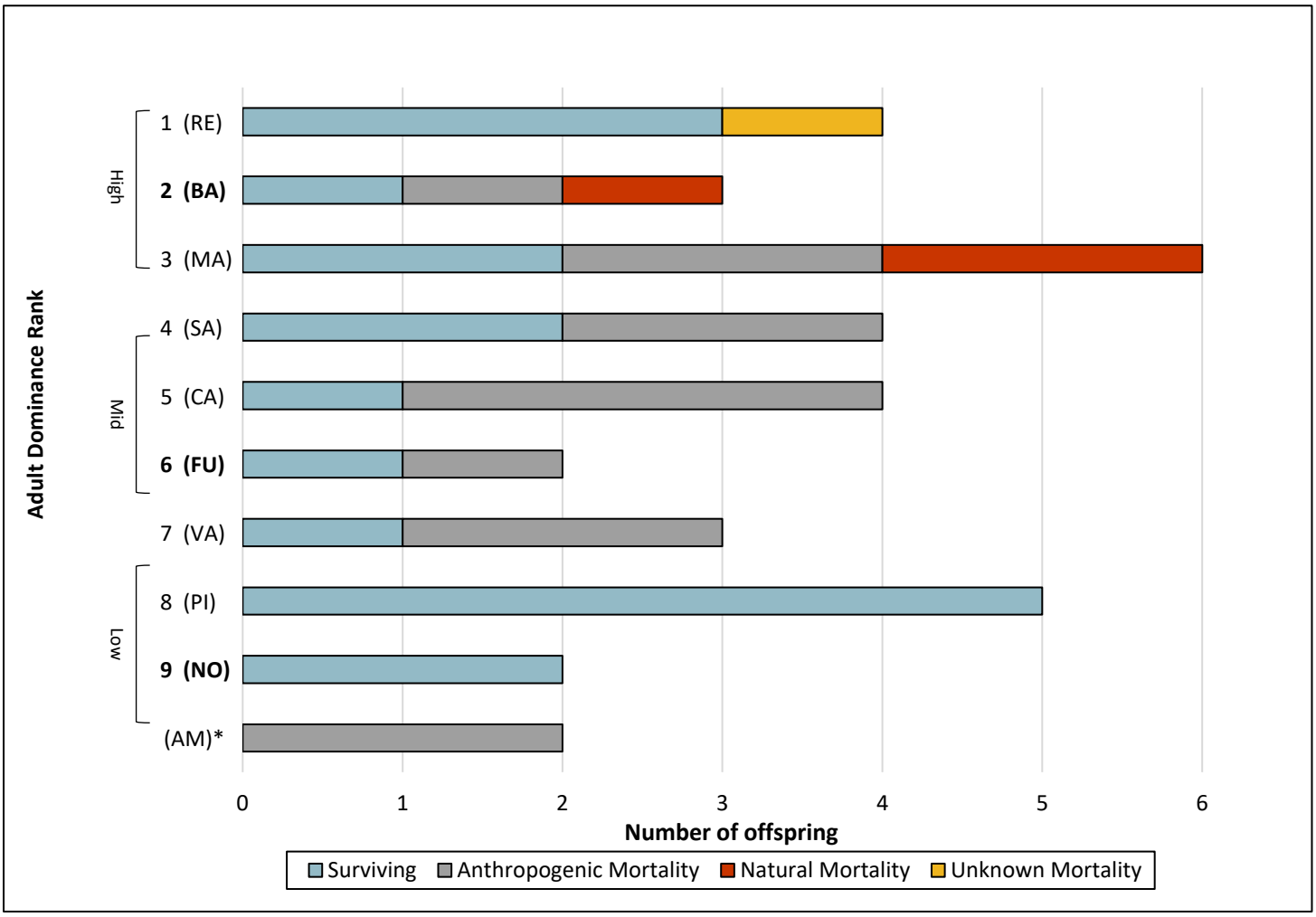


Figure 5.9. The number of offspring that survived or died for each of ten adult females in the Rooiels troop over 49 months. Individual females are listed in descending order of dominance rank (1-9) with their identity code in parenthesis. Individual females in bold died during the study. *AM was not included in the dominance ranking as she had not reached adulthood during the behavioral observation period.

Similarly, female rank did not impact the likelihood of anthropogenic offspring mortality ($H_{(9.5)} = 6$, $p = 0.1473$), but only high-ranking females lost offspring to presumed natural causes, all of which occurred less than one month after birth (Figure 1.4). Excluding the effects of infant mortality, the average lactational period was 10.7 ± 2.6 months (n = 3 females, n = 6 infants) and the average interbirth interval (IBI) was 20 ± 1.0 months (n = 3 females, n = 4 infants). The alpha female had a shorter average lactational period and IBI than both low and mid ranking females (**Table 5.1**).

Table 5.1. Average lactational period and interbirth interval for the three adult females of differing social rank with surviving consecutive offspring where exact birth dates were known.

ID	Dominance Rank	Average Lactational Period (months)	Average Interbirth Interval (months)
RE	High	7.6 (n = 3)	18.5 (n = 2)
SA	Mid	14 (n = 1)	21.3 (n = 1)
PI	Low	10.6 (n = 2)	20 (n = 1)

Adult male recruitment and alpha male tenure

The alpha male (CL) at the onset of the study had a tenure of 40 months, beginning in December 2015 (J. Stark, pers. comm., 2022) and ending in March 2019. In January 2017, an adult male (CR) joined the troop without any observed overt aggression toward the alpha male or the rest of the troop. CR made no observed attempts to challenge for alpha status and emigrated after four weeks. An attempted immigration was made by an adult male on the outskirts of the Rooiels village in April 2018, but he abandoned his attempts after a week due to continued aggression by CL. Natal adult male CH was observed emigrating in September 2018 to the neighboring Gordon's Bay troop. Beginning in October 2018, natal adult male IN began spending more time on the periphery of the troop, but regularly visited with the core of the troop to partake in social interaction. In March 2019, natal adult male (BE) took over alpha male status from CL who remained with the troop.

5.4 DISCUSSION

Troop size

The average size of the Rooiels troop over the study period was similar to those of neighbouring baboon troops (mean = 26.5, range = 17 - 43, n = 8 troops: Human Wildlife Solutions, 2021), but smaller than the average size of troops in other coastal areas in the Western Cape (mean = 37.6, range = 16 – 115, n = 9 troops, Hoffman & O'Riain, 2012). Despite the birth of twenty-four infants over the course of the study, the troop size only increased by three individuals with an average annual birth to mortality ratio of 6:5. Given the high rate of infant mortality and the reduction in the number of adult females in the troop (two died and one became anestrous) the troop is predicted to remain constant or decline in the near future.

Sex ratios

At the start of the study, the troop had an adult sex ratio of 1 male:9 females which is highly skewed compared to troops solely ranging in natural habitat (1 male:2-3 females; Henzi et al., 1999) but similar to those in the Cape Peninsula before management interventions were implemented (Kansky & Gaynor, 2000). Adult males in peri-urban areas of the Cape Peninsula are more likely to enter houses for food and thus more likely to be killed either indirectly (e.g., dogs) or directly (e.g., guns) by residents (Kansky & Gaynor, 2000; van Doorn & O'Riain 2020). There is anecdotal evidence of historical persecution of adult males in Rooiels (J. Stark, pers. comm., 2018) because they are bolder and more likely to enter houses with people and hence were perceived by residents to be a greater threat to safety (Mormile & Hill, 2016). Adult male baboons are more likely to be subject to retaliatory attacks in rural areas as well (Lee & Priston, 2005). However, I cannot discount the potential impacts of a skewed sex ratio at birth in previous years (Silk, 1983), an increased maturation rate of females

compared to males in response to high-quality food availability (Samuels & Altmann, 1991), potential exclusion of immigrants to protect a highly valued ranging area (Hoffman & O'Riain, 2012), or a combination of these factors. Following the death of three adult females, and the recruitment of one natal female to the adult age class, coupled with the maturation of two males to adult status, the troops adult sex ratio approached the recognized norm for the species of 1 adult male to 2.3 adult females (Henzi et al., 1999) by the end of the study period.

Interbirth intervals

Interbirth intervals for females whose offspring attained nutritional independence (mean = 20 ± 1.0 month) were similar to those in exclusively natural foraging troops (20.9 ± 3.8 months, Gesquiere et al., 2017). The average lactational period for the Rooiels females (10.7 ± 2.6 months) was also similar to free ranging troops in natural habitat (10.9 ± 2.8 months, Gesquiere et al., 2017). Together these data do not suggest a positive impact on fecundity associated with urban space use in baboons. Only the alpha female in the Rooiels troop had a shorter lactational period and interbirth interval compared to the other females and as revealed in Chapter 3, she also monopolized access to a provisioning site in the village. Access to high quality resources allows high ranking females to wean infants sooner than their lower ranking peers (Cheney et al., 2006). However, as only three adult females successfully raised consecutive infants in this study, I could not explore the relationship between rank and fecundity statistically, nor could I explore the established link between fecundity and female age (Cheney et al., 2006; Strum & Western, 1982). Primiparous females, who are typically young, often exhibit longer lactational periods and IBIs due to a combination of both inexperience in foraging while rearing an infant and caloric investment in reaching their maximum potential body size (Gesquiere et al., 2017). The mid-ranked Rooiels female was a young adult who had given birth to only one infant prior to the study period, which died at four months of age. The alpha female and low-ranked female were both multiparous mothers of middle age, which has been shown to be the most efficient period of a female's reproductive life (Gesquire et al., 2017).

Causes of mortality: predation

Despite the birth of twenty-four infants during the study period, the troop only increased in total size by three individuals, with most deaths (75%) occurring in the infant age class. Longitudinal studies of baboons in natural habitats have found similar trends in age-linked mortality with most deaths attributed to infants under one year of age (Altmann, 2001; Cheney et al., 2006). However, infant mortality was exceptionally high in the Rooiels troop (66%) and mostly attributed to anthropogenic causes (80%), compared to troops living in natural environments where infant mortality is typically much lower (e.g., 28%, Altmann, 2001; 20 - 45%, Bulger & Hamilton, 1987; 38%, Cheney et al., 2006; 38 - 41%, Palombit et al., 2000) and predominantly attributed to infanticide and predation.

Leopards routinely predate baboons in the Western Cape (Mann et al., 2019) and throughout South Africa (Jooste et al., 2013). An ongoing camera trap survey (Cape Leopard Trust and Rooiels Conservancy, 2013 – present) in the natural habitat surrounding Rooiels has confirmed the presence of leopards in the immediate Rooiels area with occasional rare sightings within the village itself (D. Blake pers. comm., 2016). A leopard predation of a baboon from a neighboring troop was observed just outside the Rooiels village shortly after this study ended (HWS, September 2021) but only one death in the Rooiels troop could potentially be attributed to a predation event, viz., the disappearance overnight of a healthy young male. Foraging in the village almost certainly reduces the availability of the troop to leopard predation during the day but because the troop sleeps exclusively in natural habitat outside the village they remain vulnerable to predation when commuting to and from their sleeping sites. The limited evidence of leopard predation for this troop is thus more likely a function of the low density of leopards in the Overberg (Hinde, 2022) and/or preference for less risky prey in the area, such as small antelope, which typically compromise a larger portion of their diets (Mann et al., 2019).

Causes of mortality: infanticide

Infanticide is a pervasive threat to infants associated predominantly with a change in the alpha male position within a troop (Palombit et al., 2000; Zipple et al., 2017). Alpha males achieve greater mating success and sire more offspring than other adult males in a troop (Alberts & Altmann, 2006; Palombit et al., 2000). The average tenure for an alpha male is typically brief (e.g., 5-6 months (Hamilton & Burger 1990), 6.5 months, Palombit et al., 2000), although this can vary with geographic location (e.g., mountain-dwelling chacma baboons: ~20.5 months (Weingrill, 2000)) and species (e.g., Kinda baboons (*Papio kindae*): 16 – 40 months (Petersdorf et al., 2019)). Critical to improving access to receptive females is thus terminating lactational amenorrhea (Palombit et al., 2000) which is best achieved by killing the infants of lactating females. Estimates of infanticide in solely natural living troops range from 23 – 70% (Cheney et al., 2006) and 31 - 76% (Palombit et al., 2000) suggesting it is a major cause of infant mortality. While not all new alpha males commit infanticide (Palombit et al., 2000), the probability increases with each takeover and prolonged periods of alpha stability may limit infanticidal threats.

The alpha male for most of this study (CL) held tenure for a period of 40 months, which is up to six times longer than the average for alpha males in other recorded troops, before being replaced by a natal younger adult male (BE) towards the end of the study period. During the research period only one male immigrated into the troop, but he did not challenge CL for alpha status and emigrated soon after. While females mated with natal males of reproductive age classes in the troop, CL typically

monopolised mating opportunities during the females' peak estrus states, as is characteristic of alpha male chacma baboons (Bulger, 1993; Palombit et al., 2000). His presumed siring of all offspring in the troop and low competition from natal and immigrating males negated the need for infanticide. Infanticide was also not carried out by BE following his takeover as alpha male despite that he was unlikely to have sired existing infants in the troop. Possible relatedness to existing infants, albeit distant, may have been a contributing factor to the absence of this behaviour. Though infanticide by natal alpha males has been documented, it remains understudied and poorly understood (Palombit et al., 2000). The absence of infanticide in this troop despite the general prevalence in the species reinforces the conclusion that this behaviour is highly variable and may be conditional on factors such as environment, extent of male competition, food availability, and personality (Itani, 1982; Palombit et al., 2000; Swedell & Saunders, 2006; van Schaik & Janson, 2000).

Causes of mortality: natural and inbreeding

In baboon social systems, males of reproductive age typically disperse from their natal troop to avoid inbreeding (Alberts & Altmann, 1995). Research on various species of wildlife indicates that inbred infants, particularly those of close relatives, exhibit a higher likelihood of death in early infancy than outbred infants (Pusey, 2018; Ralls & Ballou, 1982; Ralls et al., 1988). Three of the fifteen infant deaths were presumed to be the result of natural causes. As these infants had not sustained any visible injuries, were less than one month old at the time of death and were born to two females with adjacent rank and therefore possibly sisters, hereditary defects due to a close genetic relationship with the sire of their offspring may have been responsible. While the natal origin of the likely sire of these offspring (former alpha male, CL) is unknown and thus hereditary defects due to inbreeding cannot be confirmed, the current alpha male (BE) is a known natal male and thus there is presently a high likelihood of close inbreeding in the troop.

Causes of mortality: human-induced

Human-induced deaths accounted for 75% of all mortalities in the Rooiels troop and 80% of females lost at least one infant or juvenile during the study to this cause. Similarly, human-induced deaths were high for baboons in the Cape Peninsula accounting for 58% of all deaths over a three-year period during which baboons had regular access to urban areas (Beamish & O'Riain, in press). However, once baboons were more effectively kept out of urban areas, human-induced deaths dropped to 30% over a similar period of three years (Beamish & O'Riain, in press). These data reveal that spatial overlap with urban areas is strongly associated with higher levels of baboon mortality that exceed rates for troops living in natural habitats.

Human-induced mortality: roads

Most human-induced mortalities in the Rooiels troop were the result of motor vehicle collisions. The R44 highway runs through much of the troop's home range (Chapter 2). The road has high traffic volumes, many blind corners, and a speed limit of 80 km/h in most areas (NB: this was reduced to 60 km/h after the study concluded). As the road approaches the Rooiels village from both directions, it widens slightly to include a shoulder where the troop often rests and socializes in the morning. The speed limit in this section is reduced to 60kmh, however speed cameras recorded an average of more than 100 motorists per day exceeding the speed limit over a five-hour trapping session along the stretch of road that traverses the village (K. Philips, pers. comm., 2019). The troop routinely crosses this road to enter and leave the village resulting in frequent exposure to fast moving vehicles. This high rate of road mortality is unsurprising given that motor vehicle collisions are a leading cause of anthropogenic-induced wildlife mortality in the Cape Peninsula (Leighton et al., 2022a; Okes, 2017), throughout South Africa (Periquet et al., 2018) and globally (Barrientos et al., 2021). Primates are no exception and road mortality has been documented as a significant contributing factor to anthropogenic causes of death for various species of primates (Cunneyworth & Duke, 2020; Hetman et al., 2019; Linden et al., 2022).

Only infant baboons were confirmed to be killed by motor vehicles in this study with most deaths occurring around five months of age. Infant baboons start to become more independent and increase their distance from their mothers at five months (Altmann, 2001). When this growing independence is coupled with their mothers resting on or near the road, there is a high probability of infants being struck by vehicles. There was no effect of mother rank on the likelihood of losing an offspring to anthropogenic causes. Interestingly, no infants over the age of nine months, juveniles, subadults, or adults were confirmed to have been involved in motor vehicle collisions during the study period. This is likely to be a combination of an increased awareness of the dangers of the road in combination with improved agility and strength, allowing them to be more aware of vehicles and better at taking evasive action. The cause of injury and subsequent euthanasia of one adult female was suspected to have been due to a motor vehicle collision. It is likely that her advanced age and poor body condition (Mormile unpublished data, 2020) significantly limited her ability to rapidly navigate the road.

One may assume that mothers who have lost offspring to motor vehicle collisions would perceive the road or vehicles to be dangerous for future offspring. However, of the five females who lost infants to road accidents, all had lost more than one infant sequentially to motor vehicle collisions. This suggests that these mothers are not acquiring enough information from the loss of their infants to vehicles to consider vehicles or roads as threatening to their offspring. There is no evidence to suggest that coaching or active teaching of immature baboons by mothers, or any other troop members, takes place

in baboon societies (Alberts, 2019) as it does in other species of primates and wildlife (Hoppitt et al., 2008). This limits the spread of vital information from mothers to offspring as well as amongst troop members. Baboon theory of mind suggests a potential further obstacle to females' ability to adapt to roads and vehicles in that research suggests they possess only a vague intuition about the intentions of other individuals as opposed to a highly developed ability to recognize and understand the state of mind of others, as is found in humans (Cheney & Seyfarth, 2006).

Cheney and Seyfarth (2007) describe numerous occasions where baboon mothers left their infants behind to cross rivers on their own. River crossing is inherently dangerous due to the risk of attack by various predators as well as drowning. Infants and juveniles showed heightened levels of anxiety associated with river crossing and continually called for their mothers. However, the mothers did not return to retrieve their offspring. They were seemingly unable to perceive the situation as anxiety-inducing or dangerous for others, presumably as they themselves had made it across safely. Alternatively, these females may be prioritizing their own survival over that of their dependents. As motor vehicle deaths in this study involved infants exclusively, this suggests that adults can more reliably navigate roads and vehicles. As such, these mothers may be unable to conceive that their infants would be unable to do the same. Baboons' limited theory of mind and difficulty in categorizing roads or vehicles as novel predators unfortunately predicts that accidents in this area will continue.

Human-induced mortality: dogs

Domestic dog attacks were the second leading cause of death in the Rooiels troop. Similarly, attacks from domestic dogs were a leading cause of injury and mortality in urban baboons of the Cape Peninsula (Beamish, 2010; Fehlmann et al., 2017), other species of urban-dwelling primates including langurs (*Trachypithecus vetulus nestor*) (Sinha & Vijayakrishnan, 2017), howler monkeys (*Alouatta guariba clamitans*) (Chaves et al., 2022) and other neotropical primates (Ehlers et al., 2021), as well other urban wildlife species worldwide (Bateman & Fleming, 2012, Holderness-Roddam & McQuillan, 2014). The behaviour of domestic dogs towards baboons can be highly variable with some ignoring baboons and others displaying overt aggression. Dog attacks in this study all involved dogs that were contained by boundary fences on resident properties. The dogs on the two properties where baboons were attacked behaved outwardly aggressive towards baboons when they traveled and foraged near these properties. Direct observations revealed the troop actively avoided both properties when the dogs were visible and barking. Thus, while baboons typically avoid interactions with aggressive dogs, they will still take risks and enter such properties, presumably when food rewards are potentially high (e.g., windows open with food on display) and the dogs are not visible.

Human-induced mortality: people

Research from the Cape Peninsula has shown that baboon troops that frequent urban areas experience high rates of intentional human-caused injuries and deaths (Beamish, 2011). However, despite the almost daily presence of the study troop in the Rooiels village, only one mortality was attributed to direct, intentional human action. This difference is likely attributed to a complex suite of social differences between residents in Rooiels and the Cape Peninsula, including better education and awareness and an understanding that residents are living in an urban conservancy (Chapter 6).

Evolutionary trap

The findings of this study challenge the assumption that sharing urban space is in the best interests of baboons. Baboons prefer low-lying land where food and water resources are typically more abundant (Hoffman & O'Riain 2011, 2012) but which are more likely to be transformed for agricultural and urban uses. Rooiels offers baboons access to the coastal plain and anthropogenically modified habitat in the form of landscaped and watered gardens, and provisioning of human-derived foods either deliberately or accidentally when baboons gain access to houses and waste sources (Chapter 3). Additionally, time in town reduces the probability of an encounter with natural predators and wild adult male baboon immigrants both of which would be unlikely to follow the troop into a human-modified landscape. Thus, the two most common causes of mortality for troops solely living in natural habitats (i.e., predation and infanticide) are greatly reduced when utilising urban areas. This combination of increased resources and reduced threats may explain why the Rooiels troop preferentially selects for this portion of their home range. But at what cost?

The use of human-dominated landscapes results in high rates of accidental or intentional human-induced deaths (Nyhus, 2016) as has been seen for many species, including baboons (Beamish, 2010), caracals (Leighton, 2021), African wild dogs (*Lycaon pictus*) (van der Meer et al., 2014), and brown bears (*Ursus arctos*) (Lamb et al., 2017), amongst others. Due to the community's acceptance of sharing space with the troop, most of the mortalities that took place during the study period were not intentional or retaliatory but were linked to the baboons' presence in an urban area. As a result of the high level of anthropogenic mortality associated with the troop's use of the village, Rooiels offers short term rewards with long term adverse consequences.

These data suggest that baboons sharing space with people in an urban context qualifies as an 'evolutionary trap'. Schlaepfer et al. (2002), coined the term 'evolutionary trap' to describe a wide-ranging set of situations in which a formerly reliable behavioral cue (e.g., what to eat, where to live) becomes maladaptive due to anthropogenic disturbance, thus negatively impacting an organism's survival or fitness. While baboons are one of the most adaptable mammal species and routinely exploit

human-developed landscapes, the high mortality rate in Rooiels may be evidence of the baboons' inability to accurately judge novel complex risks associated with these productive landscapes. Evolutionary traps are often associated with human activity, such as urbanization, because the rate of landscape alteration occurs more rapidly than an animal's behavioural cues evolve (Lamb et al., 2017). In Rooiels, motor vehicle collisions resulted in high mortality rates, but the troop continued to cross the road to enter the village on a near daily basis (Chapters 2 and 3). Similarly, despite the repeated occurrence of dog attacks, the presence of dogs did not deter the troop from visiting the village or even properties with dogs that have injured and killed baboons previously. As baboons have not evolved alongside urban threats, these threats must be learned through association. This however relies heavily on the consistency of a stimulus in producing a specific outcome as well as a prompt temporal succession from stimulus to outcome (Pearce & Bouton, 2001). Associations are exceptionally difficult to form in this case as vehicles and dogs are both ubiquitous in their presence and unreliable in the degree of risk they pose when encountered. Contrastingly both the threat of and actual incidents of predation have been shown to influence how baboons use their home range in solely natural foraging troops, spending less time in areas where visibility and access to safe refuges is reduced (Cowlishaw, 1997).

An additional long-term cost for Rooiels baboons is the higher probability of inbreeding through limited immigration and emigration. Dispersal is necessary to prevent inbreeding, which is known to reduce the viability of offspring (Pusey, 2018). The availability of attractive food opportunities in their natal range may provide little motivation for young adult males to disperse from their natal troop (Penteriani et al., 2018). Potential immigrant males that are not habituated to urban areas are unlikely to follow the troop into urban areas and if they do, will be at a disadvantage to local males that have already learned to navigate the many novel risks and benefits therein. The frequent retention of young adult males in natal troops and the frequent inheriting of the alpha position in the urban areas of the Cape Peninsula has also been observed (E. Beamish, pers. comm., 2023; NCC, 2023). A potential consequence of persisting in an evolutionary trap may also include inbreeding depression in the long term (Porlier et al., 2009) and this relatively atypical pattern warrants further investigation.

The unpredictability of novel urban threats, in addition to a lack of teaching ability and poorly developed theory of mind in baboons, forecast very little potential for the development of a selection process which favours eventual microevolution to urban landscapes geared at surviving or thriving, as opposed to simply persisting through reactive behavioural modification and chance. This is due to 1) the inability of baboons to accurately gauge the cost to benefit ratio of visiting the village, and 2) the heavily concentrated mortality within the infant age class. If the behavioural adaptation(s) which favored the parent's survival does not result in offspring which survive to reproductive age, the

potential for increased fitness of the parent is never realized and thus the behaviour is not truly evolutionarily advantageous, and the parent's adaptation, however successful in the short term, subsequently dies with them. Over millennia, baboons have evolved remarkable strategies to counter ever-present causes of mortality such as social cohesion to prevent predation and female reproductive strategies to prevent infanticide. Selection should in theory favour baboons that avoid enticing urban landscape traps as a whole. This is, however, discouragingly unrealistic given that the characteristics which lure them so easily into traps largely define them as a species. Furthermore, given the rapid rate of land transformation, baboons and many other species of wildlife are likely to be driven to endure limited survival in the urban landscape over the prospects of heightened competition for the limited and shrinking natural space.

The Rooiels community has demonstrated a valiant and sustained attempt to harmoniously coexist with baboons through improved education which has led to higher acceptance for their presence (Chapter 4). However, by welcoming the movement and foraging of the troop within an urban area they have unwittingly created the conditions for an evolutionary trap in which short term gains in food, shelter and reduced causes of natural mortality are trumped by excess deaths (particularly of infants) from anthropogenic causes.

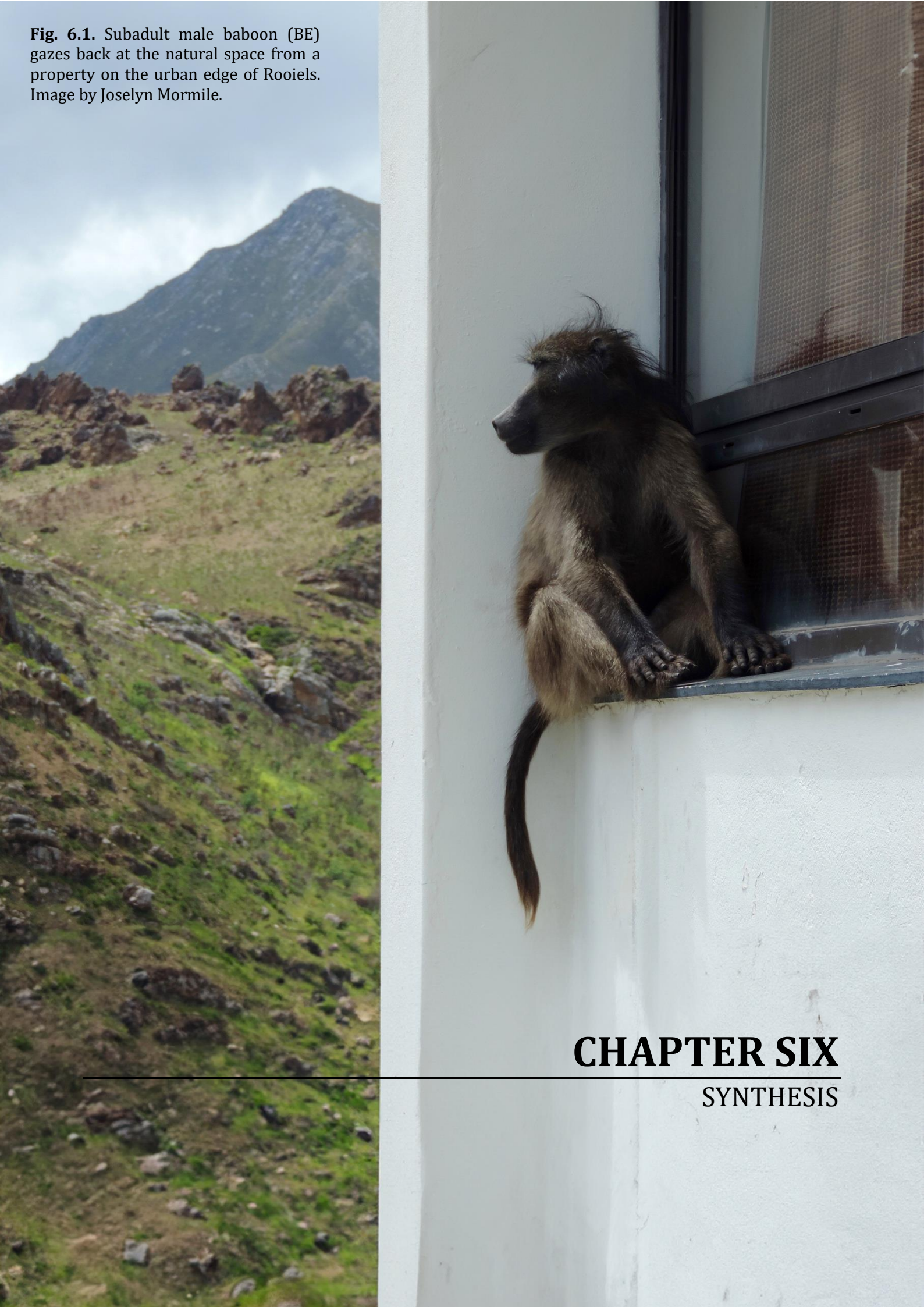


Fig. 6.1. Subadult male baboon (BE) gazes back at the natural space from a property on the urban edge of Rooiels. Image by Joselyn Mormile.

CHAPTER SIX

SYNTHESIS

The ever-expanding human population has driven widespread transformation of natural habitat, particularly for agricultural and urban land uses. Urbanization causes stark landscape changes resulting in the exclusion of most specialist species (Soulsbury & White, 2015) and favouring only a few, mostly generalist species (Fehlmann et al. 2020; Perry et al., 2020). Persistence of wildlife in urban areas is influenced not only by how the physical landscape is transformed, but also by how human inhabitants perceive and act towards them (Brenner & Metcalf, 2020). Research that seeks to understand the impacts of human-modified landscapes on wildlife must thus include the human dimension (Fuentes, 2023). Despite this, studies on wildlife in urban areas represent only a small proportion of all wildlife research (Soulsbury & White, 2015), and those that include the human dimensions of such wildlife lag even further behind (Manfredo, 1989). Importantly, in recent years, research on human-wildlife interactions has been criticised for focusing solely on conflicts with wildlife. Some scholars maintain that this framing, both in terminology (i.e., "human-wildlife conflict") and emphasis, contributes to a combative dichotomy of wildlife acting against humans and underestimates the existence and importance of neutral and positive interactions, which may shed light on ways to achieve coexistence (Bhatia et al., 2020; Hill, 2021).

As dexterous, agile, intelligent, dietary generalists, baboons do not restrict themselves to green open spaces within urban landscapes, as is seen for many wildlife species (Gallo et al., 2017; Gallo & Fidino, 2018). Rather, baboons have learned to access food across the urban matrix including from vehicles, houses, shops, restaurants and even directly from people (Fehlmann et al., 2017; Hoffman, 2011). Baboons thus present unique challenges within the urban landscape, which often leads to them being viewed as competitors, making them an exceptionally difficult species with which to share space (Hurn, 2011). Competition is often associated with negative interactions and in part explains the high levels of human-induced injury and mortality experienced by baboons that frequent urban areas (Beamish & O'Riain, 2014).

Considerable research effort has been made to understand the drivers of urban space use by baboons (Hoffman & O'Riain, 2011, 2012a, 2012b; van Doorn et al., 2010), methods to reduce such overlap (Fehlmann et al. 2023; Kaplan et al., 2011; Kaplan & O'Riain 2015; van Doorn & O'Riain, 2020; Walsh et al. 2023) and the behavioural and physiological consequences of urban foraging (Bracken et al., 2022a, 2022b; Christensen et al., 2023; Fehlmann et al., 2016, 2017, 2020; Johnson et al., 2013, Leith et al., 2020). The implicit assumption by affected communities, that baboons do not belong in urban areas, has been common to this research. By contrast, the Rooiels community have adopted an urban inclusion model where residents accept the sharing of urban space with baboons as commonplace and desirable. For wildlife species that have successfully adapted to human modified landscapes or where such landscapes are being actively modified to encourage the return of wildlife, it is essential to

understand the long-term impacts of sharing space for both wildlife and people. Rooiels presents the first opportunity to explore how baboon behaviour, diet, space use and life history varies for a troop that has access to urban and natural land in addition to exploring the human dimension of this space sharing approach.

The baboons have adapted to and benefit from the village

The most common cause of wildlife entering urban landscapes is a lack of resources in the remaining natural land, forcing animals into overlap with transformed areas (McCleery et al., 2014). The Rooiels troop showed strong preference for the small village area (ca. 1 km2), despite having access to large contiguous tracts of natural land within the biosphere reserve (Chapter 2). Previous research on baboons in this region of South Africa has revealed a preference for foraging in low-lying coastal areas where food resources are more abundant and nutritious (Hoffman & O'Riain 2012c; Lewis & O'Riain 2017). The village of Rooiels is situated on a coastal plain at the confluence of a river and the ocean and thus almost certainly offers more concentrated food resources than the surrounding mountainous terrain. Additionally, frequent human-caused fires in the mountains surrounding Rooiels (Daams, 2006; RERA, 2018) have greatly depleted the standing biomass of plants (Bond et al., 2003), further incentivizing the troop to forage within the village which is protected by active fire suppression.

In addition to abundant natural and exotic plant foods, the village also provides access to provisioned foods and shelter from weather extremes and natural predators. Together these benefits have manifested in an activity budget similar to that of a semi-provisioned troop (Chapter 2) with more resting and less foraging than troops living in natural habitats (Lewis & O'Riain, 2017). It is well established that access to human-derived foods from houses, vehicles and bins provides significant incentives for baboons (Hoffman & O'Riain, 2012c) and other animals to enter the urban space (Bateman & Fleming, 2012; Beckman & Berger, 2003). Surprisingly however, despite regularly visiting the village, the troop rarely accessed human-derived foods, due to the community's awareness and baboon-proofing. It is worth noting that access to these foods increased during the summer months with the influx of baboon-naïve visitors. This study revealed that the troop remains strongly attracted to the village, where they spend considerable time, despite the low inaccessibility of waste and other human-derived foods.

The residents: much more than adapting to baboons

Through extensive community-led education and awareness efforts, the community fostered the concept of sharing space with baboons and adapting human behaviour to be more sensitive to baboons. How did they achieve this and is it possible elsewhere? At the most practical level, residents adapted to the presence of baboons through high levels of baboon-proofing (**Table 6.1**).

Table 6.1. Baboon-proofing by questionnaire respondents (n = 104).

Type of baboon-proofing	Percent
Baboon-proof bins	100%
Baboon-proof window fixtures	94.2%
Baboon-proof door fixtures	66.3%
Strict house rules to prevent entry	90.4%

As the questionnaire respondent below illustrates, the physical act of baboon-proofing was done out of a sense of responsibility to baboons in a shared environment:

> *"The baboons are not a problem, the people are a problem. The baboons are doing the baboon thing and they will come into your house to get food. The people are the problem if they aren't making the efforts to keep their houses baboon-proof. The baboons are clever as they are focused on food and they will get it the quickest, easiest way they can. People must know that and work around that."* – resp. F

In the nearby Cape Peninsula, which supports a government funded urban-exclusion model, residents showed a relatively low rate of baboon-proofing (baboon-proof doors: 40.4%, baboon-proof windows: 58.7% and baboon-proof bins: 77.2%) (Kansky, 2015). Baboon-proofing is beneficial, even in communities with exclusionary models, as it reduces baboon access to attractants and the chance of negative or unwanted interactions on properties should the management model fail to exclude baboons at all times, as is often the case (Bracken et al., 2022a; Fehlmann et al., 2017). This lower level of baboon-proofing may reflect reduced levels of responsibility by residents given there is a full-time service provider employed by the city to keep baboons out of the suburbs. When there are governance structures in place, citizens are less likely to take the initiative in addressing challenges (Wachinger et al., 2013). However, Dickman (2010) reported that people are on average 1000 times more likely to accept risks they assume voluntarily (e.g., sharing space with wildlife) than risks imposed upon them. This important finding cautions against the termination of an exclusion program to keep baboons out of urban areas in favour of an inclusion model where residents are required to accept responsibility for their own properties. In fact, Wachinger et al., (2013) found that even when the reduction of service provision by authorities necessitated increased responsibility by individuals and communities for their own preparedness, the perception that authorities were responsible for the well-being of its citizens remained unchanged, thus likely limiting their willingness to increase their preparedness. This suggests that switching from authority to community run models can result in poor uptake by community members and ultimately a failed program. Furthermore, while baboon-proofing reduces baboon access to houses, it does not prevent baboons from coming into residential areas, as Chapter 2

revealed, and thus the potential for interactions between residents and baboons outside of houses (e.g., in gardens, on roads) remains high.

Table 6.2. Breakdown of respondent participation in baboon-proofing based on wildlife value orientation (WVO) and attitude towards baboons from questionnaire in Chapter 4 (n = 104).

	Has baboon-proof window fixtures	**Has baboon-proof door fixtures**	**Has strict house rules to prevent entry**
WVO			
Mutualist (n = 67)	94%	67.2%	91%
Pluralist (n = 23)	100%	65.2%	91.3%
Utilitarian (n = 14)	85.7%	64.3%	85.7%
Attitude			
Like (n = 73)	94.5%	65.8%	91.8%
Neutral (n = 12)	100%	75%	100%
Dislike (n = 19)	89.5%	63.2%	78.9%

Importantly, baboon-proofing in Rooiels was instituted by most respondents independent of their value orientation or attitude towards baboons (**Table 6.2**). From the perspective of a mutualist resident, baboon-proofing prevents the development of unmanageable challenges with baboons which may lead to unfavourable outcomes for baboons, such as retaliation by fellow residents or lethal removal. From the perspective of a utilitarian resident, baboon-proofing prevents unwanted interactions with baboons which may cause frustration and property damage. A willingness to baboon-proof, regardless of value orientation and attitude, shows that the education and collaboration in Rooiels was able to transcend personal beliefs on sharing space with baboons for a common goal of preventing baboon access to houses. This finding is valuable and suggests that value-framing educational communications, which lead to better outcomes when dealing with negative human-wildlife interactions (Miller et al., 2018), may be useful for larger, more diverse communities living near baboons.

The community went beyond physically adapting houses to prevent baboon entry, however. They showed a high level of acceptance for sharing space with baboons (Chapter 4), where most respondents held a mutualistic wildlife value orientation, which emphasizes care for wildlife and a desire to protect it for current and future generations (Teel & Manfredo, 2010). Additionally, most respondents reported moving to Rooiels to live closer to nature. Together these two factors likely went a long way towards priming residents for an education and awareness program on responsible human

behaviour (e.g., baboon-proofing, vigilance) to prevent unwanted or negative interactions with baboons.

Place attachment, defined as a "positive connection between a person and a particular place" (Giuliani & Feldman, 1993) may also explain high levels of cooperation and responsibility in the Rooiels community. Vaske & Kobrin (2001) describe place attachment "as a component of self-identity which enhances self-esteem and increases feelings of belonging to one's community" and showed that strong emotional place attachment to a natural setting facilitates pro-environmental behaviours. In Japan, residents with poor emotional place attachment to their community, were less likely to secure their homes against macaques despite negative interactions on their properties (Nakamura et al., 2023). A strong sense of community and shared concern for the environment in Rooiels can be found in community communications such as this statement below:

> "Rooielsers came together in the last Century and developed a shared vision of how to conserve our heritage and our village. This reaffirmed the need to support each other in our efforts to protect nature and our way of life... We resolved to strive to be caring and supportive towards each other, and to take responsibility for our priceless natural heritage." – excerpt from Living the Vision (abbreviated), 2017

Place attachment was further cultivated through educational materials and community communications which unwittingly played upon elements of conservation "pride campaigns". Pride campaigns are named as such because they "inspire people to take pride in the species and habitats that make their communities unique" (Butler et al., 2013), as was illustrated in a community statement below:

> "Rooielsers take pride in being a conservation community supporting each other and living within the transition zone of the Kogelberg Biosphere Reserve in the heart of the Cape Floral Kingdom…As part of this heritage, we acknowledge that it is both a privilege and responsibility to live in a biosphere reserve where wildlife, marine life and flora are protected and the integrity of the UNESCO biosphere principles are maintained." – excerpt from Living the Vision (abbreviated), 2017

Contrary to the prior belief that pro-environmental behaviour is largely motivated by individuals seeking to avoid negative emotions such as guilt, Onwezen et al. (2013) showed that people are equally motivated to act in an effort to achieve positive emotions such as pride. Pride campaigns aim to strengthen momentum for conservation initiatives by building enthusiasm and commitment in local communities and individuals (Butler et al., 2013). By utilising the human psychological need to adopt in-group practices, pride campaigns seek to influence group norms to encourage sustainable behaviour (Ellemers & Haslam, 2011). Positive change in communities can be facilitated through initiatives which emphasize desired norms and focus attention on one's group identity (Turner et al., 2008, White &

Simpson, 2013), and such campaigns have been successful (Andriamalala et al., 2013; Butler et al., 2013).

The community characteristics above highlight important elements of the Rooiels culture, which may be best labelled as a culture of stewardship. Stewardship towards wildlife is described by Bhatia et al. (2020) as situations where an individual or community protects a wild animal(s) despite the damage it may cause due to perceived significance of the species (e.g., conservation or cultural value). Bhatia et al. (2020) proposed a typology of ultimate factors which represent the potential underlying mechanisms of human responses to wildlife (**Table 6.3**), which range from manifested intolerance (i.e., negative attitude and negative behaviour towards wildlife) to stewardship (i.e., positive attitude and positive actions towards wildlife) (**Fig. 6.2**). When this typology is broadly applied to the Rooiels community it can be surmised that most residents perceive low levels of risk regarding baboons, experience few negative interactions with baboons, consider baboons to be an asset, hold mutualistic value orientations, exhibit strong community cooperation for the shared goal of preventing negative interactions and, given their moderate to high socioeconomic status, likely have the ability to cope with potential resources lost to baboons (e.g., property damage). These positive factors point to stewardship, which in addition to community characteristics that sustain these principles, culminates in the formation of a stewardship culture.

Table 6.3. The typology of factors underlying human responses to wildlife in the context of the Rooiels community. Table adapted from Bhatia et al. (2020).

Ultimate factor	**Meaning**	**Rooiels community**
Value orientations	A preferred organization of beliefs that mediates an individual's relationship with the society and environment	Respondent wildlife value orientations were mostly mutualistic, which emphasize care and concern for wildlife
Perceptions of risk	Judgements regarding negative wildlife impacts, based on cognitive & affective evaluations	Most respondents were not afraid of baboons and did not consider baboons dangerous
Nature of interaction with the animal	The context in which humans & wildlife interact	The rate of baboon access to houses was low for most of the year (non-holiday period), most respondents allowed baboons onto their properties, considered baboons an asset and had a positive attitude towards baboons
Social interactions	The extent of cooperation, faith & confidence between the individual & the community, & between the community & the managing agencies in dealing with wildlife impacts	The Rooiels community opted to share space with baboons and collaborate as a community to prevent negative interactions through education, awareness, vigilance and baboon-proofing
Resource dependence	The extent of market & non-market dependence on a resource that could overlap with the needs of wildlife	Resident livelihoods do not rely on resources which could be impacted by baboons (e.g., crops). The community is mid to high socioeconomic status and thus likely to be able to compensate for potential damage to property by baboons

The stewardship culture created in Rooiels is likely unique. The replication of a community culture which voluntarily assumes significant personal responsibility for the environment will be extremely difficult to achieve in other communities. Rooiels' conservation culture was founded on the village's location within a biosphere reserve, for which residents act as self-appointed custodians with strong intrinsic motivation (Bennett et al., 2018) that goes far beyond just responsible behaviour regarding baboons. Acts of stewardship can however take place in any community and can produce highly beneficial environmental outcomes (Bennett et al., 2018). There may be potential to encourage a similar incentive for the stewardship of baboons in other areas where human settlements sit adjacent to protected natural areas, such as within baboon-impacted suburbs of the Cape Peninsula that border Table Mountain National Park. It must also be emphasized however, that the Rooiels community is small, consisting of approximately 150 full-time residences. Given the tight social network of the community in which most residents know their neighbours, the impact of social influence to adopt in-group practices was likely a key factor to encouraging pro-environmental behaviour (Abrahamse & Steg, 2013) and community collaboration. Such a degree of social influence will be difficult to achieve in larger, more diverse community networks, which may have less social cohesion, more diverse reasons for living in that area (e.g., proximity to schools and work), and require more community buy-in to achieve stated goals.

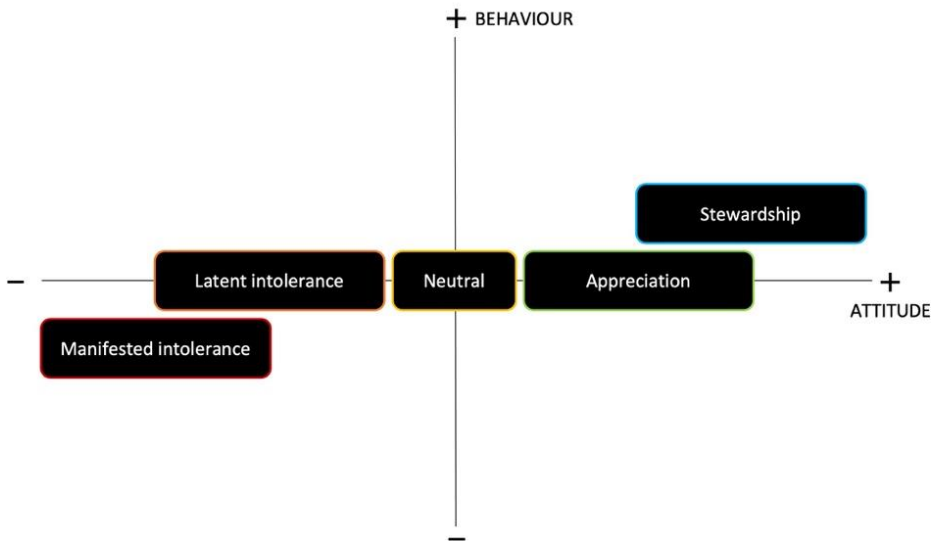


Figure 6.2. Representation of human responses to wildlife on a spectrum from negative attitude and negative behaviour ("manifested intolerance") to positive attitude and positive behaviour ("stewardship"). The Rooiels community exhibits stewardship towards the baboons. Figure adapted from Bhatia et al. (2020).

Limitations to the inclusion model: people

In the summer season, particularly within the summer school holiday period, the extensive efforts made by the community to prevent baboon access to human-derived foods is set back and the culture

of stewardship is diluted. During this time, the troop obtained human-derived foods from houses, vehicles, and bins at a rate over four times higher than during the rest of the year (Chapter 3). This difference can firstly be attributed to an overall increase in opportunities to access these foods as the village has much higher occupancy during this period. More importantly however, these properties are typically occupied by baboon-naïve holidaymakers and visitors who because of limited exposure to the Rooiels culture, baboon-specific education, or personal interest, do not necessarily uphold the same level of acceptance for sharing space with baboons, vigilance, or baboon-proofing, as the average Rooiels resident.

Direct, intentional killing of baboons, which is a common cause of mortality for baboons in other areas of high human-baboon overlap (Beamish & O'Riain, 2014), was not a common cause of mortality in the Rooiels troop (Chapter 5). The only such incident occurred during this holiday period when a property owner, who rarely stays in the village, bludgeoned an adult female baboon with a pole as she attempted to protect her juvenile offspring which was being attacked by the owner's dog. Both the female and juvenile baboon were euthanised as a result of extensive injuries. Resident accounts of the event suggested that the situation could have been prevented had the dog been brought inside when the owner became aware of the proximity of the troop to their property. The individual involved stated they were aware of the presence of the troop on the neighbouring property for several minutes prior to the incident but believed the baboons should have the understanding that their fenced property is unsafe due to the presence of their dog and that their response to the situation was justified in defense of their dog and family. Situations such as these illustrate the negative consequences that exist for baboons when venturing into the complex urban matrix, particularly when residents are naive to, or disinterested in committing to, the high level of proactive behaviour and vigilance essential to the successful sharing of space.

The substantial increase in the rate of access to human-derived foods during the holiday period highlights the strength of community awareness, vigilance, and baboon-proofing by residents in preventing access to human-derived foods throughout most of the year, while also highlighting the fragility of the community's inclusionary approach. The negative impacts on baboons (i.e., reinforcing the nutritional rewards associated with accessing human-derived foods, and death) during the holiday season highlight that Rooiels' inclusion model is only as sustainable as the least baboon-wise, and/or tolerant, human occupant. Furthermore, despite the considerable effort the community has made to create buy-in for their inclusion model, visitors to the village remain a challenge to influence. This brief holiday period is a snapshot example of the limitations which could be expected in an even slightly larger, less tightly knit community.

Additionally, it is essential to note that while the Rooiels community at the time of this study exhibited a high level of acceptance for sharing space with baboons, this support for coexistence is susceptible to change. Given that values shift in response to intergenerational replacement, Bruskotter et al. (2019) states that "we can anticipate new groups (that espouse [existing values] to different degrees) will arise to replace old groups and stimulate discussion, debate, and possible conflict over conservation-related decisions.". In Rooiels these differing views on sharing space with baboons may arise as newcomers move into the community or in light of a significant change in the troop (e.g., increased or assertive focus on accessing human-derived food, significant increase in troop size). Maintaining support for the current status quo is reliant on significant and sustained community education and awareness efforts for both new and existing residents, with an improved focus on holidaymakers and visitors.

Limitations to the inclusion model: R44

Use of the village, which offers increased food resources, protection from natural predators, and thermoregulatory benefits, should ultimately equate to increased fitness and an increase in troop size. However, over the four-year life history data collection period, the troop averaged 24 baboons, which falls on the low end of the range for Cape chacma baboon troop sizes in this region (Lewis & O'Riain, 2017). The fact that the troop's size remained small despite the nutritional and ecological benefits of utilising the urban space was a result of their high mortality rate (Chapter 5). Twenty-four infants were born during the research period, with 20 mortalities, mostly within the infant age class and almost entirely from anthropogenic causes. High rates of anthropogenic injury and mortality, both direct (e.g., shooting) and indirect (e.g., electrocution), are common amongst primate groups living in human-dominated landscapes (Beamish & O'Riain, in press; Cunneyworth & Slade, 2021). While intentional killing of baboons was not a common cause of mortality in the Rooiels troop, most mortalities were linked to the baboons' movement into the village across the R44 highway.

While the R44 runs the entire length of the troop's estimated home range and thus collisions could occur anywhere within their range, the ~800m section of the road that crosses the village features a large blind bend which hinders road-user visibility (**Fig. 6.3**). This section of road was routinely used by the troop to enter and exit the village and was a hotspot for collisions involving baboons and other wildlife (Appendix 6). Though interested residents regularly noted the death of other wildlife species along this stretch of road, baboon mothers typically retrieve and carry their dead infants and thus the rate of infant baboon road mortalities was unknown prior to this study. During this study the community addressed their concerns about the dangers to both wildlife and people posed by vehicles on the R44, to multiple levels of government. Various mitigations to speeding vehicles and potential collisions were proposed including speed bumps, increased signage, and speed cameras, but none of

these proposals have yet been implemented. In consultation with a private roads engineer, the community was informed that a traffic circle at the main entrance to the Rooiels village may be a potential solution to calming traffic, though the viability and costs would need to be investigated (Appendix 6). Unfortunately, the troop's continued commute from natural habitat into the village across the R44 suggests that the high mortality rate in this troop will continue, and likely increase, in response to further housing development in the Overstrand and anticipated greater traffic volumes. The troop's size is thus predicted to remain constant or decline with such low recruitment and the slow attrition of adult females.

As with any approach to wildlife conservation and management, the Rooiels approach should be continually monitored and evaluated to assess long-term trends that may inform management interventions (Stem et al., 2005). I recommend that the current approach of allowing baboons to move freely in and out of the village, where they are repeatedly exposed to the dangers of the blind bend of the R44, is reviewed in light of the findings of this study. Road crossing structures of various designs have been trialed for several species of wildlife (Denneboom et al., 2021). Specifically for arboreal primates, canopy bridges have been found to be successful (Cunneyworth et al., 2022; Teixeria et al., 2013). Road crossing structures for baboons, a predominantly terrestrial species, have not been thoroughly tested, but preliminary research reveals limited use by baboons (Cunneyworth et al., 2022; Linden et al., 2022). Traffic alert systems could be explored including the appointment of full-time road crossing monitors who would alert traffic to the crossing of baboons along the stretch of road which crosses the village, and/or an RFID alert system whereby individual baboons are tagged with sensors that activate warning signs along the R44 when baboons are in the vicinity (Dexter et al., 2016; Viani et al., 2011). Alternatively, the community could investigate R44-specific aversive conditioning or herding techniques implemented by full-time individuals to encourage the troop to cross the R44 more quickly and cohesively and discourage the troop from resting on the road. Finally, attempts to exclude the troop from entering the village as a whole could be considered. The use of field rangers (Fehlmann et al., 2017; van Doorn et al., 2020), baboon-proof electric fencing (Kaplan, 2013), virtual fence systems (Richardson et al., 2017), or a combination of these strategies could be explored. All of the aforementioned suggested mitigation methods come with logistical and financial considerations, the desirability, feasibility, and sustainability of which would require investigation. Importantly, it must be noted that successful reduction of road mortalities may result in an increase in troop size. An increase in the number of baboons visiting the village could increase the potential for negative or unwanted interactions, which could alter the dynamic between residents and baboons in the village.

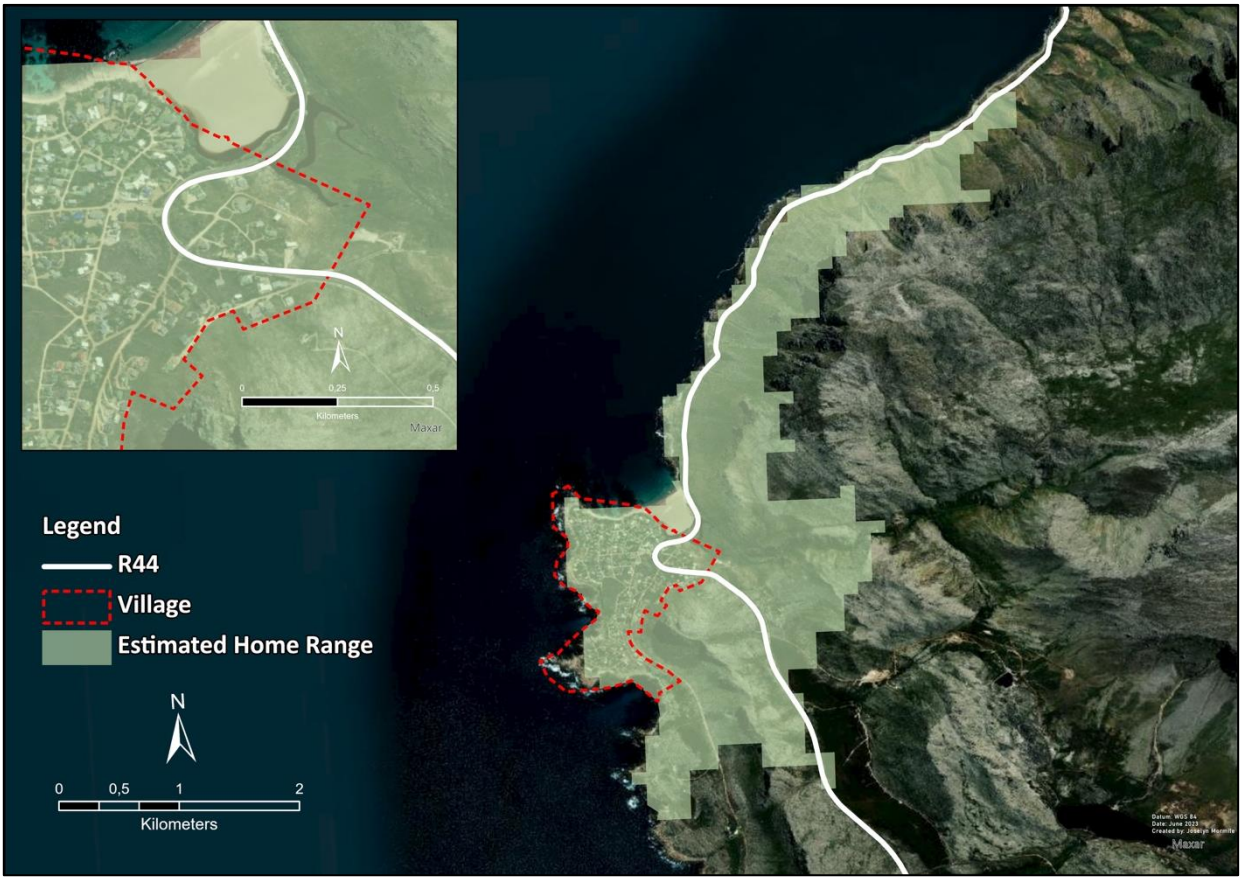


Figure 6.3. The location of the R44 highway in relation to the troop's estimated home range and the blind bend which traverses the village.

Is this coexistence and is it recommended?

I used a modified version of Frank's (2016) definition of coexistence viz., "when a compromise which satisfies the interests of humans and wildlife is negotiated, allowing the existence and persistence of both humans and wildlife in the same space". This definition largely describes the situation in Rooiels where the community has made compromises in the interests of both residents and baboons and where both species share the same space. The Rooiels community has made valiant efforts to promote the acceptance of baboons and as such represents a true outlier on a continent where baboons are widely considered to be pests and are routinely displaced from agricultural and urban land through a variety of lethal and non-lethal methods (Fehlmann et al., 2020). These efforts reveal how psychological and physical adjustments by the community and their urban environment can promote the sharing of resources between competing primate species and how these adjustments allowed the troop to forage naturally within the village with limited negative interactions. Through this approach the community have largely negated the direct human-induced mortalities, which are typically high for troops frequenting urban areas. However, Rooiels remains a human-modified landscape with unpredictable risks and high mortality from indirect factors, namely the R44 highway. Thus, while both people and baboons exist in the same space, viewing the Rooiels inclusion model as successful coexistence is arguably flawed in that baboons are sustaining high levels of mortality linked to humans

which ultimately threatens their persistence. Additionally, it was only through the long-term monitoring of the life history consequences of the Rooiels inclusion model that we learned of the risks to the survival and welfare of the troop members. What we do not yet know are the potential health risks to baboons, people, and pets of sharing space. For instance, studies in the Cape Peninsula have shown that baboons have acquired a variety of human pathogens through their close association with people (Drewe et al., 2012; Ravasi et al., 2012).

Select groups within neighbouring communities have been vocal in the local press and on social media in proposing the Rooiels urban inclusion model as a template for how humans and baboons should interact in all urban areas. However, this opinion was formed in the absence of the knowledge of the true costs baboons face when sharing space with people in urban areas. Rooiels presents the threat of an evolutionary trap for baboons (Chapter 5), and it is highly likely that the same could be said for other urban areas throughout South Africa. Vehicles and dogs, the two main causes of baboon mortality in Rooiels, are ubiquitous in urban areas throughout South Africa and when combined with both direct retributive killings and other sources of indirect mortality common in other urban areas (e.g., electrocution) make for a lethal environment with high welfare harms. Thus, while there is considerable merit to encouraging baboon-proofing and increased tolerance of baboons in urban areas elsewhere, I do not advocate efforts to replicate the Rooiels urban inclusion model in other urban areas of South Africa and suggest that both the origins and evolution of this model are an exception rather than a potential new norm.

Conclusions

This study coincides with a global trend advocating for novel ways in which humans and wildlife can share space (Frank et al., 2019; Pooley, 2021). A principal hindrance to effective environmental protection is thought to have resulted from urban lifestyles, which have created a “separation from nature” (Aminpour et al., 2022; Kareiva, 2008; Turner et al., 2004; Wells & Lekies, 2006). Aminpour et al. (2022) contend that this separation has resulted in an “urbanized knowledge syndrome” where urbanization has caused a decline in peoples’ degree of systems thinking, leading to a reduction in an understanding of the complexities of human-environment interactions. This may result in people oversimplifying their impacts on natural ecosystems, potentially leading to environmentally counterproductive decisions and actions. A call for sharing space with wildlife in urban areas may be a romanticised notion borne of the movement to “reconnect with nature” (Zylstra et al., 2014), which has been reinforced by a global shift in human value systems towards increased mutualism which views humans and wildlife as being able to share space (Manfredo et al., 2020). This shift has appreciably altered the sociopolitical landscape within which conservation decisions are made (Manfredo et al., 2020). A move towards increased space sharing, particularly within the urban context, requires

considerable adjustment by both humans and wildlife, yet how such adjustments will be encouraged, governed, measured, and sustained, remains unclear and contested (Toncheva & Fletcher, 2022).

The basic presence of wildlife within urban landscapes does not imply benefit to the species and many species living in peri-urban and urban areas may in fact be existing in ecological or evolutionary traps (e.g., Boal & Mannan, 1999; Leighton, 2021; Okes, 2017; Penteriani et al., 2018), which are likely underreported (Battin, 2004). It must thus be acknowledged that by encouraging wildlife to use urban landscapes, one type of risk to wildlife (e.g., human-induced mortality) will likely be accepted in avoidance of another (e.g., reduced natural food availability), with potentially no net improvement, or to further detriment, of the species (Hale et al., 2015). Importantly, while the success of urban inclusion models is not necessarily contingent on the complete absence of negative interactions or wildlife mortality (Pooley et al., 2021), it must be noted that human-induced wildlife injury and mortality is typically associated with extreme suffering for wildlife (Beamish & O'Riain, in press; Paquet & Darimont, 2010). This study has shown that urban communities can learn to adjust their attitudes and behaviour to wildlife in a manner that promotes coexistence, but if space sharing has unintended negative impacts on wildlife, it is misguided to encourage such idealistic initiatives until such impacts are mitigated.

Abidin, Z.A., & Jacobs, M. (2019). Relationships between valence towards wildlife and wildlife value orientations. *Journal for Nature Conservation*, ***49***, 63–68. https://doi.org/10.1016/j.jnc.2019.02.007

Abrahamse, W. & Steg, L. (2013). Social influence approaches to encourage resource conservation: A meta-analysis. *Global Environmental Change*, ***23***(6), 1773–1785. https://doi.org/10.1016/j.gloenvcha.2013.07.029

Ajzen, I. (2014). Attitude structure and behavior. In A.R. Pratkanis, S.J. Breckler and A.G. Greenwald, *Attitude Structure and Function* (pp. 241-274). Lawrence Erlbaum Associates Publishers.

Al-Razi, H., Maria, M., & Muzaffar, S.B. (2019). Mortality of primates due to roads and power lines in two forest patches in Bangladesh. *Zoologia*, ***36***, 1–6. https://doi.org/10.3897/zoologia.36.e33540

Alberts, S.C. (2019). Social influences on survival and reproduction: Insights from a long-term study of wild baboons. *Journal of Animal Ecology*, ***88***(1), 47–66. https://doi.org/10.1111/1365-2656.12887

Alberts, S.C. & Altmann, J. (1995). Balancing costs and opportunities: Dispersal in male baboons. *The American Naturalist*, ***145***(2), 279-306.

Alberts, S.C., Hollister-Smith, J.A., Mutata, R.S., Sayialel, S.N., Muruthi, P.M., Warutere, J.K., & Altmann, J. (2005). Seasonality and long-term change in a savannah environment. In C.P. Van Schaik and D. Brockman (Eds.), *Seasonality in Primates* (pp. 157-196). Cambridge University Press.

Alberts, S.C.& Altmann, J. (2006). The evolutionary past and the research future: Environmental variation and life history flexibility in a primate lineage. In L. Swedell and S.R. Leigh (Eds.), *Reproduction and Fitness in Baboons: Behavioral, Ecological, and Life History Perspectives* (pp. 147-176). Springer.

Alexander, S.M., & Draper, D.L. (2019). Worldviews and coexistence with coyotes. In B. Frank, J. A. Glikman, & S. Marchini (Eds.), *Human–Wildlife Interactions* (pp. 311–334). Cambridge University Press. https://doi.org/10.1017/9781108235730.018

Alexander, S. M., & Lukasik, V.M. (2016). Re-placing coyote. *Lo Squaderno*, ***42***, 37–42.

Altmann, J. (1974). Observational study of behavior: Sampling methods. *Behaviour*, ***49***(3/4), 227–267.

Altmann, J. (2001). *Baboon mothers and infants*. University of Chicago Press.

Altmann, J. & Altmann, S. (1981). Physical maturation and age estimates of yellow baboons, *Papio cynocephalus*, in Amboseli National Park, Kenya. *American Journal of Primatology*, ***1***, 389-399.

Altmann, J., & Alberts, S.C. (2003). Intraspecific variability in fertility and offspring survival in a non-human primate: Behavioural control of ecological and social sources. In K.W. Wachter and R.A. Bulatao (Eds.), *Offspring: The Biodemography of Fertility and Family Behaviour* (pp. 140–169). The National Academies Press.

Altmann, J., & Muruthi, P. (1988). Differences in daily life between semi-provisioned and wild-feeding baboons. *American Journal of Primatology*, ***15***(3), 213–221. https://doi.org/10.1002/ajp.1350150304

Altmann, J., Hausfater, G., & Altmann, S.A. (1985). Demography of Amboseli baboons, 1963–1983. *American Journal of Primatology*, ***8***(2), 113–125. https://doi.org/10.1002/ajp.1350080204

Altmann, S.A. (2009). Fallback foods, eclectic omnivores, and the packaging problem. *American Journal of Physical Anthropology*, ***140***(4), 615–629. https://doi.org/10.1002/ajpa.21097

American Psychological Association. (2023). Emotional stress. https://dictionary.apa.org/emotional-stress.

Aminpour, P., Gray, S.A., Beck, M.W., Furman, K.L., Tsakiri, I., Gittman, R.K., Grabowski, J.H., Helgeson, J., Josephs, L., Ruth, M. & Scyphers, S.B. (2022). Urbanized knowledge syndrome—Erosion of diversity and systems thinking in urbanites' mental models. *Npj Urban Sustainability*, ***2***(1), 11. https://doi.org/10.1038/s42949-022-00054-0

Anderson, A., Lindell, C.A., Moxcey, K.M., Siemer, W.F., Linz, G.M., Curtis, P.D., Carroll, J.E., Burrows, C. L., Boulanger, J.R., Steensma, K.M.M. & Shwiff, S.A. (2013). Bird damage to select fruit crops: The cost of damage and the benefits of control in five states. *Crop Protection*, ***52***, 103–109. https://doi.org/10.1016/j.cropro.2013.05.019

Andriamalala, G., Peabody, S., Gardner, C.J. & Westerman, K. (2013). Using social marketing to foster sustainable behaviour in traditional fishing communities of southwest Madagascar. *Conservation Evidence*, 27-41.

Arrowood, H.C., Treves, A., & Mathews, N.E. (2003). Determinants of day-range length in the black howler monkey at Lamanai, Belize. *Journal of Tropical Ecology*, ***19***(05), 591–594. https://doi.org/10.1017/S026646740300364X

Attwell, T. 2017. *Your place in the Kogelberg*. The Botanical Society of South Africa.

Bagchi, S. & Mishra, C. (2006). Living with large carnivores: Predation on livestock by the snow leopard (*Uncia uncia*). *Journal of Zoology*, ***268***(3), 217–224. https://doi.org/10.1111/j.1469-7998.2005.00030.x

Baker, L.R., Olubode, O.S., Tanimola, A.A. & Garshelis, D.L. (2014). Role of local culture, religion, and human attitudes in the conservation of sacred populations of a threatened 'pest' species. *Biodiversity and Conservation*, ***23***(8), 1895–1909. https://doi.org/10.1007/s10531-014-0694-6

Bargali, H.S, & Ahmed, T. (2018). Patterns of livestock depredation by tiger (*Panthera tigris*) and leopard (*Panthera pardus*) in and around Corbett Tiger Reserve, Uttarakhand, India. *PLOS ONE*, ***13***(5), e0195612. https://doi.org/10.1371/journal.pone.0195612

Barrientos, R., Ascensão, F., D'Amico, M., Grilo, C. & Pereira, H.M. (2021). The lost road: Do transportation networks imperil wildlife population persistence? *Perspectives in Ecology and Conservation*, ***19***(4), 411–416. https://doi.org/10.1016/j.pecon.2021.07.004

Barton, R.A., Whiten, A., Strum, S.C., Byrne, R.W. & Simpson, A. J. (1992). Habitat use and resource availability in baboons. *Animal Behaviour*, ***43***(5), 831–844. https://doi.org/10.1016/S0003-3472(05)80206-4

Barua, M., Bhagwat, S.A. & Jadhav, S. (2013). The hidden dimensions of human–wildlife conflict: Health impacts, opportunity and transaction costs. *Biological Conservation*, ***157,*** 309–316. https://doi.org/10.1016/j.biocon.2012.07.014

Bateman, P.W. & Fleming, P.A. (2012). Big city life: Carnivores in urban environments. *Journal of Zoology*, ***287***(1), 1–23. https://doi.org/10.1111/j.1469-7998.2011.00887.x

Bates, D., Mächler, M., Bolker, B. & Walker, S. (2014). Fitting Linear Mixed-Effects Models using lme4 (arXiv:1406.5823). arXiv. http://arxiv.org/abs/1406.5823

Bateson, M. & Martin, P. (2007). *Measuring Behaviour: An Introductory Guide*. Cambridge University Press.

Battin, J. (2004). When good animals love bad habitats: Ecological traps and the conservation of animal populations. *Conservation Biology*, ***18***(6), 1482–1491. https://doi.org/10.1111/j.1523-1739.2004.00417.x

Baum, A., Fleming, R. & Reddy, D.M. (1986). Unemployment stress: Loss of control, reactance and learned helplessness. *Social Science & Medicine*, ***22***(5), 509–516. https://doi.org/10.1016/0277-9536(86)90016-X

Beamish, E. K. (2011). *Causes and consequences of mortality and mutilation in the Cape Peninsula baboon population, South Africa* [MSc thesis, University of Cape Town].

Beamish, E.K. & O'Riain, M.J. (2014). The effects of permanent injury on the behavior and diet of commensal chacma baboons (*Papio ursinus*) in the Cape Peninsula, South Africa. *International Journal of Primatology*, ***35***(5), 1004–1020. https://doi.org/10.1007/s10764-014-9779-z

Beamish, E.K. & O'Riain, M.J. (in press). Understanding and mitigating conflict between baboons and people in a large city. In J. Wallis (Ed.), Untitled book.

Beckmann, J.P. & Berger, J. (2003). Rapid ecological and behavioural changes in carnivores: The responses of black bears (*Ursus americanus*) to altered food. *Journal of Zoology*, ***261***(2), 207–212. https://doi.org/10.1017/S0952836903004126

Beckmann, J.P. & Lackey, C.W. (2008). Carnivores, urban landscapes, and longitudinal studies: A case history of black bears. *Human-Wildlife Conflicts*, ***2***(2), 168–174.

Beehner, J.C., Phillips-Conroy, J.E. & Whitten, P.L. (2005). Female testosterone, dominance rank, and aggression in an Ethiopian population of hybrid baboons. *American Journal of Primatology*, ***67***, 101-119.

Behr, D.M., Ozgul, A. & Cozzi, G. (2017). Combining human acceptance and habitat suitability in a unified socio-ecological suitability model: A case study of the wolf in Switzerland. *Journal of Applied Ecology*, ***54(***6), 1919–1929. https://doi.org/10.1111/1365-2664.12880

Bennett, N.J. & Dearden, P. (2014). Why local people do not support conservation: Community perceptions of marine protected area livelihood impacts, governance and management in Thailand. *Marine Policy*, ***44***, 107–116. https://doi.org/10.1016/j.marpol.2013.08.017

Bennett, N.J., Whitty, T.S., Finkbeiner, E., Pittman, J., Bassett, H., Gelcich, S. & Allison, E.H. (2018). Environmental stewardship: A conceptual review and analytical framework. *Environmental Management*, ***61***(4), 597–614. https://doi.org/10.1007/s00267-017-0993-2

Benson, J.F., Sikich, J.A. & Riley, S.P.D. (2020). Survival and competing mortality risks of mountain lions in a major metropolitan area. *Biological Conservation*, ***241***, 108294.

Bercovitch, F.B. & Strum, S.C. (1993). Dominance rank, resource availability, and reproductive maturation in female savanna baboons. *Behavioral Ecology and Sociobiology*, ***33***(5). https://doi.org/10.1007/BF00172929

Berenstain, L. (1986). Responses of long-tailed macaques to drought and fire in eastern Borneo: A preliminary report. *Biotropica*, ***18***(3), 257. https://doi.org/10.2307/2388494

Berman, C.M., Li, J., Ogawa, H., Ionica, C. & Yin, H. (2007). Primate tourism, range restriction, and infant risk among *Macaca thibetana* at Mt. Huangshan, China. *International Journal of Primatology*, ***28***(5), 1123–1141. https://doi.org/10.1007/s10764-007-9199-4

Bersacola, E., Hockings, K.J., Harrison, M.E., Imron, M.A., Bessa, J., Ramon, M., de Barros, A.R., Jaló, M., Sanhá, A., Ruiz-Miranda, C.R., Ferraz, L.P., Talebi, M. & McLennan, M.R. (2023). Primate conservation in shared landscapes. In T. McKinney, S. Waters and M. Rodrigues (Eds.), *Primates in Anthropogenic Landscapes Exploring Primate Behavioural Flexibility Across Human Contexts* (pp. 162-175). Springer.

Bhatia, S., Redpath, S.M., Suryawanshi, K. & Mishra, C. (2020). Beyond conflict: Exploring the spectrum of human–wildlife interactions and their underlying mechanisms. *Oryx*, ***54(***5), 621–628. https://doi.org/10.1017/S003060531800159X

Bista, A., Chanchani, P., Subedi, N. & Bajracharya, S.B. (2022). The peri-urban leopards of Kathmandu: Assessing determinants of presence and predation on domestic animals. *Oryx*, ***56***(1), 91–100. https://doi.org/10.1017/S0030605320000423

Bjurlin, C.D. & Cypher, B.L. (2005). Encounter frequency with the urbanized San Joaquin kit fox correlates with public beliefs and attitudes toward the species. *Endangered Species Update*, ***22***(3), 107–115.

Boal, C.W. & Mannan, R.W. (1999). Comparative breeding ecology of Cooper's hawks in urban and exurban areas of southeastern Arizona. *The Journal of Wildlife Management*, ***63***(1), 77. https://doi.org/10.2307/3802488

Bond, W.J., Midgley, G.F. & Woodward, F.I. (2003). What controls South African vegetation – climate or fire? *South African Journal of Botany*, ***69***(1), 79-91.

Boug, A., Biquand-Guyot, V., & Kamal, K. (1994). The response of commensal hamadryas baboons to seasonal in food provisioning. Revue d'Ecologie, *Terre et Vie*, ***49***(3), 307–319.

Bracken, A.M., Christensen, C., O'Riain, M.J., Fehlmann, G., Holton, M.D., Hopkins, P.W., Fürtbauer, I. & King, A.J. (2022a). Socioecology explains individual variation in urban space use in response to management in Cape chacma baboons (*Papio ursinus*). *International Journal of Primatology*, ***43***(6), 1159–1176. https://doi.org/10.1007/s10764-021-00247-x

Bracken, A.M., Christensen, C., O'Riain, M.J., Fürtbauer, I. & King, A.J. (2022b). Flexible group cohesion and coordination, but robust leader–follower roles, in a wild social primate using urban space. *Proceedings of the Royal Society B, **289***(1967), 20212141. https://doi.org/10.1098/rspb.2021.2141

Brennan, E.J., Else, J.G. & Altmann, J. (1985). Ecology and behaviour of a pest primate: Vervet monkeys in a tourist-lodge habitat. *African Journal of Ecology*, ***23***(1), 35–44. https://doi.org/10.1111/j.1365-2028.1985.tb00710.x

Brenner, L.J. & Metcalf, E.C. (2020). Beyond the tolerance/intolerance dichotomy: Incorporating attitudes and acceptability into a robust definition of social tolerance of wildlife. *Human Dimensions of Wildlife*, ***25***(3), 259–267. https://doi.org/10.1080/10871209.2019.1702741

Bronikowski, A.M., & Altmann, J. (1996). Foraging in a variable environment: Weather patterns and the behavioral ecology of baboons. *Behavioral Ecology and Sociobiology*, ***39***(1), 11–25. https://doi.org/10.1007/s002650050262

Brooks, J., Kays, R., & Hare, B. (2020). Coyotes living near cities are bolder: Implications for dog evolution and human-wildlife conflict. *Behaviour*, ***157***(3–4), 289–313. https://doi.org/10.1163/1568539X-bja10002

Brown, G.P., Phillips, B.L., Webb, J.K. & Shine, R. (2006). Toad on the road: Use of roads as dispersal corridors by cane toads (*Bufo marinus*) at an invasion front in tropical Australia. *Biological Conservation*, ***133***(1), 88–94. https://doi.org/10.1016/j.biocon.2006.05.020

Bruskotter, J.T. & Wilson, R.S. (2014). Determining where the wild things will be: Using psychological theory to find tolerance for large carnivores. *Conservation Letters*, ***7***(3), 158–165. https://doi.org/10.1111/conl.12072

Bruskotter, J.T., Schmidt, R.H. & Teel, T.L. (2007). Are attitudes toward wolves changing? A case study in Utah. *Biological Conservation*, ***139***(1–2), 211–218. https://doi.org/10.1016/j.biocon.2007.06.016

Bruskotter, J.T., Vucetich, J.A., Dietsch, A., Slagle, K.M., Brooks, J.S. & Nelson, M. P. (2019). Conservationists' moral obligations toward wildlife: Values and identity promote conservation conflict. *Biological Conservation*, ***240***, 108296. https://doi.org/10.1016/j.biocon.2019.108296

Bulger, J.B. (1993). Dominance rank and access to estrous females in male savanna baboons. *Behaviour*, ***127***(1–2), 67–103. https://doi.org/10.1163/156853993X00434

Bulger, J. & Hamilton, W.J. (1987). Rank and density correlates of inclusive fitness measures in a natural chacma baboon (*Papio ursinus*) troop. *International Journal of Primatology*, ***8***(6), 635–650. https://doi.org/10.1007/BF02735781

Butler, P., Green, K. & Galvin, D. (2013). The Principles of Pride: The science behind the mascots. Arlington, VA: Rare.

Campbell-Smith, G., Simanjorang, H.V.P., Leader-Williams, N. & Linkie, M. (2010). Local attitudes and perceptions toward crop-raiding by orangutans (*Pongo abelii*) and other nonhuman primates in northern Sumatra, Indonesia. *American Journal of Primatology*, ***72***(10), 866–876. https://doi.org/10.1002/ajp.20822

Campbell, M.O. & Torres Alvarado, M E. (2011). Public perceptions of jaguars *Panthera onca*, pumas *Puma concolor* and coyotes *Canis latrans* in El Salvador. *Area*, ***43***(3), 250–256. https://doi.org/10.1111/j.1475-4762.2011.00996.x

Camphuysen, K.C.J., Shamoun-Baranes, J., Van Loon, E.E. & Bouten, W. (2015). Sexually distinct foraging strategies in an omnivorous seabird. *Marine Biology*, ***162***(7), 1417–1428. https://doi.org/10.1007/s00227-015-2678-9

Carthew, S.M., Yáñez, B.M. & Ruykys, L. (2015). Straddling the divide: Den use by brushtail possums (*Trichosurus vulpecula*) in urban parklands. *Urban Ecosystems*, ***18***(2), 525–538. https://doi.org/10.1007/s11252-014-0420-x

Castillo-Huitrón, N.M., Naranjo, E.J., Santos-Fita, D. & Estrada-Lugo, E. (2020). The importance of human emotions for wildlife conservation. *Frontiers in Psychology*, ***11***, 1277. https://doi.org/10.3389/fpsyg.2020.01277

Chapman, C.A. & Chapman, L.J. (1990). Dietary variability in primate populations. *Primates*, ***31***(1), 121–128. https://doi.org/10.1007/BF02381035

Chapman, C.A. & Chapman, L. J. (2000). Constraints on group size in red colobus and red-tailed guenons: Examining the generality of the ecological constraints model. *International Journal of Primatology*, ***21***(4), 565–585.

Chaves, Ó.M., Júnior, J.S., Buss, G., Hirano, Z.M.B., Jardim, M., Amaral, E., Godoy, J., Peruchi, A., Michel, T. & Bicca-Marques, J.C. (2022). Wildlife is imperiled in peri-urban landscapes: Threats to arboreal mammals. *Science of The Total Environment*, ***821***, 152883.

Cheney, D.L., Seyfarth, R.M., Fischer, J., Beehner, J., Bergman, T., Johnson, S.E., Kitchen, D.M., Palombit, R.A., Rendall, D. & Silk, J.B. (2004). Factors affecting reproduction and mortality among baboons in the Okavango Delta, Botswana. *International Journal of Primatology*, ***25***(2), 401–428. https://doi.org/10.1023/B:IJOP.0000019159.75573.13

Cheney, D.L., Seyfarth, R.M., Fischer, J., Beehner, J.C., Bergman, T.J., Johnson, S.E., Kitchen, D.M., Palombit, R.A., Rendall, D. & Silk, J.B. (2006). Reproduction, mortality and female reproductive success in chacma baboons of the Okavango Delta, Botswana. In L. Swedell and S.R. Leigh (Eds.), *Reproduction and Fitness in Baboons: Behavioral, Ecological, and Life History Perspectives* (pp. 147-176). Springer.

Chowdhury, A.N., Mondal, R., Brahma, A. & Biswas, M.K. (2008). Eco-psychiatry and environmental conservation: Study from Sundarban Delta, India. *Environmental Health Insights*, ***2***, EHI.S935. https://doi.org/10.4137/EHI.S935

Chowdhury, S., Brown, J.L. & Swedell, L. (2021). Costs of seasonality at a southern latitude: Behavioral endocrinology of female baboons in the Cape Peninsula of South Africa. *Hormones and Behavior*, ***134***, 105020. https://doi.org/10.1016/j.yhbeh.2021.105020

Christensen, C., Bracken, A.M., O'Riain, M.J., Fehlmann, G., Holton, M., Hopkins, P., King, A.J. & Fürtbauer, I. (2023). Quantifying allo-grooming in wild chacma baboons (*Papio ursinus*) using tri-axial acceleration data and machine learning. *Royal Society Open Science*, ***10***(4), 221103. https://doi.org/10.1098/rsos.221103

Cliffe, R.N., Haupt, R.J., Kennedy, S., Felton, C., Williams, H.J., Avey-Arroyo, J. & Wilson, R. (2023). The behaviour and activity budgets of two sympatric sloths; *Bradypus variegatus* and *Choloepus hoffmanni*. *PeerJ*, ***11***, e15430. https://doi.org/10.7717/peerj.15430

Coetzee, J.H., Wright, M.G. & Giliomee, J.H. (1997). Anti-herbivore mechanisms of economically important *Proteaceae* species in the African Cape Fynbos. *Journal of Applied Entomology*, ***121***(1–5), 367–372. https://doi.org/10.1111/j.1439-0418.1997.tb01421.x

Conover, M.R. (1998). Perceptions of American agricultural producers about wildlife on their farms and ranches. *Wildlife Society Bulletin*, ***26***(3), 597–604.

Conover, M.R. & Kania, G.S. (1995). Annual variation in white-tailed deer damage in commercial nurseries. *Agriculture, Ecosystems & Environment*, ***55***(3), 213–217. https://doi.org/10.1016/0167-8809(95)00621-X

Constantino, P.J. & Wright, B.W. (2009). The importance of fallback foods in primate ecology and evolution. *American Journal of Primatology*, ***140***, 599-602.

Cowling, R.M., Rundel, P.W., Lamont, B.B., Kalin Arroyo, M. & Arianoutsou, M. (1996). Plant diversity in Mediterranean-climate regions. *Trends in Ecology & Evolution*, ***11***(9), 362–366. https://doi.org/10.1016/0169-5347(96)10044-6

Cowlishaw, G. (1997). Trade-offs between foraging and predation risk determine habitat use in a desert baboon population. *Animal Behaviour*, ***53***(4), 667–686. https://doi.org/10.1006/anbe.1996.0298

Craney, T.A. & Surles, J. G. (2002). Model-dependent variance inflation factor cutoff values. *Quality Engineering*, ***14***(3), 391–403. https://doi.org/10.1081/QEN-120001878

Culliney, T.W. (2014). Crop losses to arthropods. In D. Pimentel and R. Peshin (Eds.), *Integrated Pest Management* (pp. 201–225). Springer Netherlands. https://doi.org/10.1007/978-94-007-7796-5_8

Cunha, A.A., Vieira, M.V. & Grelle, C.E.V. (2006). Preliminary observations on habitat, support use and diet in two non-native primates in an urban Atlantic forest fragment: The capuchin monkey (*Cebus* sp.) and the common marmoset (*Callithrix jacchus)* in the Tijuca forest, Rio de Janeiro. *Urban Ecosystems*, ***9***(4), 351–359. https://doi.org/10.1007/s11252-006-0005-4

Cunneyworth, P.M.K. & Slade, A.M. (2021). Impact of electric shock and electrocution on populations of four monkey species in the suburban town of Diani, Kenya. *International Journal of Primatology*, ***42***(2), 171–186. https://doi.org/10.1007/s10764-020-00194-z

Cunneyworth, P.M.K., Donaldson, A. & Onyancha, F. (2022). Canopy bridges are an economical mitigation reducing the road barrier effect for three of four species of monkeys in Diani, Kenya. *Folia Primatologica*, ***93***(3–6), 217–234. https://doi.org/10.1163/14219980-bja10002

Cunneyworth, P.M.K. & Duke, J. (2020). Vehicle collisions among four species of monkeys between 2000 and 2018 on a suburban road in Diana, Kenya. *International Journal of Primatology*, ***41***, 45-60.

Curtin, S. (2009). Wildlife tourism: The intangible, psychological benefits of human–wildlife encounters. *Current Issues in Tourism*, ***12***(5–6), 451–474. https://doi.org/10.1080/13683500903042857

Curtis, P.D. & Hadidian, J. (2010). Responding to human-carnivore conflicts in urban areas. In S.D. Gehrt, S.P.D. Riley, and B.L. Cypher (Eds.), *Urban Carnivores Ecology, Conflict, and Conservation* (pp. 201 - 213). The Johns Hopkins University Press.

Daams, F. (2006). *A study of the 2006 Overberg fire: application of the veldfire risk management framework to two wildflower farms and two wildflower export businesses* [BSc Honours thesis, University of Cape Town].

Davies, N. B., Krebs, J. R., & West, S. A. (2012). *An Introduction to Behavioural Ecology* (4th ed.). Blackwell Publishing.

De Vos, A., O'Riain, M.J., Meyer, M.A., Kotze, P.G.H. & Kock, A.A. (2015). Behavior of Cape fur seals (*Arctocephalus pusillus pusillus)* in relation to temporal variation in predation risk by white sharks (*Carcharodon carcharias*) around a seal rookery in False Bay, South Africa. *Marine Mammal Science*, ***31(***3), 1118–1131. https://doi.org/10.1111/mms.12208

Denneboom, D., Bar-Massada, A. & Shwartz, A. (2021). Factors affecting usage of crossing structures by wildlife – A systematic review and meta-analysis. *Science of The Total Environment, **777***, 146061. https://doi.org/10.1016/j.scitotenv.2021.146061

Destefano, S. & Deblinger, R.D. (2005). Wildlife as valuable natural resources vs. intolerable pests: A suburban wildlife management model. *Urban Ecosystems*, ***8***(2), 179–190. https://doi.org/10.1007/s11252-005-4379-5

Dexter, C.E., Appleby, R.G., Edgar, J.P., Scott, J. & Jones, D.N. (2016). Using complementary remote detection methods for retrofitted eco-passages: A case study for monitoring individual koalas in south-east Queensland. *Wildlife Research*, ***43***(5), 369. https://doi.org/10.1071/WR15153

Dias, B.A.C., Hannibal, W., Martinez, R.A. & Machado, P.R.R. (2022). Distribution, activity patterns and diet of *Callithrix penicillata* (Primates: *Callithrichidae*) in an urban area in central Brazil. *Research, Society and Development*, ***11***(8), e14811830717. https://doi.org/10.33448/rsd-v11i8.30717

Dickman, A.J. (2010). Complexities of conflict: The importance of considering social factors for effectively resolving human-wildlife conflict. *Animal Conservation, **13***(5), 458–466. https://doi.org/10.1111/j.1469-1795.2010.00368.x

Dietsch, A.M., Manfredo, M.J., Sullivan, L., Bruskotter, J.T. & Teel, T.L. (2019). A multilevel, systems view of values can inform a move towards human–wildlife coexistence. In B. Frank, J. A. Glikman, and S. Marchini (Eds.), *Human–Wildlife Interactions* (pp. 20–44). Cambridge University Press. https://doi.org/10.1017/9781108235730.005

Dinno, A. (2015). Nonparametric pairwise multiple comparisons in independent groups using Dunn's test. *The Stata Journal: Promoting Communications on Statistics and Stata*, ***15***(1), 292–300. https://doi.org/10.1177/1536867X1501500117

Dormann, C.F., Elith, J., Bacher, S., Buchmann, C., Carl, G., Carré, G., Marquéz, J.R.G., Gruber, B., Lafourcade, B., Leitão, P.J., Münkemüller, T., McClean, C., Osborne, P.E., Reineking, B., Schröder, B., Skidmore, A.K., Zurell, D. & Lautenbach, S. (2013). Collinearity: A review of methods to deal with it and a simulation study evaluating their performance. *Ecography*, ***36***(1), 27–46. https://doi.org/10.1111/j.1600-0587.2012.07348.x

Drewe, J.A., O'Riain, M.J., Beamish, E., Currie, H. & Parsons, S. (2012). Survey of Infections transmissible between baboons and humans, Cape Town, South Africa. *Emerging Infectious Diseases*, ***18***(2), 298–301. https://doi.org/10.3201/eid1802.111309

Drouilly, M., Tafani, M., Nattrass, N. & O'Riain, J. (2018). Spatial, temporal and attitudinal dimensions of conflict between predators and small-livestock farmers in the Central Karoo. *African Journal of Range & Forage Science*, ***35***(3–4), 245–255. https://doi.org/10.2989/10220119.2018.1522669

Duarte, J., Farfán, M.A., Fa, J.E. & Vargas, J.M. (2015). Deer populations inhabiting urban areas in the south of Spain: Habitat and conflicts. *European Journal of Wildlife Research*, ***61***(3), 365–377. https://doi.org/10.1007/s10344-015-0902-z

Ducatez, S., Audet, J.N., Rodriguez, J.R., Kayello, L. & Lefebvre, L. (2017). Innovativeness and the effects of urbanization on risk-taking behaviors in wild Barbados birds. *Animal Cognition*, ***20****(*1), 33–42. https://doi.org/10.1007/s10071-016-1007-0

Duffy, X., Wellian, J. & Smith, R. L. (2022). Use of space by black-and-gold howler monkeys (*Alouatta caraya*) in an urban environment in Paraguay. [Preprint]. https://doi.org/10.21203/rs.3.rs-238106/v1

Dunbar, R.I.M. (1992). Time: A hidden constraint on the behavioural ecology of baboons. *Behavioral Ecology and Sociobiology*, ***31***(1), 35–49. https://doi.org/10.1007/BF00167814

Dunbar, RI. M., Korstjens, A.H. & Lehmann, J. (2009). Time as an ecological constraint. *Biological Reviews*, ***84****(*3), 413–429. https://doi.org/10.1111/j.1469-185X.2009.00080.x

Dwernychuk, L.W. & Boag, D.A. (1972). Ducks nesting in association with gulls—An ecological trap? *Canadian Journal of Zoology*, ***50***(5), 559–563. https://doi.org/10.1139/z72-076

Eagly, A.H. & Chaiken, S. (1993). *The Psychology of Attitudes*. Harcourt Brace Jovanovich College Publishers.

Ekman, P. (1992). Are there basic emotions? *Psychological Review*, ***99***(3), 550-553.

Elfström, M., Zedrosser, A., Jerina, K., Støen, O., Kindberg, J., Budic, L., Jonozovič, M. & Swenson, J.E. (2014). Does despotic behavior or food search explain the occurrence of problem brown bears in Europe? *The Journal of Wildlife Management*, ***78***(5), 881–893. https://doi.org/10.1002/jwmg.727

Ellemers, N. & Haslam, S.A. (2011). Social identity theory. In P.A.M. Van Lange, A.W. Kruglanski and E.T. Higgins*, Handbook of Theories of Social Psychology* (pp.379-398). Sage Publications Inc.

Ellis, E.C., Goldewijk, K.K., Siebert, S., Lightman, D. & Ramankutty, N. (2010). Anthropogenic transformation of the biomes, 1700 to 2000. *Global Ecology and Biogeography*, ***19***, 589–606.

Ellwanger, N. W. (2020). *Pressed for time: foraging and social strategies of chacma baboons (Papio hamadryas ursinus) in a seasonal and anthropogenic habitat in South Africa* [Doctoral thesis, University of Texas at San Antonio].

Else, J.G. (1991). Nonhuman primates as pests. In H.O. Box (Ed.), Primate Responses to Environmental Change (pp. 155-165). Chapman and Hall.

Engelbrecht, T., Kock, A., Waries, S. & O'Riain, M. J. (2017). Shark spotters: Successfully reducing spatial overlap between white sharks (*Carcharodon carcharias*) and recreational water users in False Bay, South Africa. *PLoS ONE*, ***12***(9), e0185335. https://doi.org/10.1371/journal.pone.0185335

Engh, A.L., Beehner, J.C., Bergman, T.J., Whitten, P.L., Hoffmeier, R. R., Seyfarth, R.M. & Cheney, D.L. (2006). Behavioural and hormonal responses to predation in female chacma baboons (*Papio hamadryas ursinus*). *Proceedings of the Royal Society B*, ***273***(1587), 707–712. https://doi.org/10.1098/rspb.2005.3378

Ericsson, G. & Heberlein, T.A. (2003). Attitudes of hunters, locals, and the general public in Sweden now that the wolves are back. *Biological Conservation*, ***111****(*2), 149–159. https://doi.org/10.1016/S0006-3207(02)00258-6

Espinosa, S. & Jacobson, S.K. (2012). Human-wildlife conflict and environmental education: Evaluating a community program to protect the Andean bear in Ecuador. *The Journal of Environmental Education*, ***43***(1), 55–65. https://doi.org/10.1080/00958964.2011.579642

Estrada, A., Garber, P.A., Rylands, A.B., Roos, C., Fernandez-Duque, E., Di Fiore, A., Nekaris, K.A.I., Nijman, V., Heymann, E.W., Lambert, J.E., Rovero, F., Barelli, C., Setchell, J.M., Gillespie, T.R., Mittermeier, R.A., Arregoitia, L.V., De Guinea, M., Gouveia, S., Dobrovolski, R., … Li, B.

(2017). Impending extinction crisis of the world's primates: Why primates matter. *Science Advances*, ***3***(1), e1600946. https://doi.org/10.1126/sciadv.1600946

Fabian, D. K., & Flatt, T. (2012). Life history evolution. *Nature Education Knowledge*, ***3***(10), 1–13.

Fabrigar, L.R., MacDonald, T.K. & Wegener, D.T. (2018). The origins and structure of attitudes. In D. Albarracín and B.T. Johnson (Eds.), *The Handbook of Attitudes: Basic Principles* (pp. 109-157). Routledge.

Fehlmann, G., O'Riain, M.J., FÜrtbauer, I. & King, A.J. (2020). Behavioral causes, ecological consequences, and management challenges associated with wildlife foraging in human-modified landscapes. *BioScience*, biaa129. https://doi.org/10.1093/biosci/biaa129

Fehlmann, G., O'Riain, M.J., Kerr-Smith, C. & King, A.J. (2016). Adaptive space use by baboons (*Papio ursinus*) in response to management interventions in a human-changed landscape. *Animal Conservation*, ***20***, 101–109.

Fehlmann, G., O'Riain, M.J., Kerr-Smith, C., Hailes, S., Luckman, A., Shepard, E.L.C. & King, A.J. (2017). Extreme behavioural shifts by baboons exploiting risky, resource-rich, human-modified environments. *Scientific Reports*, ***7***(1), 15057. https://doi.org/10.1038/s41598-017-14871-2

Fehlmann, G., O'Riain, M.J., Kerr-Smith, C., Hailes, S., Holton, M., Hopkins, P. & King, A.J. (2023). Using behavioral studies to adapt management decisions and reduce negative interactions between humans and baboons in Cape Town, South Africa. *Conservation Science and Practice*, ***5***(7), e12948. https://doi.org/10.1111/csp2.12948

Fergusson, R.A. (2005). Review of baboons, baboon damage and baboon control in South African plantation forests with particular reference to Mpumulanga Province. Report to the Baboon Damage Working Group of South Africa, Sabie, South Africa.

Firth, A. (2011). Rooiels main place 172006 from census 2011. https://census2011.adrianfrith.com/place/172006

Fleming, P.A. & Bateman, P.W. (2018). Novel predation opportunities in anthropogenic landscapes. *Animal Behaviour*, ***138***, 145–155. https://doi.org/10.1016/j.anbehav.2018.02.011

Frank, B. (2016). Human–wildlife conflicts and the need to include tolerance and coexistence: An introductory comment. *Society & Natural Resources*, ***29***(6), 738–743. https://doi.org/10.1080/08941920.2015.1103388

Frank, B. & Glikman, J. A. (2019). Human–wildlife conflicts and the need to include coexistence. In B. Frank, J. A. Glikman and S. Marchini (Eds.), *Human–Wildlife Interactions* (pp. 1–19). Cambridge University Press. https://doi.org/10.1017/9781108235730.004

Frank, B., Glikman, J.A. & Marchini, S. (Eds.). (2019). *Human–Wildlife Interactions: Turning Conflict into Coexistence*. Cambridge University Press. https://doi.org/10.1017/9781108235730

Friedrich, L.A., Jefferson, R. & Glegg, G. (2014). Public perceptions of sharks: Gathering support for shark conservation. *Marine Policy*, ***47***, 1–7. https://doi.org/10.1016/j.marpol.2014.02.003

Fuentes, A. (2023). Foreword: primatology in the Anthropocene. In T. McKinney, S. Waters and M. Rodrigues (Eds.), *Primates in Anthropogenic Landscapes Exploring Primate Behavioural Flexibility Across Human Contexts* (pp. v-vii). Springer.

Fuentes, A., Rompis, A.L.T., Putra, I.G.A.A., Watiniasih, N.L., Suartha, I.N., Soma, I.G., Wandia, I.N., Putra, I.D.K.H, Stephenson, R. & Selamet, W. (2011). Macaque behavior at the human-monkey interface: The activity and demography of semi-free-ranging *Macaca fascicularis* at Padengtegal, Bali, Indonesia. In M.D. Gumert, A. Fuentes and L. Jones-Engel (Eds.), *Monkeys on the Edge Ecology and Management of Long-Tailed Macaques and Their Interface* (pp. 159-179). Cambridge University Press.

Fuentes, A., Southern, M. & Suaryana, K.G. (2005). Monkey forests and human landscapes: Is extensive sympatry sustainable for *Homo sapiens* and *Macaca fascicularis* on Bali? In J.D. Paterson and J. Wallis (Eds.) *Commensalism and Conflict: The Human-Primate Interface* (pp. 168-95). American Society of Primatologists.

Fulton, D.C., Manfredo, M.J. & Lipscomb, J. (1996). Wildlife value orientations: A conceptual and measurement approach. *Human Dimensions of Wildlife*, ***1***(2), 24–47. https://doi.org/10.1080/10871209609359060

Gallo, T. & Fidino, M. (2018). Making wildlife welcome in urban areas. *eLife*, ***7***, e41348. https://doi.org/10.7554/eLife.41348

Gallo, T., Fidino, M., Lehrer, E.W. & Magle, S.B. (2017). Mammal diversity and metacommunity dynamics in urban green spaces: Implications for urban wildlife conservation. *Ecological Applications,* ***27***(8), 2330–2341. https://doi.org/10.1002/eap.1611

Gates, J.E. & Gysel, L.W. (1978). Avian nest dispersion and fledging success in field-forest ecotones. *Ecology*, ***59***(5), 871–883. https://doi.org/10.2307/1938540

Gehrt, S.D. & Riley, S.P.D. (2010). Coyotes (*Canis latrans*). In S.D. Gehrt, S.P.D. Riley and B.L. Cypher (Eds.), *Urban Carnivores Ecology, Conflict, and Conservation* (pp. 79-97). John Hopkins University Press.

Gerber, A. (2004). *Baboons: Tales, Traits and Troubles*. LAPA publishers.

Gesquiere, L.R., Altmann, J., Archie, E.A. & Alberts, S.C. (2018). Interbirth intervals in wild baboons: Environmental predictors and hormonal correlates. *American Journal of Physical Anthropology*, ***166***(1), 107–126. https://doi.org/10.1002/ajpa.23407

Gesquiere, L.R., Learn, N.H., Simao, M.C.M., Onyango, P.O., Alberts, S.C. & Altmann, J. (2011). Life at the top: Rank and stress in wild male baboons. *Science*, ***333***(6040), 357–360. https://doi.org/10.1126/science.1207120

Gill, J.A., Norris, K. & Sutherland, W.J. (2001). Why behavioural responses may not reflect the population consequences of human disturbance. *Biological Conservation*, ***97***, 265-268.

Giuliani, M.V., & Feldman, R. (1993). Place attachment in a developmental and cultural context. *Journal of Environmental Psychology*, ***13***(3), 267–274. https://doi.org/10.1016/S0272-4944(05)80179-3

Glikman, J.A., Frank, B., Ruppert, K.A., Knox, J., Sponarski, C.C., Metcalf, E.C., Metcalf, A.L. & Marchini, S. (2021). Coexisting with different human-wildlife coexistence perspectives. *Frontiers in Conservation Science*, ***2***, 703174. https://doi.org/10.3389/fcosc.2021.703174

Gonçalves, B.A., Lima, L.C.P. & Aguiar, L.M. (2022). Diet diversity and seasonality of robust capuchins (*Sapajus* sp.) in a tiny urban forest. *American Journal of Primatology*, ***84***(8), e23396.

Gore, M.L., Knuth, B.A., Curtis, P.D. & Shanahan, J.E. (2007). Factors influencing risk perception associated with human–black bear conflict. *Human Dimensions of Wildlife*, ***12***(2), 133–136. https://doi.org/10.1080/10871200701195985

Gradolewski, D., Dziak, D., Martynow, M., Kaniecki, D., Szurlej-Kielanska, A., Jaworski, A. & Kulesza, W. J. (2021). Comprehensive bird preservation at wind farms. *Sensors*, ***21***(1), 267. https://doi.org/10.3390/s21010267

Gross, E., Jayasinghe, N., Brooks, A., Polet, G., Wadhwa R. & Hilderink-Koopmans, F. (2021). A future for all: The need for human-wildlife coexistence. (WWF, Gland, Switzerland).

Grow, N.B., Gursky-Doyen, S. & Krzton, A. (Eds.). (2014). *High Altitude Primates*. Springer. https://doi.org/10.1007/978-1-4614-8175-1

Gubbi, S., Swaminath, M.H., Poornesha, H.C., Bhat, R. & Raghunath, R. (2014). An elephantine challenge: Human–elephant conflict distribution in the largest Asian elephant population, southern India. *Biodiversity and Conservation*, ***23***(3), 633–647. https://doi.org/10.1007/s10531-014-0621-x

Guil, F. & Pérez-García, J.M. (2022). Bird electrocution on power lines: Spatial gaps and identification of driving factors at global scales. *Journal of Environmental Management*, ***301***, 113890. https://doi.org/10.1016/j.jenvman.2021.113890

Gumert, M.D. (2011). The common monkey of Southeast Asia: Long-tailed macaque populations, ethnophoresy, and their occurrence in human environments. In M.D. Gumert, A. Fuentes and L. Jones-Engel (Eds.), *Monkeys on the Edge Ecology and Management of Long-Tailed Macaques and their Interface* (pp. 3-44). Cambridge University Press.

Gursky, S.L. & Nekaris, K.A.I. (2007). *Primate Anti-Predator Strategies*. Springer.

Guyett, E. (2006). *The effects of human food on foraging and social behaviour in the chacma baboon (Papio c. ursinus)* [MSc thesis, University of Lincoln].

Haag-Wackernagel, D. & Geigenfeind, I. (2008). Protecting buildings against feral pigeons. *European Journal of Wildlife Research*, ***54***(4), 715–721. https://doi.org/10.1007/s10344-008-0201-z

Hair, J. & Sarstedt, M. (2021). Explanation plus prediction—The logical focus of project management research. *Project Management Journal*, ***52***(4), 319-322.
Hair, J. & Alamer, A. (2022). Partial least squares structural equation modeling (PLS-SEM) in second language and education research: Guidelines using an applied example. *Research Methods in Applied Linguistics*, ***1***(3), 100027. https://doi.org/10.1016/j.rmal.2022.100027
Hale, R., Coleman, R., Pettigrove, V. & Swearer, S.E. (2015). Review: Identifying, preventing and mitigating ecological traps to improve the management of urban aquatic ecosystems. *Journal of Applied Ecology*, ***52***(4), 928–939. https://doi.org/10.1111/1365-2664.12458
Hall, K.R.L. (1962). Numerical data, maintenance activities and locomotion of the wild chacma baboon, *Papio ursinus*. *Proceedings of the Zoological Society of London*, ***139***(2), 181–220. https://doi.org/10.1111/j.1469-7998.1962.tb01827.x
Hamilton, W.J. (1985). Demographic consequences of a food and water shortage to desert chacma baboons, *Papio ursinus*. *International Journal of Primatology*, ***6***(5), 451–462. https://doi.org/10.1007/BF02735570
Hamilton, W.J. & Bulger, J. B. (1990). Natal male baboon rank rises and successful challenges to resident alpha males. *Behavioral Ecology and Sociobiology*, ***26***(5), 357–362. https://doi.org/10.1007/BF00171102
Hamilton, W.J., Buskirk, R.E. & Buskirk, W.H. (1976). Defense of space and resources by chacma (*Papio ursinus*) baboon troops in an African desert and swamp. *Ecology*, ***57***, 1264-1272.
Hanya, G. (2004). Seasonal variations in the activity budget of Japanese macaques in the coniferous forest of Yakushima: Effects of food and temperature. *American Journal of Primatology*, ***63***(3), 165–177. https://doi.org/10.1002/ajp.20049
Hanya, G., Stevenson, P., Van Noordwijk, M., Te Wong, S., Kanamori, T., Kuze, N., Aiba, S., Chapman, C. A. & Van Schaik, C. (2011). Seasonality in fruit availability affects frugivorous primate biomass and species richness. *Ecography*, ***34***(6), 1009–1017. https://doi.org/10.1111/j.1600-0587.2010.06775.x
Harcourt, A. H. (1989). Environment, competition and reproductive performance of female monkeys. *TREE*, ***4***(4), 101–105.
Harel, R., Loftus, J.C. & Crofoot, M.C. (2021). Locomotor compromises maintain group cohesion in baboon troops on the move. *Proceedings of the Royal Society B*, ***288***(1955), 20210839.
Harris, N.C., Wilkinson, C.E., Fleury, G. & Nhleko, Z.N. (2023). Responsibility, equity, justice, and inclusion in dynamic human–wildlife interactions. *Frontiers in Ecology and the Environment*, ***21***(8), 380–387. https://doi.org/10.1002/fee.2603
Harrison, R.L. (1998). Bobcats in residential areas: Distribution and homeowner attitudes. *The Southwestern Naturalist*, ***43***(4), 469-475.
Hartel, C.M., Carlton, J.S. & Prokopy, L.S. (2015). The role of value orientations and experience on attitudes toward a well-liked threatened reptile. *Human Dimensions of Wildlife*, ***20***(6), 553–562. https://doi.org/10.1080/10871209.2015.1079935
Haynes, W. (2013). Holm's method. In W. Dubitzky, O. Wolkenhauer, K.H. Cho and H. Yokota (Eds.), *Encyclopedia of Systems Biology* (pp. 902). Springer.
Hazzah, L., Dolrenry, S., Kaplan, D. & Frank, L. (2013). The influence of park access during drought on attitudes toward wildlife and lion killing behaviour in Maasailand, Kenya. *Environmental Conservation*, ***40***(3), 266–276. https://doi.org/10.1017/S0376892913000040
Heberlein, T.A. (2012). Navigating Environmental Attitudes. *Conservation Biology*, ***26***(4), 583–585. https://doi.org/10.1111/j.1523-1739.2012.01892.x
Heimlich, J.E. & Ardoin, N.M. (2008). Understanding behavior to understand behavior change: A literature review. *Environmental Education Research*, ***14***(3), 215–237. https://doi.org/10.1080/13504620802148881
Henzi, S.P. & Lycett, J.E. (1995). Population structure, demography, and dynamics of mountain baboons: An interim report. *American Journal of Primatology*, ***35***(2), 155–163. https://doi.org/10.1002/ajp.1350350208
Henzi, S.P., Weingrill, T. & Barrett, L. (1999). Male behaviour and the evolutionary ecology of chacma baboons. *South African Journal of Science*, ***95***, 240–242.

Hermann, N., Voß, C. & Menzel, S. (2013). Wildlife value orientations as predicting factors in support of reintroducing bison and of wolves migrating to Germany. *Journal for Nature Conservation*, ***21***(3), 125–132. https://doi.org/10.1016/j.jnc.2012.11.008

Herzog, N.M., Keefe, E.R., Parker, C.H. & Hawkes, K. (2016). What's burning got to do with it? Primate foraging opportunities in fire-modified landscapes. *American Journal of Primatology, **159***, 432-441.

Hetman, M., Kubicka, A.M., Sparks, T.H. & Tryjanowski, P. (2019). Road kills of non-human primates: A global view using a different type of data. *Mammal Review*, ***49***(3), 276–283. https://doi.org/10.1111/mam.12158

Higham, J.P., Warren, Y., Adanu, J., Umaru, B.N., MacLarnon, A.M., Sommer, V. & Ross, C. (2009). Living on the edge: Life-history of olive baboons at Gashaka-Gumti National Park, Nigeria. *American Journal of Primatology*, ***71***(4), 293–304. https://doi.org/10.1002/ajp.20651

Hill, C.M. (2000). Conflict of interest between people and baboons: crop raiding in uganda. *International Journal of Primatology*, ***21***(2), 299–315.

Hill, C.M. (2005). People, crops and primates: A conflict of interests. In J.D. Paterson and J. Wallis (Eds.), *Commensalism and Conflict: The Human-Primate Interface* (pp. 40-59). American Society of Primatologists.

Hill, C.M. (2017). Primate crop feeding behavior, crop protection, and conservation. *International Journal of Primatology*, **38**(2), 385–400. https://doi.org/10.1007/s10764-017-9951-3

Hill, C.M. (2021). Conflict is integral to human-wildlife coexistence. *Frontiers in Conservation Science*, ***2***, 734314. https://doi.org/10.3389/fcosc.2021.734314

Hill, C.M. & Webber, A. D. (2010). Perceptions of nonhuman primates in human-wildlife conflict scenarios. *American Journal of Primatology*, ***72***(10), 919–924. https://doi.org/10.1002/ajp.20845

Hill, R. A. (2006). Thermal constraints on activity scheduling and habitat choice in baboons. *American Journal of Physical Anthropology*, ***129***(2), 242–249. https://doi.org/10.1002/ajpa.20264

Hill, R. A., Weingrill, T., Barrett, L. & Henzi, S. P. (2004). Indices of environmental temperatures for primates in open habitats. *Primates*, ***45***(1), 7–13. https://doi.org/10.1007/s10329-003-0054-8

Hill, R.A. & Dunbar, R.I.M. (2002). Climatic determinants of diet and foraging behaviour in baboons. *Evolutionary Ecology*, ***16***, 579-593.

Hinde, K. (2022). *The density of leopards in a mixed-use landscape in the Western Cape, South Africa* [MSc thesis, University of Cape Town].

Hockings, K.J. (2016). Mitigating human–nonhuman primate conflict. In M. Bezanson, K. C. MacKinnon, E. Riley, C. J. Campbell, K. A. I. Nekaris, A. Estrada, A. F. Di Fiore, S. Ross, L. E. Jones-Engel, B. Thierry, R. W. Sussman, C. Sanz, J. Loudon, S. Elton and A. Fuentes (Eds.), *The International Encyclopedia of Primatology* (pp. 1–2). Wiley. https://doi.org/10.1002/9781119179313.wbprim0053

Hockings, K.J. & McLennan, M.R. (2012). From forest to farm: systematic review of cultivar feeding by chimpanzees – management implications for wildlife in anthropogenic landscapes. *PLoS ONE*, *7(*4), e33391. https://doi.org/10.1371/journal.pone.0033391

Hoffman, T.S. & O'Riain, M. J. (2011). The spatial ecology of chacma baboons (*Papio ursinus*) in a human-modified environment. *International Journal of Primatology*, ***32***(2), 308–328. https://doi.org/10.1007/s10764-010-9467-6

Hoffman, T.S. & O'Riain, M.J. (2012a). Troop size and human-modified habitat affect the ranging patterns of a chacma baboon population in the Cape Peninsula, South Africa. *American Journal of Primatology*, ***74***(9), 853–863. https://doi.org/10.1002/ajp.22040

Hoffman, T.S. & O'Riain, M.J. (2012b). Monkey management: using spatial ecology to understand the extent and severity of human-baboon conflict in the Cape Peninsula, South Africa. *Ecology and Society*, ***17***(3), art13. https://doi.org/10.5751/ES-04882-170313

Hoffman, T.S. & O'Riain, M.J. (2012c). Landscape requirements of a primate population in a human-dominated environment. *Frontiers in Zoology*, ***9***(1), 1. https://doi.org/10.1186/1742-9994-9-1

Hoffman, T.S. (2011). *The spatial ecology of chacma baboons (Papio ursinus) in the Cape Peninsula, South Africa: Towards improved management and conservation strategies* [Doctoral thesis, University of Cape Town].

Holderness-Roddam, B. & McQuillan, P.B. (2014). Domestic dogs (*Canis familiaris*) as a predator and disturbance agent of wildlife in Tasmania. *Australasian Journal of Environmental Management*, ***21***(4), 441–452. https://doi.org/10.1080/14486563.2014.952787

Hoppitt, W., Brown, G., Kendal, R., Rendell, L., Thornton, A., Webster, M. & Laland, K. (2008). Lessons from animal teaching. *Trends in Ecology & Evolution*, ***23***(9), 486–493. https://doi.org/10.1016/j.tree.2008.05.008

Hosaka, T., Sugimoto, K. & Numata, S. (2017). Effects of childhood experience with nature on tolerance of urban residents toward hornets and wild boars in Japan. *PLoS ONE*, ***12***(4), e0175243. https://doi.org/10.1371/journal.pone.0175243

Hughes, J. (2014). ngspatial: A package for fitting the centered autologistic and sparse spatial generalized linear mixed models for areal data. *The R Journal*, ***6***(2), 81. https://doi.org/10.32614/RJ-2014-026

Hughes, J. & Cui, X. (2013). ngspatial: classes for spatial data. Available from: http://cran.r-project.org/package=ngspatial

Hughes, J. & Haran, M. (2013). Dimension reduction and alleviation of confounding for spatial generalized linear mixed models. *Journal of the Royal Statistical Society Series B: Statistical Methodology*, ***75***(1), 139–159. https://doi.org/10.1111/j.1467-9868.2012.01041.x

Human Wildlife Solutions. (2021). Report of death of PBF3 on 29 September 2021.

Hurn, S. (2011). "Like herding cats!" managing conflict over wildlife heritage on South Africa's Cape Peninsula. *Ecological and Environmental Anthropology*, ***6***, 40–53.

Hyrenbach, K.D., Hester, M.M., Adams, J., Titmus, A.J., Michael, P., Wahl, T., Chang, C.W., Marie, A. & Vanderlip, C. (2017). Plastic ingestion by black-footed albatross (*Phoebastria nigripes*) from Kure Atoll, Hawai'i: linking chick diet remains and parental at-sea foraging distributions. *Marine Ornithology*, ***45***, 225–236.

Ibrahim, H., Bekele, A., Yazezew, D. & Mekonnen, A. (2023). Assessment of crop foraging by hamadryas baboons (*Papio hamadryas*) in and around Borena-Sayint National Park, northern Ethiopia. *Global Ecology and Conservation*, ***44***, e02498. https://doi.org/10.1016/j.gecco.2023.e02498

Illham, K., Rizaldi, Nurdin, J. & Tsuji, Y. (2017). Status of urban populations of the long-tailed macaque (*Macaca fascicularis*) in West Sumatra, Indonesia. *Primates*, ***58***(2), 295–305. https://doi.org/10.1007/s10329-016-0588-1

Inskip, C., Ridout, M., Fahad, Z., Tully, R., Barlow, A., Barlow, C.G., Islam, M. A., Roberts, T. & MacMillan, D. (2013). Human–tiger conflict in context: risks to lives and livelihoods in the Bangladesh Sundarbans. *Human Ecology*, ***41***(2), 169–186. https://doi.org/10.1007/s10745-012-9556-6

Isbell, L.A. & Young, T.P. (1993). Social and ecological influences on activity budgets of vervet monkeys, and their implications for group living. *Behavioral Ecology and Sociobiology*, ***32***(6), 377–385.

Itani, J. (1982). Intraspecific killing among non-human primates. *Journal of Social and Biological Structure*, ***5***, 361–368.

Jackman, J.L. & Rutberg, A.T. (2015). Shifts in attitudes toward coyotes on the urbanized east coast: the cape cod experience, 2005–2012. *Human Dimensions of Wildlife*, ***20***(4), 333–348. https://doi.org/10.1080/10871209.2015.1027973

Jacobs, M.H. (2012). Human emotions toward wildlife. *Human Dimensions of Wildlife*, ***17***(1), 1–3. https://doi.org/10.1080/10871209.2012.653674

Jacobs, M.H., Dubois, S., Hosaka, T., Ladanović, V., Muslim, H.F.M., Miller, K.K., Numata, S., Ranaweerage, E., Straka, T.M., Weston, M.A. & Abidin, Z.A.Z. (2022). Exploring cultural differences in wildlife value orientations using student samples in seven nations. *Biodiversity and Conservation*, ***31***(3), 757–777. https://doi.org/10.1007/s10531-022-02361-5

Jacobs, M.H., Vaske, J.J. & Sijtsma, M.T.J. (2014). Predictive potential of wildlife value orientations for acceptability of management interventions. *Journal for Nature Conservation*, ***22***(4), 377–383. https://doi.org/10.1016/j.jnc.2014.03.005

Jacobs, M.H., Vaske, J.J., Dubois, S. & Fehres, P. (2014). More than fear: Role of emotions in acceptability of lethal control of wolves. *European Journal of Wildlife Research*, ***60***(4), 589–598. https://doi.org/10.1007/s10344-014-0823-2

Jacobs, M. & Vaske, J.J. (2019). Understanding emotions as opportunities for and barriers to coexistence with wildlife. In B. Frank, J. A. Glikman and S. Marchini (Eds.), *Human–Wildlife Interactions* (pp. 65–84). Cambridge University Press. https://doi.org/10.1017/9781108235730.007

Jacobson, S.K., Seavey, J.R. & Mueller, R.C. (2016). Integrated science and art education for creative climate change communication. *Ecology and Society*, ***21***(3), art30. https://doi.org/10.5751/ES-08626-210330

Jaman, M.F. & Huffman, M. A. (2008). Enclosure environment affects the activity budgets of captive Japanese macaques (*Macaca fuscata*). *American Journal of Primatology*, ***70***(12), 1133–1144. https://doi.org/10.1002/ajp.20612

Johansson, M., Sjöström, M., Karlsson, J. & Brännlund, R. (2012). Is human fear affecting public willingness to pay for the management and conservation of large carnivores? *Society & Natural Resources*, ***25***(6), 610–620. https://doi.org/10.1080/08941920.2011.622734

Johns, M., Veldtman, A. & Cleaver-Christie, G. 2012. Kogelberg Nature Reserve Complex Management Plan 2013-2018. CapeNature.

Johnson, C.A., Raubenheimer, D., Rothman, J.M., Clarke, D. & Swedell, L. (2013). 30 days in the life: daily nutrient balancing in a wild chacma baboon. *PLoS ONE*, ***8***(7), e70383. https://doi.org/10.1371/journal.pone.0070383

Johnson, S.D. (1993). Climatic and phylogenetic determinants of flowering seasonality in the cape flora. *The Journal of Ecology*, ***81***(3), 567. https://doi.org/10.2307/2261535

Jones, G.L., Haran, M., Caffo, B.S. & Neath, R. (2006). Fixed-width output analysis for Markov chain Monte Carlo. *Journal of the American Statistical Association*, ***101***(476), 1537–1547. https://doi.org/10.1198/016214506000000492

Jooste, E., Pitman, R.T., Van Hoven, W. & Swanepoel, L.H. (2013). Unusually high predation on chacma baboons (*Papio ursinus*) by female leopards (*Panthera pardus*) in the Waterberg Mountains, South Africa. *Folia Primatologica*, ***83***(3–6), 353–360. https://doi.org/10.1159/000339644

Kaburu, S.S.K., Beisner, B., Balasubramaniam, K.N., Marty, P.R., Bliss-Moreau, E., Mohan, L., Rattan, S. K., Arlet, M.E., Atwill, E.R. & McCowan, B. (2019). Interactions with humans impose time constraints on urban-dwelling rhesus macaques (*Macaca mulatta*). *Behaviour*, ***156(***12), 1255–1282. https://doi.org/10.1163/1568539X-00003565

Kansky, R. (2015). *Towards understanding tolerance to damage causing wildlife* [Doctoral thesis, Stellenbosch University].

Kansky, R. & Gaynor, D. (2000). Baboon Management Strategy for the Cape Peninsula. Final Report, Table Mountain Fund Project number ZA 568, Cape Town, South Africa.

Kansky, R., Kidd, M. & Knight, A.T. (2014). Meta-analysis of attitudes toward damage-causing mammalian wildlife. *Conservation Biology*, ***28***(4), 924–938. https://doi.org/10.1111/cobi.12275

Kansky, R., Kidd, M., & Knight, A.T. (2016). A wildlife tolerance model and case study for understanding human wildlife conflicts. *Biological Conservation*, ***201***, 137–145. https://doi.org/10.1016/j.biocon.2016.07.002

Kaplan, B. (2013). *In pursuit of a panacea: mitigating human-baboon conflict in the Cape Peninsula, South Africa* [Doctoral thesis, University of Cape Town].

Kaplan, B. S. & O'Riain, M. J. (2015). Shedding light on reflective prisms as potential baboon (*Papio ursinus*) deterrents in the Cape Peninsula, South Africa. *African Journal of Wildlife Research*, ***45***(1), 117. https://doi.org/10.3957/056.045.0108

Kaplan, B.S., O'Riain, M.J., Van Eeden, R. & King, A. J. (2011). A low-cost manipulation of food resources reduces spatial overlap between baboons (*Papio ursinus*) and humans in conflict. *International Journal of Primatology*, ***32***(6), 1397–1412. https://doi.org/10.1007/s10764-011-9541-8

Kareiva, P. (2008). Ominous trends in nature recreation. *Proceedings of the National Academy of Sciences*, ***105***(8), 2757–2758. https://doi.org/10.1073/pnas.0800474105

Katsvanga, C.A.T., Mudyiwa, S.M. & Gwenzi, D. (2006). Bark stripping and population dynamics of baboon troops after chemical control in pine plantations of Zimbabwe. *African Journal of Ecology*, ***44***(3), 413–416. https://doi.org/10.1111/j.1365-2028.2006.00653.x

Keener-Eck, L.S., Morzillo, A.T. & Christoffel, R.A. (2020). A comparison of wildlife value orientations and attitudes toward timber rattlesnakes (*Crotalus horridus*). *Human Dimensions of Wildlife*, ***25***(1), 47–61. https://doi.org/10.1080/10871209.2019.1694108

Kifle, A. (2022). Human-olive baboon (*Papio anubis*) conflict in the human-modified landscape, Wollo, Ethiopia. *Global Ecology and Conservation*, ***31***, e01820.

Kim, E. & Donohue, K. (2011). Demographic, developmental and life-history variation across altitude in *Erysimum capitatum*: Altitudinal variation in the life history of a mustard. *Journal of Ecology*, ***99***(5), 1237–1249. https://doi.org/10.1111/j.1365-2745.2011.01831.x

Kimmig, S.E., Flemming, D., Kimmerle, J., Cress, U. & Brandt, M. (2020). Elucidating the socio-demographics of wildlife tolerance using the example of the red fox (*Vulpes vulpes*) in Germany. *Conservation Science and Practice*, ***2***(7). https://doi.org/10.1111/csp2.212

King, A.J. & Cowlishaw, G. (2009). All together now: Behavioural synchrony in baboons. *Animal Behaviour*, ***78***(6), 1381–1387. https://doi.org/10.1016/j.anbehav.2009.09.009

King, A.J., Douglas, CM. S., Huchard, E., Isaac, N.J.B. & Cowlishaw, G. (2008). Dominance and affiliation mediate despotism in a social primate. *Current Biology*, ***18***(23), 1833–1838. https://doi.org/10.1016/j.cub.2008.10.048

King, A.J., Douglas, C.M.S., Huchard, E., Isaac, N.J.B. & Cowlishaw, G. (2011). Dominance and affiliation mediate despotism in a social primate. *Current Biology*, ***18***, 1833-1838.

Kirilyuk, A. & Ke, R. (2020). Wolf depredation on livestock in Daursky State Nature Biosphere Reserve, Russia. *Journal for Nature Conservation*, ***58***, 125916. https://doi.org/10.1016/j.jnc.2020.125916

Klegarth, A.R., Hollocher, H., Jones-Engel, L., Shaw, E., Lee, B.P.Y.H., Feeney, T., Holmes, D., Laguea, D. & Fuentes, A. (2017). Urban primate ranging patterns: GPS-collar deployments for *Macaca fascicularis* and *M. sylvanus*. *American Journal of Primatology*, ***79***(5), e22633. https://doi.org/10.1002/ajp.22633

Kleiven, J., Bjerke, T. & Kaltenborn, B.P. (2004). Factors influencing the social acceptability of large carnivore behaviours. *Biodiversity and Conservation*, ***13***(9), 1647–1658. https://doi.org/10.1023/B:BIOC.0000029328.81255.38

Knopff, A.A., Knopff, K.H. & St. Clair, C.C. (2016). Tolerance for cougars diminished by high perception of risk. *Ecology and Society*, ***21***(4), art33. https://doi.org/10.5751/ES-08933-210433

Knysna Municipality Addressing Baboon Issue (2016, 15 December). In ShowMe. https://showme.co.za/knysna/news/knysna-municipality-addressing-baboon-issue

Kogelberg Biosphere Reserve Company. (2022). https://kogelbergbiosphere.org.za/

König, H.J., Kiffner, C., Kramer-Schadt, S., Fürst, C., Keuling, O. & Ford, A.T. (2020). Human–wildlife coexistence in a changing world. *Conservation Biology*, ***34***(4), 786–794. https://doi.org/10.1111/cobi.13513

Krishnamani, R. & Mahaney, W. C. (2000). Geophagy among primates: Adaptive significance and ecological consequences. *Animal Behaviour*, ***59***(5), 899–915. https://doi.org/10.1006/anbe.1999.1376

Lahvis, G.P., Wells, R.S., Kuehl, D.W., Rhinehart, H.L. & Via, C.S. (1995). Decreased lymphocyte responses in free-ranging bottlenose dolphins (*Tursiops truncatus*) are associated with increased concentrations of PCBs and DDT in peripheral blood. *Environmental Health Perspectives*, ***103***, 67-72.

Lamb, C.T., Mowat, G., McLellan, B.N., Nielsen, S.E. & Boutin, S. (2017). Forbidden fruit: Human settlement and abundant fruit create an ecological trap for an apex omnivore. *Journal of Animal Ecology,* ***86***(1), 55–65. https://doi.org/10.1111/1365-2656.1258

Lambert, J.E. & Rothman, J.M. (2015). Fallback foods, optimal diets, and nutritional targets: primate responses to varying food availability and quality. *Annual Review of Anthropology*, ***44***(1), 493–512. https://doi.org/10.1146/annurev-anthro-102313-025928

Larson, K.L., Rosales Chavez, J.B., Brown, J.A., Morales-Guerrero, J. & Avilez, D. (2023). Human–wildlife interactions and coexistence in an urban desert environment. *Sustainability*, ***15***(4), 3307. https://doi.org/10.3390/su15043307

Lee, P.C. & Priston, N.E.C. (2005). Human attitudes to primates: perceptions of pests, conflict and consequences for primate conservation. In J.D. Paterson and J. Wallis (Eds.), *Commensalism and Conflict: The Human-Primate Interface* (pp. 1–23). American Society of Primatologists.

Leighton, G.R.M., Bishop, J.M., Merondun, J., Winterton, D.J., O'Riain, M.J. & Serieys, L.E.K. (2022a). Hiding in plain sight: Risk mitigation by a cryptic carnivore foraging at the urban edge. *Animal Conservation*, ***25***(2), 244–258. https://doi.org/10.1111/acv.12732

Leighton, G.R.M. (2021). *Life on the edge: Exploring the effects of urbanisation on the foraging ecology and ecotoxicology of caracals* [Doctoral thesis, University of Cape Town].

Leighton, G.R.M., Bishop, J.M., Camarero, R.M., O'Riain, M.J. & Serieys, L.E.K. (2022b). Poisoned chalice: Use of transformed landscapes associated with increased persistent organic pollutant concentrations and potential immune effects for an adaptable carnivore. *Science of the Total Environment*, ***882***, 153581.

Leith, D.A., Mpofu, B.S., Van Velden, J.L., Reed, C.C., Van Boom, K.M., Breed, D. & Kohn, T. A. (2020). Are cape peninsula baboons raiding their way to obesity and type II diabetes? - A comparative study. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology,* ***250***, 110794. https://doi.org/10.1016/j.cbpa.2020.110794

Lewis, M.C. & O'Riain, M.J. (2017). Foraging profile, activity budget and spatial ecology of exclusively natural-foraging chacma baboons (*Papio ursinus*) on the Cape Peninsula, South Africa. *International Journal of Primatology*, ***38***(4), 751–779. https://doi.org/10.1007/s10764-017-9978-5

Li, Y., Li, D., Ren, B., Hu, J., Li, B., Krzton, A. & Li, M. (2015). Differences in the activity budgets of yunnan snub-nosed monkeys (*Rhinopithecus bieti*) by age-sex class at Xiangguqing in Baimaxueshan Nature Reserve, China. *Folia Primatologica*, ***85***(6), 335–342. https://doi.org/10.1159/000368831

Li, Z. & Rogers, E. (2004). Habitat quality and activity budgets of white-headed langurs in Fusui, China. *International Journal of Primatology*, ***25***(1), 41–54. https://doi.org/10.1023/B:IJOP.0000014644.36333.94

Linden, B., Cuozzo, F.P., Sauther, M.L. & Collinson Jonker, W. (2022). Impact of linear infrastructure on South Africa's primate fauna: The need for mitigation. *Folia Primatologica*, ***93***(3–6), 235–253. https://doi.org/10.1163/14219980-20211112

Lindshield, S.M. (2016). Protecting nonhuman primates in peri-urban environments: a case study of neotropical monkeys, corridor ecology, and coastal economy in the Caribe Sur of Costa Rica. In M. T. Waller (Ed.), *Ethnoprimatology* (pp. 351–369). Springer International Publishing. https://doi.org/10.1007/978-3-319-30469-4_19

Lischka, S.A., Teel, T.L., Johnson, H.E. & Crooks, K.R. (2019). Understanding and managing human tolerance for a large carnivore in a residential system. *Biological Conservation*, ***238***, 108189. https://doi.org/10.1016/j.biocon.2019.07.034

Lowry, H., Lill, A. & Wong, B.B.M. (2012). Behavioural responses of wildlife to urban environments. Biological Reviews, 88(3), 537-549. https://doi: 10.1111/brv.12012

Mackenzie, C.A. & Ahabyona, P. (2012). Elephants in the garden: Financial and social costs of crop raiding. *Ecological Economics*, ***75***, 72–82. https://doi.org/10.1016/j.ecolecon.2011.12.018

Malik, I., Seth, P.K. & Southwick, C.H. (1984). Population growth of free-ranging rhesus monkeys at Tughlaqabad. *American Journal of Primatology*, ***7***(4), 311–321. https://doi.org/10.1002/ajp.1350070402

Manfredo, M.J. (1989). Human dimensions of wildlife management. *Wildlife Society Bulletin (1973-2006)*, ***17***, 447–449.

Manfredo, M.J. & Dayer, A.A. (2004). Concepts for exploring the social aspects of human–wildlife conflict in a global context. *Human Dimensions of Wildlife*, ***9***(4), 1–20. https://doi.org/10.1080/10871200490505765

Manfredo, M.J., Teel, T.L. & Dietsch, A.M. (2016). Implications of human value shift and persistence for biodiversity conservation: Value shift and conservation. *Conservation Biology*, ***30***(2), 287–296. https://doi.org/10.1111/cobi.12619

Manfredo, M.J., Urquiza-Haas, E.G., Don Carlos, A.W., Bruskotter, J.T. & Dietsch, A. M. (2020). How anthropomorphism is changing the social context of modern wildlife conservation. *Biological Conservation,* ***241***, 108297. https://doi.org/10.1016/j.biocon.2019.108297

Manfredo, M.J., Vaske, J.J. & Decker, D.J. (1995). Human dimensions of wildlife management: Basic concepts. In R.L. Knight and K. Gutzwiller, *Wildlife and Recreationists: Coexistence through Management and Research* (pp. 17-31). Island Press.

Manfredo, M.J. (2008). Who Cares About Wildlife? Social Science Concepts for Exploring Human-Wildlife Relationships and Conservation Issues. Springer.

Mann, G.K.H., O'Riain, M.J. & Parker, D.M. (2015). The road less travelled: Assessing variation in mammal detection probabilities with camera traps in a semi-arid biodiversity hotspot. *Biodiversity and Conservation*, ***24***(3), 531–545. https://doi.org/10.1007/s10531-014-0834-z

Mann, G.K.H., Wilkinson, A., Hayward, J., Drouilly, M., O'Riain, M.J. & Parker, D.M. (2019). The effects of aridity on land use, biodiversity and dietary breadth in leopards. *Mammalian Biology*, ***98***, 43–51. https://doi.org/10.1016/j.mambio.2019.07.003

Manning, J. (2018). Field guide to fynbos. Struik Nature.

Marshall, A.J. & Wrangham, R.W. (2007). Evolutionary consequences of fallback foods. *International Journal of Primatology*, ***28***, 1219-1235.

Masi, S., Cipolletta, C. & Robbins, M.M. (2009). Western lowland gorillas (*Gorilla gorilla gorilla*) change their activity patterns in response to frugivory. *American Journal of Primatology*, ***71***(2), 91–100. https://doi.org/10.1002/ajp.20629

McCleery, R.A., Moorman, C.E. & Peterson, M.N. (Eds.). (2014). *Urban Wildlife*. Springer US. https://doi.org/10.1007/978-1-4899-7500-3

McDonald, P., Edwards, R.A., Greenhalgh, J.F.D., Morgan, C.A., Sinclair, L.A. & Wilkinson, R.G. (2011). *Animal Nutrition*, Seventh Edition. Pearson.

McDonnell, M.J. (2011). The history of urban ecology: An ecologist's perspective. In J. Niemelä, J. H. Breuste, T. Elmqvist, G. Guntenspergen, P. James and N. E. McIntyre, *Urban ecology: Patterns, Processes, and Applications* (pp. 5-13). Oxford University Press.

McKinney, T., Waters, S. & Rodrigues, M.A. (Eds.). (2023). *Primates in Anthropogenic Landscapes: Exploring Primate Behavioural Flexibility Across Human Contexts*. Springer. https://doi.org/10.1007/978-3-031-11736-7

McLean, E.M., Archie, E.A. & Alberts, S.C. (2019). Lifetime fitness in wild female baboons: trade-offs and individual heterogeneity in quality. *The American Naturalist*, ***194***(6), 745–759. https://doi.org/10.1086/705810

McLennan, M.R., Spagnoletti, N. & Hockings, K.J. (2017). The implications of primate behavioral flexibility for sustainable human–primate coexistence in anthropogenic habitats. *International Journal of Primatology*, ***38***(2), 105–121. https://doi.org/10.1007/s10764-017-9962-0

Meeus, S.J. & Gulinck, H. (2008). Semi-urban areas in landscape research: a review. *Living Reviews in Landscape Research*, ***2***, 3. https://doi.org/10.12942/lrlr-2008-3

Ménard, N., Motsch, P., Delahaye, A., Saintvanne, A., Le Flohic, G., Dupé, S., Vallet, D., Qarro, M. & Pierre, J.S. (2013). Effect of habitat quality on the ecological behaviour of a temperate-living primate: Time-budget adjustments. *Primates*, ***54***(3), 217–228. https://doi.org/10.1007/s10329-013-0350-x

Merz, L., Pienaar, E.F., Fik, T. & Muyengwa, S. (2021). Tolerance of wildlife in protected area borderlands [Preprint]. *Ecology*. https://doi.org/10.1101/2021.03.27.436188

Miller, Z.D., Freimund, W., Metcalf, E.C. & Nickerson, N. (2018). Targeting your audience: Wildlife value orientations and the relevance of messages about bear safety. *Human Dimensions of Wildlife,* ***23***(3), 213–226. https://doi.org/10.1080/10871209.2017.1409371

Mohnot, S.M., Gadgil, M. & Makwana, S.C. (1981). On the dynamics of the Hanuman langur populations of Jodhpur (Rajasthan, India). *Primates*, ***22***(2), 182–191. https://doi.org/10.1007/BF02382609

Mormile, J.E. & Hill, C.M. (2017). Living with urban baboons: exploring attitudes and their implications for local baboon conservation and management in Knysna, South Africa. *Human Dimensions of Wildlife*, ***22***(2), 99–109. https://doi.org/10.1080/10871209.2016.1255919

Musah, Y., Attuquayefio, D.K., Pobee, A.N.A. & Holbech, L.H. (2022). Ophidiophobia, myth generation, and human perceptions: Implications for snake conservation in a typical savanna community of northern Ghana. *Human Dimensions of Wildlife*, ***27***(4), 321–342. https://doi.org/10.1080/10871209.2021.1952357

Myonki, F.J., Estes, A.B., Msuha, M.J., Litchenfeld, L.L. & Durant, S.M. (2017). Local attitudes and perceptions toward large carnivores in a human-dominated landscape of northern Tanzania. *Human Dimensions of Wildlife*, ***22***(4), 314-330.

Nahallage, C. A., & Huffman, M. A. (2012). Macaque–human interactions in past and present-day Sri Lanka. In S. Radhakrishna, M.A. Huffman and A. Sinha (Eds.), *The Macaque connection: Cooperation and conflict between humans and macaques* (pp. 135-148). Springer.

Nakamura, D., Yoshida, Y. & Takeuchi, M. (2023). Reluctance of urban residents to adopt preparedness behaviors against wild monkey intrusion: A case of the northern area of Mount Fuji. *Human Dimensions of Wildlife*, ***28***(2), 121–137. https://doi.org/10.1080/10871209.2021.2015016

Naughton-Treves, L., Treves, A., Chapman, C. & Wrangham, R. (1998). Temporal patterns of crop-raiding by primates. *Journal of Applied Ecology*, ***35***, 596–606.

Naughton, L., Rose, R. & Treves, A. (1999). The social dimensions of human-elephant conflict in Africa: A literature review and case studies from Uganda and Cameroon. A Report to the African Elephant Specialist Group, Human-Elephant Conflict Task Force, IUCN, Glands, Switzerland.

NCC Environmental Services. (2023). Information and leaflets. https://ncc-group.co.za/information-and-leaflets/

NCC Environmental Services. (2023). Management Reports. https://ncc-group.co.za/urban-baboon-programme/

Neuman, C. & Kulik, L. (2020). Elorating: Animal dominance hierarchies by Elo Rating, R package.

Newing, H. (2010). Conducting research in conservation: social science methods and practice. Routledge.

Nijman, V. & Nekaris, K.A.I. (2010). Testing a model for predicting primate crop-raiding using crop- and farm-specific risk values. *Applied Animal Behaviour Science*, ***127*(**3–4), 125–129. https://doi.org/10.1016/j.applanim.2010.08.009

Nyhus, P.J. (2016). Human–wildlife conflict and coexistence. *Annual Review of Environment and Resources*, ***41***(1), 143–171. https://doi.org/10.1146/annurev-environ-110615-085634

Okecha, A.A. & Newton-Fisher, N.E. (2006). The diet of olive baboons (*Papio anubis*) in the Budongo Forest Reserve, Uganda. In N.E. Newton-Fisher, H. Notman, J.D. Paterson and V. Reynolds (Eds.), *Primates of Western Uganda* (pp. 61–73). Springer.

Okes, N.C. (2017). *Conservation ecology of the Cape clawless otter, Aonyx capensis, in an urban environment* [Doctoral thesis, University of Cape Town].

Olaleru, F., Ogunfuwa, A.A. & Omoregie, Q.O. (2020). An assessment of human-monkey conflict in urban communities in Lagos State, Nigeria. *Unilag Journal of Medicine, Science and Technology*, ***8***(1), 160–175.

Onwezen, M.C., Antonides, G. & Bartels, J. (2013). The norm activation model: An exploration of the functions of anticipated pride and guilt in pro-environmental behaviour. *Journal of Economic Psychology*, ***39***, 141–153. https://doi.org/10.1016/j.joep.2013.07.005

Ostermann-Miyashita, E.F., Pernat, N., König, H.J., Hemminger, K., Gandl, N., Bellingrath-Kimura, S.D., Hibler, S. & Kiffner, C. (2023). Attitudes of wildlife park visitors towards returning wildlife species: An analysis of patterns and correlates. *Biological Conservation*, ***278***, 109878. https://doi.org/10.1016/j.biocon.2022.109878

Overstrand Municipality (2017). Infrastructure & Planning: GIS department.

Overstrand Baboon Management (2022, March 23). In Overstrand Municipality. https://www.overstrand.gov.za/overstrand-baboon-management/

Palagi, E. (2018). Not just for fun! Social play as a springboard for adult social competence in human and non-human primates. *Behavioral Ecology and Sociobiology*, ***72***(6), 90. https://doi.org/10.1007/s00265-018-2506-6

Palmer, M.S., Fieberg, J., Swanson, A., Kosmala, M. & Packer, C. (2017). A 'dynamic' landscape of fear: Prey responses to spatiotemporal variations in predation risk across the lunar cycle. *Ecology Letters*, ***20***(11), 1364–1373. https://doi.org/10.1111/ele.12832

Palombit, R.A., Cheney, D.L., Fischer, J., Johnson, S., Rendall, D., Seyfarth, R.M. & Silk, J.B. (2000). Male infanticide and defense of infants in chacma baboons. In C. P. Van Schaik & C. H. Janson (Eds.), *Infanticide by Males and its Implications* (pp. 123–152). Cambridge University Press. https://doi.org/10.1017/CBO9780511542312.008

Paquet, P. & Darimont, C. (2010). Wildlife conservation and animal welfare: Two sides of the same coin? *Animal Welfare*, ***19***(2), 177–190. https://doi.org/10.1017/S0962728600001433

Parsons, W.J. (2021). *Understanding human-wildlife conflict: a geographic study of the Pringle Bay chacma baboon troop* [MSc thesis, Rhodes University].

Patterson, L., Kalle, R. & Downs, C. (2018). Factors affecting presence of vervet monkey troops in a suburban matrix in KwaZulu-Natal, South Africa. *Landscape and Urban Planning*, ***169***, 220–228. https://doi.org/10.1016/j.landurbplan.2017.09.016

Pearce, J.M. & Bouton, M.E. (2001). Theories of associative learning in animals. *Annual Review of Psychology*, ***52***, 111-139.

Pebsworth, P.A. & Radhakrishna, S. (2021). The costs and benefits of coexistence: What determines people's willingness to live near nonhuman primates? *American Journal of Primatology*, ***83***(9). https://doi.org/10.1002/ajp.23310

Pebsworth, P.A., Bardi, M. & Huffman, M.A. (2012). Geophagy in chacma baboons: Patterns of soil consumption by age class, sex, and reproductive state. *American Journal of Primatology*, ***74***(1), 48–57. https://doi.org/10.1002/ajp.21008

Pebsworth, P.A., Huffman, M.A., Lambert, J.E. & Young, S.L. (2018). Geophagy among nonhuman primates: A systematic review of current knowledge and suggestions for future directions. *Journal of Physical Anthropology, **168***, 164-194. https://doi.org 10.1002/ajpa.23724

Penteriani, V., Delgado, M.D.M., Krofel, M., Jerina, K., Ordiz, A., Dalerum, F., Zarzo-Arias, A. & Bombieri, G. (2018). Evolutionary and ecological traps for brown bears *Ursus arctos* in human-modified landscapes. *Mammal Review*, ***48***(3), 180–193. https://doi.org/10.1111/mam.12123

Périquet, S., Roxburgh, L., Le Roux, A. & Collinson, W.J. (2018). Testing the Value of Citizen Science for Roadkill Studies: A Case Study from South Africa. *Frontiers in Ecology and Evolution*, ***6***, 15. https://doi.org/10.3389/fevo.2018.00015

Perry, G., Boal, C., Verble, R. & Wallace, M. (2020). "Good" and "bad" urban wildlife. In F. M. Angelici & L. Rossi (Eds.), *Problematic Wildlife II* (pp. 141–170). Springer International Publishing. https://doi.org/10.1007/978-3-030-42335-3_5

Petersdorf, M., Weyher, A.H., Kamilar, J.M., Dubuc, C. & Higham, J.P. (2019). Sexual selection in the Kinda baboon. *Journal of Human Evolution*, ***135***, 102635. https://doi.org/10.1016/j.jhevol.2019.06.006

Pfaff, M.C., Logston, R.C., Raemaekers, S.J.P.N., Hermes, J.C., Blamey, L.K., Cawthra, H.C., Colenbrander, D.R., Crawford, R.J.M., Day, E., Du Plessis, N., Elwen, S.H., Fawcett, S.E., Jury, M. R., Karenyi, N., Kerwath, S.E., Kock, A.A., Krug, M., Lamberth, S.J., Omardien, A., … Kirkman, S.P. (2019). A synthesis of three decades of socio-ecological change in False Bay,

South Africa: Setting the scene for multidisciplinary research and management. *Elementa: Science of the Anthropocene*, ***7***, 32. https://doi.org/10.1525/elementa.367

Philo, C. & Wilbert, C. (2000). Animal space, beastly places: an introduction. In C. Philo and C. Wilbert (Eds.) *Animal Spaces, Beastly Places New Geographies of Human-Animal Relations* (pp. 1-35). Routledge.

Pimm, S.L. & Raven, P. (2000). Extinction by numbers. *Nature*, ***403***(6772), 843–845. https://doi.org/10.1038/35002708

Pooley, J.A. & O'Connor, M. (2000). Environmental education and attitudes: emotions and beliefs are what is needed. *Environment and Behavior*, ***32***(5), 711–723. https://doi.org/10.1177/0013916500325007

Pooley, S. (2021). Coexistence for whom? *Frontiers in Conservation Science*, ***2***, 726991. https://doi.org/10.3389/fcosc.2021.726991

Pooley, S., Bhatia, S. & Vasava, A. (2021). Rethinking the study of human–wildlife coexistence. *Conservation Biology*, ***35***(3), 784–793. https://doi.org/10.1111/cobi.13653

Porlier, M., Bélisle, M. & Garant, D. (2009). Non-random distribution of individual genetic diversity along an environmental gradient. *Philosophical Transactions of the Royal Society B*, ***364***(1523), 1543–1554. https://doi.org/10.1098/rstb.2009.0010

Post, D.G., Hausfater, G. & McCuskey, S.A. (1980). Feeding behavior of yellow baboons (*Papio cynocephalus*): relationship to age, gender and dominance rank. *Folia primatologica*, ***34***(3-4), 170-195.

Prange, S., Gehrt, S.D. & Wiggers, E.P. (2004). Influences of anthropogenic resources on raccoon (*Procyon lotor*) movements and spatial distribution. *Journal of Mammalogy*, ***85***(3).

Prokop, P., Kubiatko, M. & Fančovičová, J. (2008). Slovakian pupils' knowledge of, and attitudes toward, birds. *Anthrozoös*, ***21***(3), 221–235. https://doi.org/10.2752/175303708X332035

Pusey, A.E. (2018). Inbreeding avoidance, evolutionary mechanisms of. In H. Callan (Ed.), *The International Encyclopedia of Anthropology* (pp. 1–6). Wiley. https://doi.org/10.1002/9781118924396.wbiea1747

Ralls, K. & Ballou, J. (1982). Effect of inbreeding on juvenile mortality in some small mammal species. *Laboratory Animals*, ***16***(2), 159–166. https://doi.org/10.1258/002367782781110151

Ralls, K., Ballou, J.D. & Templeton, A. (1988). Estimates of lethal equivalents and the cost of inbreeding in mammals. *Conservation Biology*, ***2***(2), 185–193. https://doi.org/10.1111/j.1523-1739.1988.tb00169.x

Ramakrishnan, B., Ilakkia, M. & Ramkumar, K. (2014). Use of shade trees for Asian elephants (*Elephas maximus*) in the Mudumalai Tiger Reserve, Nilgris, Tamilnadu, Southern India. *Journal of Scientific Transactions in Environment and Technovation*, ***7***(3), 144-150.

Ravasi, D.F., O'Riain, M.J., Davids, F. & Illing, N. (2012). Phylogenetic evidence that two distinct trichuris genotypes infect both humans and non-human primates. *PLoS ONE*, ***7***(8), e44187. https://doi.org/10.1371/journal.pone.0044187

Ray, S., Danks, N. & Valdez, C.A. (2021). SEMinR: domain-specific language for building, estimating, and visualizing structural equation models in r.

Rebelo, A.G., Boucher, C., Helme, N., Mucina, L. & Rutherford, M.C. (2006). Fynbos biome. In L. Mucina and M.C. Rutherford (Eds.) *The Vegetation of South Africa, Lesotho and Swaziland*. Strelitiza 19.

Redpath, S. M., Bhatia, S. & Young, J. (2015a). Tilting at wildlife: Reconsidering human–wildlife conflict. *Oryx*, ***49***(2), 222–225. https://doi.org/10.1017/S0030605314000799

Redpath, S.M., Gutiéerrez, R.J., Wood, K.A., Sidaway, R. & Young, J.C. (2015b). An introduction to conservation conflicts. In S. M. Redpath, R. J. Gutiérrez, K. A. Wood, & J. C. Young (Eds.), *Conflicts in Conservation* (pp. 3–18). Cambridge University Press. https://doi.org/10.1017/CBO9781139084574.002

RERA. (2018). *Rooiels: A village between the mountains and the sea*. Rooiels Ratepayers' Association (RERA). Betty's Bay, South Africa.

Reyna-Hurtado, R., Teichroeb, J.A., Bonnell, T.R., Hernández-Sarabia, R.U., Vickers, S.M., Serio-Silva, J. C., Sicotte, P. & Chapman, C.A. (2018). Primates adjust movement strategies due to

changing food availability. *Behavioral Ecology*, ***29***(2), 368–376. https://doi.org/10.1093/beheco/arx176

Rhine, R.J., Bioland, P. & Lodwick, L. (1985). Progressions of adult male chacma baboons (*Papio ursinus*) in the Moremi Wildlife Reserve. *International Journal of Primatology*, ***6***(2), 115–122. https://doi.org/10.1007/BF02693649

Rice, K.J. & Emery, N.C. (2003). Managing microevolution: Restoration in the face of global change. *Frontiers in Ecology and the Environment*, ***1***(9), 469–478.

Richardson, D.M., van Wilgen, B.W., Higgins, S.I., Trinder-Smith, T.H., Cowling, R.M. & McKell, D.H. (1996). Current and future threats to plant biodiversity on the Cape Peninsula, South Africa. *Biodiversity and Conservation*, ***5***, 607-647.

Richardson, P.R.K., Conradie, E.C., Olivier, P.A., Rode, S.C. Ferreira, S., Khoury, R.E., Shutte, C. & Loubser, B. (2017). Virtual fencing as a new strategy for baboon management. In Proceedings of the 14th Annual Savanna Science Network Meeting, Skukuza, South Africa, 12-17, March 2016.

Riley, C. M., Koenig, B. L. & Gumert, M. D. (2015). Observation of a fatal dog attack on a juvenile long-tailed macaque in a human-modified environment in Singapore. *Nature in Singapore*, ***8***, 57-63.

Riley, E. P. (2008). Ranging patterns and habitat use of Sulawesi Tonkean macaques (Macaca tonkeana) in a human-modified habitat. *American Journal of Primatology*, ***70***(7), 670–679. https://doi.org/10.1002/ajp.20543

Riley, S. J. & Decker, D. J. (2000). Wildlife stakeholder acceptance capacity for cougars in Montana. *Wildlife Society Bulletin (1973-2006)*, ***28***(4), 931–939.

Riley, S.P.D., Boydston, E.E., Crooks, K.R. & Lyren, L.M. (2010). Bobcats (*Lynx rufus*). In S.D. Gehrt, S.P.D. Riley, and B.L. Cypher (Eds.), *Urban Carnivores Ecology, Conflict, and Conservation* (pp. 121-141). John Hopkins University Press.

Robertson, B. A. & Hutto, R. L. (2006). A framework for understanding ecological traps and an evaluation of existing evidence. *Ecology*, ***87***(5), 1075–1085. https://doi.org/10.1890/0012-9658(2006)87[1075:AFFUET]2.0.CO;2

Rodewald, A. D. & Gehrt, S. D. (2014). Wildlife population dynamics in urban landscapes. *Urban Wildlife Conservation*, 117-147.

Rooiels Conservancy. (2021). Baboon coexistence pathway. https://rooiels.weebly.com/baboon-coexistence-pathway.html

Rooiels Conservancy. (2023). Living the Rooiels vision. https://rooiels.weebly.com/re-living-vision.html

Rudd, J.L., McMillin, S.C., Kenyon, M.W., Clifford, D.L. & Poppenga, R.H. (2018). Prevalence of first and second-generation anticoagulant rodenticide exposure in California mountain lions (*Puma concolor*). *Proceedings of the Vertebrate Pest Conference*, ***28***. https://doi.org/10.5070/V42811046

Saj, T. L., Sicotte, P. & Paterson, J. D. (2001). The conflict between vervet monkeys and farmers at the forest edge in Entebbe, Uganda. *African Journal of Ecology*, ***39***, 195–199.

Saj, T., Sicotte, P. & Paterson, J.D. (1999). Influence of Human Food Consumption on the Time Budget of Vervets. *International Journal of Primatology*, ***20***(6), 977–994.

Sambrook, T.D., Whiten, A. & Strum, S.C. (1995). Priority of access and grooming patterns of females in a large and a small group of olive baboons. *Animal Behaviour*, ***50***(6), 1667–1682. https://doi.org/10.1016/0003-3472(95)80020-4

Samuels, A. & Altmann, J. (1991). Baboons of the Amboseli basin: Demographic stability and change. *International Journal of Primatology*, ***12***(1), 1–19. https://doi.org/10.1007/BF02547555

SANBI. (2018). National Vegetation Map. https://www.sanbi.org/biodiversity/foundations/national-vegetation-map/

Schlaepfer, M.A., Runge, M.C. & Sherman, P.W. (2002). Ecological and evolutionary traps. *Trends in Ecology & Evolution*, ***17***(10), 474–480. https://doi.org/10.1016/S0169-5347(02)02580-6

Seitz, S.J., Lord, C.G. & Taylor, C.A. (2007). Beyond pleasure: emotion activity affects the relationship between attitudes and behavior. *Personality and Social Psychology Bulletin*, ***33***(7), 933–947. https://doi.org/10.1177/0146167207301025

Seymour, C.L., Simmons, R. E., Morling, F., George, S.T., Peters, K. & O'Riain, M.J. (2020). Caught on camera: The impacts of urban domestic cats on wild prey in an African city and neighbouring protected areas. *Global Ecology and Conservation*, ***23***, e01198. https://doi.org/10.1016/j.gecco.2020.e01198

Sha, J.C.M., Gumert, M.D., Lee, B.P.Y.H., Fuentes, A., Rajathurai, S., Chan, S. & Jones-Engel, L. (2009). Status of the long-tailed macaque *Macaca fascicularis* in Singapore and implications for management. *Biodiversity and Conservation*, ***18***(11), 2909–2926. https://doi.org/10.1007/s10531-009-9616-4

Sharma, G., Ram, C. & Rajpurohit, L.S. (2011). Study of man-monkey conflict and its management in Jodhpur, Rajasthan (India). *Journal of Evolutionary Biology Research*, ***3***(1), 1–3.

Sharma, S. & Kreye, M.M. (2021). Public attitudes towards birds and private forest land conservation. *Forests*, ***12***(11), 1525. https://doi.org/10.3390/f12111525

Sharma, S., Kooner, R. & Arora, R. (2017). Insect pests and crop losses. In R. Arora and S. Sandhu (Eds.) *Breeding Insect Resistant Crops for Sustainable Agriculture* (pp. 45-66). Springer.

Siex, K.S. & Struhsaker, T.T. (1999). Ecology of the zanzibar red colobus monkey: demographic variability and habitat stability. *International Journal of Primatology*, ***20***, 163–192.

Silk, J.B. (1983). Local resource competition and facultative adjustment of sex ratios in relation to competitive abilities. *The American Naturalist*, ***121***(1), 56–66.

Sinha, A. & Vijayakrishnan, S. (2017). Primates in urban settings. In M. Bezanson, K. C. MacKinnon, E. Riley, C. J. Campbell, K. A. I. Nekaris, A. Estrada, A. F. Di Fiore, S. Ross, L. E. Jones-Engel, B. Thierry, R. W. Sussman, C. Sanz, J. Loudon, S. Elton and A. Fuentes (Eds.), *The International Encyclopedia of Primatology* (pp. 1–8). John Wiley & Sons, Inc. https://doi.org/10.1002/9781119179313.wbprim0458

Sithaldeen, R. & Rylands, A.B. 2020. *Papio ursinus* ssp*. ursinus*. The IUCN Red List of Threatened Species 2020: e.T136856A17986139

Skead, C.J. (1980). Historical Mammal Incidence in the Cape Province. Volume 1. Department of Nature and Environmental Conservation, Cape Town.

Skupien, G.M., Andrews, K.M. & Larson, L.R. (2016). Teaching tolerance? effects of conservation education programs on wildlife acceptance capacity for the american alligator. *Human Dimensions of Wildlife*, ***21***(3), 264–279. https://doi.org/10.1080/10871209.2016.1147624

Slabbekoorn, H. & Peet, M. (2003). Birds sing at a higher pitch in urban noise. *Nature*, ***424***(6946), 267–267. https://doi.org/10.1038/424267a

Slagle, K.M., Bruskotter, J.T. & Wilson, R.S. (2012). The role of affect in public support and opposition to wolf management. *Human Dimensions of Wildlife*, ***17***(1), 44–57. https://doi.org/10.1080/10871209.2012.633237

Slagle, K., Zajac, R., Bruskotter, J., Wilson, R. & Prange, S. (2013). Building tolerance for bears: A communications experiment: Building Tolerance for Bears. *The Journal of Wildlife Management*, ***77***(4), 863–869. https://doi.org/10.1002/jwmg.515

Sol, D., González-Lagos, C., Moreira, D., Maspons, J. & Lapiedra, O. (2014). Urbanisation tolerance and the loss of avian diversity. *Ecology Letters*, ***17***(8), 942–950. https://doi.org/10.1111/ele.12297

Sol, D., Lapiedra, O. & González-Lagos, C. (2013). Behavioural adjustments for a life in the city. *Animal Behaviour*, ***85***(5), 1101–1112. https://doi.org/10.1016/j.anbehav.2013.01.023

Soulsbury, C.D. & White, P.C.L. (2015). Human–wildlife interactions in urban areas: A review of conflicts, benefits and opportunities. *Wildlife Research*, ***42***(7), 541. https://doi.org/10.1071/WR14229

Soulsbury, C.D., Baker, P.J., Iossa, G. & Harris, S. (2010). Red foxes (*Vulpes vulpes*). In S.D. Gehrt, S.P.D. Riley, and B.L. Cypher (Eds.), *Urban Carnivores Ecology, Conflict, and Conservation* (pp. 63-75). John Hopkins University Press.

South African Weather Service (2022). Weather Questions. https://www.weathersa.co.za/home/weatherques

Spelt, A., Soutar, O., Williamson, C., Memmott, J., Shamoun-Baranes, J., Rock, P. & Windsor, S. (2021). Urban gulls adapt foraging schedule to human-activity patterns. *Ibis*, ***163***(1), 274–282. https://doi.org/10.1111/ibi.12892

Stem, C., Margoluis, R., Salafsky, N. & Brown, M. (2005). Monitoring and evaluation in conservation: a review of trends and approaches. *Conservation Biology*, ***19***(2), 295–309. https://doi.org/10.1111/j.1523-1739.2005.00594.x

Stone, W.B., Okoniewski, J.C. & Stedelin, J.R. (1999). Poisoning of wildlife with anticoagulant rodenticides in New York. *Journal of Wildlife Diseases*, ***35***(2), 187–193. https://doi.org/10.7589/0090-3558-35.2.187

Straka, T.M., Greving, H. & Voigt, C.C. (2021). The effects of bat photographs on emotions, attitudes, intentions, and wildlife value orientations. *Human Dimensions of Wildlife*, ***26***(6), 596–603. https://doi.org/10.1080/10871209.2020.1864068

Straka, T.M., Miller, K.K. & Jacobs, M.H. (2020). Understanding the acceptability of wolf management actions: Roles of cognition and emotion. *Human Dimensions of Wildlife*, ***25***(1), 33–46. https://doi.org/10.1080/10871209.2019.1680774

Strum, S.C. (1994). Prospects for management of primate pests. *Revue d'Écologie* (*La Terre et La Vie*), ***49***(3), 295–306. https://doi.org/10.3406/revec.1994.2479

Strum, S.C. (2010). The Development of Primate Raiding: Implications for Management and Conservation. *International Journal of Primatology*, ***31***(1), 133–156. https://doi.org/10.1007/s10764-009-9387-5

Strum, S.C. & Western, J.D. (1982). Variations in fecundity with age and environment in olive baboons (Papio anubis). *American Journal of Primatology*, ***3***(1–4), 61–76. https://doi.org/10.1002/ajp.1350030106

Stueckle, S. & Zinner, D. (2008). To follow or not to follow: decision making and leadership during the morning departure in chacma baboons. *Animal Behaviour*, ***75***, 1995-2004.

Swedell, L. (2011). African papionins, diversity of social organization and ecological flexibility. In C. J. Campbell, A. Fuentes, K. C. MacKinnon, S. K. Bearder, R. M. Stumpf (Eds.) *Primates in Perspective* (pp. 241–277). Oxford University Press.

Swedell, L. & Saunders, J. (2006). Infant Mortality, Paternity Certainty, and Female Reproductive Strategies in Hamadryas Baboons. In L. Swedell & S. R. Leigh (Eds*.), Reproduction and Fitness in Baboons: Behavioral, Ecological, and Life History Perspectives* (pp. 19–51). Springer US. https://doi.org/10.1007/978-0-387-33674-9_2

Tan, A.S.L., De La Torre, J.A., Wong, E.P., Thuppil, V. & Campos-Arceiz, A. (2020). Factors affecting urban and rural tolerance towards conflict-prone endangered megafauna in Peninsular Malaysia. *Global Ecology and Conservation*, ***23***(e01179), 1–11. https://doi.org/10.1016/j.gecco.2020.e01179

Taylor, B.D., & Goldingay, R.L. (2004). Wildlife road-kills on three major roads in north-eastern New South Wales. *Wildlife Research*, ***31***(1), 83. https://doi.org/10.1071/WR01110

Teel, T.L. & Manfredo, M.J. (2010). understanding the diversity of public interests in wildlife conservation. *Conservation Biology*, ***24***(1), 128–139. https://doi.org/10.1111/j.1523-1739.2009.01374.x

Teixeira, F.Z., Printes, R.C., Fagundes, J.C.G., Alonso, A.C. & Kindel, A. (2013). Canopy bridges as road overpasses for wildlife in urban fragmented landscapes. *Biota Neotropica*, ***13***(1), 117–123. https://doi.org/10.1590/S1676-06032013000100013

Thatcher, H.R., Downs, C.T. & Koyama, N.F. (2019). Anthropogenic influences on the time budgets of urban vervet monkeys. *Landscape and Urban Planning*, ***181***, 38–44. https://doi.org/10.1016/j.landurbplan.2018.09.014

Thatcher, H.R., Downs, C.T. & Koyama, N.F. (2023). Primates in the urban mosaic: terminology, flexibility, and management. In T. McKinney, S. Waters and M.A. Rodrigues (Eds.) *Primates in Anthropogenic Landscapes Exploring Primate Behavioural Flexibility Across Human Contexts* (pp. 121-137). Springer.

The Baboons and Monkeys Are Back (2018, August 13). In George Herald. https://www.georgeherald.com/News/Article/Local-News/the-baboons-and-monkeys-are-back-201808130324

Thirgood, S., Woodroffe, R. & Rabinowitz, A. (2005). The impact of human-wildlife conflict on human lives and livelihoods. In S. Thirgood, R. Woodroffe and A. Rabinowitz (Eds.) *People and Wildlife Conflict or Coexistence* (pp. 13-26). Cambridge University Press.

Thompson, C.G., Kim, R.S., Aloe, A.M. & Becker, B.J. (2017). Extracting the Variance Inflation Factor and Other Multicollinearity Diagnostics from Typical Regression Results. *Basic and Applied Social Psychology*, ***39***(2), 81–90. https://doi.org/10.1080/01973533.2016.1277529

Tobin, M.E. & Fall, M.W. (2004). Pest control: Rodents. In R. Lal (Ed.) *Agricultural Sciences Volume II* (pp. 352-371). Eolss Publishers Co. Ltd.

Toncheva, S. & Fletcher, R. (2022). Knowing bears: An ethnographic study of knowledge and agency in human–bear cohabitation. *Environment and Planning E: Nature and Space*, ***5***(2), 901–923. https://doi.org/10.1177/25148486211015037

Trapanese, C., Meunier, H. & Masi, S. (2019). What, where and when: Spatial foraging decisions in primates: Spatial foraging decisions in primates. *Biological Reviews*, ***94***(2), 483–502. https://doi.org/10.1111/brv.12462

Treves, A. & Santiago-Ávila, F. J. (2020). Myths and assumptions about human-wildlife conflict and coexistence. *Conservation Biology*, ***34***(4), 811–818. https://doi.org/10.1111/cobi.13472

Treves, A., Naughton-Treves, L. & Shelley, V. (2013). Longitudinal analysis of attitudes toward wolves: attitudes toward wolves deteriorated. *Conservation Biology*, ***27***(2), 315–323. https://doi.org/10.1111/cobi.12009

Treves, A., Wallace, R.B. & White, S. (2009). Participatory planning of interventions to mitigate human–wildlife conflicts. *Conservation Biology*, ***23***(6), 1577–1587. https://doi.org/10.1111/j.1523-1739.2009.01242.x

Tsuji, Y., Hanya, G. & Grueter, C.C. (2013). Feeding strategies of primates in temperate and alpine forests: Comparison of Asian macaques and colobines. *Primates*, ***54***(3), 201–215. https://doi.org/10.1007/s10329-013-0359-1

Turner, W.R., Nakamura, T. & Dinetti, M. (2004). Global Urbanization and the separation of humans from nature. *BioScience*, ***54***(6), 585. https://doi.org/10.1641/0006-3568(2004)054[0585:GUATSO]2.0.CO;2

U.S. Geological Survey. (2019). Shuttle Radar Topography Mission. https://www.usgs.gov/centers/eros/science/usgs-eros-archive-digital-elevation-shuttle-radar-topography-mission-srtm. Accessed 28 June 2019.

UNESCO. (2019). Kogelberg Biosphere Reserve, South Africa. https://en.unesco.org/biosphere/africa/kogelberg

United Nations Department of Economic and Social Affairs, Population Division (2022). World Population Prospects 2022: Summary of Results. UN DESA/POP/2022/TR/NO.3.

United Nations, Department of Economic and Social Affairs, Population Division (2019). World Urbanization Prospects: The 2018 Revision (ST/ESA/SER.A/420). New York: United Nations.

United Nations. (2023). UN Population Division. https://population.un.org/dataportal/

van Beuningen, D. (2011). *Activity budgets and movement patterns of a marine foraging troop of chacma baboons (Papio ursinus) in Rooi Els, South Africa* [BSc Honours thesis, University of Cape Town].

Van Cleave, E.K., Bidner, L.R., Ford, A.T., Caillaud, D., Wilmers, C.C. & Isbell, L.A. (2018). Diel patterns of movement activity and habitat use by leopards (*Panthera pardus pardus*) living in a human-dominated landscape in central Kenya. *Biological Conservation, **226***, 224–237. https://doi.org/10.1016/j.biocon.2018.08.003

van der Meer, E., Rasmussen, G.S.A., Muvengwi, J. & Fritz, H. (2014). Foraging costs, hunting success and its implications for African wild dog (*Lycaon pictus*) conservation inside and outside a protected area. *African Journal of Ecology*, ***52***(1), 69–76. https://doi.org/10.1111/aje.12092

van Doorn, A.C. & O'Riain, M.J. (2020). Nonlethal management of baboons on the urban edge of a large metropole. *American Journal of Primatology*, ***82***(8). https://doi.org/10.1002/ajp.23164

van Doorn, A.C., O'Riain, M.J. & Swedell, L. (2010). The effects of extreme seasonality of climate and day length on the activity budget and diet of semi-commensal chacma baboons (*Papio ursinus*) in the Cape Peninsula of South Africa. *American Journal of Primatology*, ***72***, 104-112. https://doi.org/10.1002/ajp.20759

Van Heezik, Y.M., Dickinson, K.J.M. & Freeman, C. (2012). Closing the gap: communicating to change gardening practices in support of native biodiversity in urban private gardens. *Ecology and Society*, ***17***(1), 34. https://doi.org/10.5751/ES-04712-170134

Van Houdt, S. & Traill, L.W. (2022). A synthesis of human conflict with an African megaherbivore; the common hippopotamus. *Frontiers in Conservation Science*, ***3***, 954722. https://doi.org/10.3389/fcosc.2022.954722

van Schaik, C.J. & Janson, C.H. (2000). Infanticide by males: prospectus. In C.J. van Schaik and C.H. Janson (Eds.), *Infanticide by Males and its Implications* (pp.1-6). Cambridge University Press.

Vaske, J. J. & Kobrin, K. C. (2001). Place attachment and environmentally responsible behavior. *The Journal of Environmental Education*, ***32***(4), 16–21. https://doi.org/10.1080/00958960109598658

Vaske, J.J. & Donnelly, M.P. (1999). A value-attitude-behavior model predicting wildland preservation voting intentions. *Society & Natural Resources*, ***12***(6), 523–537. https://doi.org/10.1080/089419299279425

Vaske, J.J., Jacobs, M.H. & Sijtsma, M.T.J. (2011). Wildlife value orientations and demographics in The Netherlands. *European Journal of Wildlife Research*, ***57***, 1179-1187.

Vaughn, A.K., Larson, L.R., Peterson, M.N. & Pacifici, L. B. (2022). Factors associated with human tolerance of snakes in the southeastern United States. *Frontiers in Conservation Science*, ***3***, 1016514. https://doi.org/10.3389/fcosc.2022.1016514

Viani, F., Rocca, P., Lizzi, L., Rocca, M., Benedetti, G. & Massa, A. (2011). WSN-based early alert system for preventing wildlife-vehicle collisions in Alps regions. 2011 IEEE-APS Topical Conference on Antennas and Propagation in Wireless Communications, 106–109. https://doi.org/10.1109/APWC.2011.6046747

Villatoro, F.J., Naughton-Treves, L., Sepúlveda, M.A., Stowhas, P., Mardones, F.O. & Silva-Rodríguez, E. A. (2019). When free-ranging dogs threaten wildlife: Public attitudes toward management strategies in southern Chile. *Journal of Environmental Management*, ***229***, 67–75. https://doi.org/10.1016/j.jenvman.2018.06.035

Wachinger, G., Renn, O., Begg, C. & Kuhlicke, C. (2013). The risk perception paradox-implications for governance and communication of natural hazard. *Risk Analysis*, ***33***(6), 1049–1065. https://doi.org/10.1111/j.1539-6924.2012.01942.x

Waite, T.A., Chhangani, A.K., Campbell, L.G., Rajpurohit, L.S. & Mohnot, S.M. (2007). Sanctuary in the city: urban monkeys buffered against catastrophic die-off during ENSO-related drought. *EcoHealth*, ***4***(3), 278–286. https://doi.org/10.1007/s10393-007-0112-6

Walsh, D., O'Riain, M.J., Nattrass, N. & Gaynor, D. (2023). On the fence: The impact of education on support for electric fencing to prevent conflict between humans and baboons in Kommetjie, South Africa. *Animals*, ***13***(13), 2125. https://doi.org/10.3390/ani13132125

Walton, B. J., Findlay, L. J. & Hill, R. A. (2021). Insights into short- and long-term crop-foraging strategies in a chacma baboon (*Papio ursinus*) from GPS and accelerometer data. *Ecology and Evolution*, ***11***(2), 990–1001. https://doi.org/10.1002/ece3.7114

Warren, Y. (2009). Crop-raiding Baboons (*Papio anubis*) and defensive farmers: A West African perspective. *West African Journal of Applied Ecology*, ***14***(1), 1–11. https://doi.org/10.4314/wajae.v14i1.44705

Warren, Y., Higham, J.P., Maclarnon, A.M. & Ross, C. (2011). Crop-raiding and commensalism in olive baboons: the sosts and benefits of living with humans. In V. Sommer & C. Ross (Eds.), *Primates of Gashaka. Developments in Primatology: Progress and Prospects* (pp. 359-384). Springer.

Weingrill, T. (2000). Infanticide and the value of male-female relationships in mountain chacma baboons. *Behaviour*, ***137***(3), 337–359.

Weingrill, T., Gray, D.A., Barrett, L. & Henzi, S.P. (2004). Fecal cortisol levels in free-ranging female chacma baboons: Relationship to dominance, reproductive state and environmental factors. *Hormones and Behavior*, ***45***(4), 259–269. https://doi.org/10.1016/j.yhbeh.2003.12.004

Wells, N.M. & Lekies, K.S. (2006). Nature and the life course: pathways from childhood nature experiences to adult environmentalism. *Children, Youth and Environments*, ***16***(1), 1–24. https://doi.org/10.1353/cye.2006.0031

Western Cape Education Department (2018). School Calendar for 2018. https://wcedonline.westerncape.gov.za/documents/calendar2018.html

Willems, E.P. & Hill, R.A. (2009). Predator-specific landscapes of fear and resource distribution: effects on spatial range use. *Ecology,* ***90***(2), 546-555.

White, A. (2019). Wild animals on our doorstep. *WellBeing News*, (***1***)10.

White, G. C. & Garrott, R.A. (1990). Analysis of wildlife radio-tracking data. Academic Press.

White, K., & Simpson, B. (2013). When do (and don't) normative appeals influence sustainable consumer behaviors? *Journal of Marketing*, ***77***(2), 78–95. https://doi.org/10.1509/jm.11.0278

Whiten, A., Bryne, R.W., Barton, R.A., Waterman, P.G. & Henzi, S.P. (1991). Dietary and foraging strategies of baboons. *Philosophical Transactions: Biological Sciences*, ***334***(1270), 187-197.

Whiten, A., Byrne, R.W. & Henzi, S.P. (1987). The behavioral ecology of mountain baboons. *International Journal of Primatology*, ***8***(4), 367–388. https://doi.org/10.1007/BF02737389

Whitten, P.L. (1983). Diet and dominance among female vervet monkeys (*Cercopithecus aethiops*). *American Journal of Primatology*, ***5***(2), 139–159. https://doi.org/10.1002/ajp.1350050205

Whittington, J., St. Clair, C.C. & Mercer, G. (2005). Spatial responses of wolves to roads and trails in mountain valleys. *Ecological Applications*, ***15***(2), 543–553. https://doi.org/10.1890/03-5317

Wildman, D.E., Bergman, T.J., al-Aghbari, A., Sterner, K.N., Newman, T.K., Phillips-Conroy, J.E., Jolly, C.J. & Disotell, T. R. (2004). Mitochondrial evidence for the origin of hamadryas baboons. *Molecular Phylogenetics and Evolution*, ***32***(1), 287–296. https://doi.org/10.1016/j.ympev.2003.12.014

Wilson, M.L. (2007). Intergroup aggression in wild primate. *Behaviour*, ***144***(12), 1469–1471.

Wrangham, J., Gittleman, L. & Chapman, C.A. (1993). Constraints on group size in primates and carnivores: population density and day-range as assays of exploitation competition. *Behavioral Ecology and Sociobiology*, ***32***(3), 199–209.

Wrangham, R.W., Conklin-Brittain, N.L. & Hunt, K.D. (1998). Dietary response of chimpanzees and cercopithecines to seasonal variation in fruit abundance. i. antifeedants. *International Journal of Primatology,* ***19***(6), 949–970.

Yeo, J.H., & Neo, H. (2010). Monkey business: Human–animal conflicts in urban Singapore. *Social & Cultural Geography*, ***11***(7), 681–699. https://doi.org/10.1080/14649365.2010.508565

Yiming, L. (2006). Seasonal variation of diet and food availability in a group of Sichuan snub-nosed monkeys in Shennongjia Nature Reserve, China. *American Journal of Primatology*, ***68***(3), 217–233. https://doi.org/10.1002/ajp.20220

Young, J.K., Olson, K.A., Reading, R.P., Amgalanbaatar, S. & Berger, J. (2011). Is wildlife going to the dogs? impacts of feral and free-roaming dogs on wildlife populations. *BioScience*, ***61***(2), 125–132. https://doi.org/10.1525/bio.2011.61.2.7

Young, S.L., Sherman, P.W., Lucks, J.B. & Pelto, G.H. (2011). Why on earth?: evaluating hypotheses about the physiological functions of human geophagy. *The Quarterly Review of Biology*, ***86***(2), 97–120. https://doi.org/10.1086/659884

Yue, S., Bonebrake, T.C. & Gibson, L. (2019). Human-snake conflict patterns in a dense urban-forest mosaic landscape. *Herpetological Conservation and Biology*, ***14***(1), 143–154.

Zeller, K.A., Wattles, D.W., Conlee, L. & DeStefano, S. (2019). Black bears alter movement in response to anthropogenic features with time of day and season. *Movement Ecology*, ***7***(19). https://doi.org/10.1186/s40462-019-0166-4

Zhao, Q. K. & Deng, Z. Y. (1992). Dramatic consequences of food handouts to *Macaca thibetana* at Mount Emei, China. *Folia Primatologica*, ***58***(1), 24-31.

Zhou, Q., Huang, C., Li, Y. & Cai, X. (2007). Ranging behavior of the François' langur (*Trachypithecus francoisi*) in the Fusui Nature Reserve, China. *Primates*, ***48***(4), 320–323. https://doi.org/10.1007/s10329-006-0027-9

Zimmermann, B., Wabakken, P. & Dötterer, M. (2001). Human-carnivore interactions in Norway: How does the re-appearance of large carnivores affect people's attitudes and levels of fear? *Forest Snow and Landscape Research*, ***76***(1/2), 137-153.

Zinn, H.C. & Pierce, C.L. (2002). Values, gender, and concern about potentially dangerous wildlife. *Environment and Behavior*, ***34***(2), 239–256. https://doi.org/10.1177/0013916502034002005

Zinner, D., Pelaez, F. & Torkler, F. (2001). Distribution and habitat associations of baboons (*Papio hamadryas*) in Central Eritrea. *International Journal of Primatology*, ***22***, 397-413.

Zipple, M.N., Grady, J.H., Gordon, J.B., Chow, L.D., Archie, E.A., Altmann, J. & Alberts, S.C. (2017). Conditional fetal and infant killing by male baboons. *Proceedings of the Royal Society B*, ***284***(1847), 20162561. https://doi.org/10.1098/rspb.2016.2561

Zuur, A.F., Ieno, E.N. & Meesters, E. (2009). A Beginner's Guide to R. Springer New York. https://doi.org/10.1007/978-0-387-93837-0

Zylstra, M.J., Knight, A.T., Esler, K.J. & Le Grange, L.L.L. (2014). Connectedness as a core conservation concern: an interdisciplinary review of theory and a call for practice. *Springer Science Reviews*, ***2***(1–2), 119–143. https://doi.org/10.1007/s40362-014-0021-3

APPENDIX 1. Geographical location of Rooiels in South Africa in reference to other baboon studies in the region that are mentioned in the thesis.

APPENDIX 2. Observed fynbos species consumed by the Rooiels baboon troop.

Overberg dune strandveld
Carpobrotus acinaciformis
Carpobrotus edulis
Euclea racemosa
*Osteosperumum moniliferum**
*Osyris compressa**
Passerina corymbosa
Pelargonium botulinum
Pelargonium cucullatum
Salvia africana-lutea
*Searsia laevigata**
*Searsia lucida**
Sideroxylon inerme
Tetragonia decumbens
Kogelberg sandstone fynbos
Aristea oligocephala
Elegia ebracteatum
Elegia stipularis
Erica brachialis
Lanaria lanata
Leucodendron salignum
Leucospermum conocarpodendron
Otholobium fruticans
Protea repens
Tritoniopsis parviflora
Watsonia borbonica

*Species which formed the majority of the troop's fynbos diet.

APPENDIX 3. Ethogram used for behavioural data collection.

ETHOGRAM

Behaviour	Definition
Feed	Individual consumes food item
Forage	Individual sifts through or manipulates food item while stationary or moving
Drink	Individual consumes water
Locomote	Individual moves by way of walking, running, or climbing
Allogroom	Individual manipulates or picks through hair or skin of another individual with hands or mouth
Autogroom	Individual manipulates or picks through their own hair or skin with hands or mouth
Sex	Two individuals copulate
Play	Individual engages in wrestling, non-aggressive chasing, non-aggressive biting, manipulation of non-food item, etc., alone or with other individual(s)
Aggression	Individual bites, grabs, scruffs, chases, lunges, eye flashes, jaw chomps, or slaps ground at another individual(s)
Rest	Individual is sitting motionless with eyes open or closed
Vigilant	Individual intently observes an element or situation in its surroundings (e.g., interaction between other individuals, potential threat)
Other social	Individual is engaged in a social behaviour not described above
Other behaviour	Individual is engaged in a non-social behaviour not described above

APPENDIX 4. Rooiels community questionnaire.

ROOIELS BABOON QUESTIONNAIRE

You are invited to complete the following questionnaire as part of an ongoing research project on the relationship between Rooiels residents and baboons. We highly value all opinions and perspectives.

The questionnaire takes approximately 15 minutes to complete. By completing this questionnaire, you give consent for your responses to be used as a part of this study. All responses will be kept confidential, and data are anonymized. Please complete the questions honestly and fully, but you may stop at any time if you no longer wish to participate.

This project is being conducted by PhD candidate Joselyn Mormile from the University of Cape Town. Please contact Joselyn at joselyn.e.mormile@gmail.com or Justin O'Riain at justin.oriain@uct.ac.za with any questions.

Email address:
_____

What is your gender?
a. Male
b. Female
c. Other

What is your age group?
a. 18-29 years
b. 30-39 years
c. 40-49 years
d. 50-59 years
e. 60-69 years
f. 70-79 years
g. 80-89 years
h. 90+ years

Where are you originally from?
_____

What is your highest level of education?
a. Some high school
b. Completed high school
c. Some college/university
d. Undergraduate degree
e. Postgraduate degree
f. Other: _____

What is your employment status?
a. Employed

b. Unemployed
c. Retired
d. Other

Is your home in Rooiels your full-time or part-time residence?
a. Full-time
b. Part-time

What year did you first move to Rooiels?
_____

Do you rent or own this property?
a. Rent
b. Own
c. Other

How often in the last 6 months have you stayed in Rooiels?
_____

How often in the last 12 months have you stayed in Rooiels?
_____

How many adults live at your residence?
_____

How many children live at your residence?
_____

How many dogs live at your residence?
_____

Why did you choose to live in Rooiels?
_____
_____
_____
_____
_____
_____

Did you know there were baboons in Rooiels before you moved here?
a. Yes
b. No
c. Unsure

If you knew there were baboons in Rooiels before moving, how did you know?
_____
_____
_____
_____

Approximately how often do baboon(s) visit your property?

_____

What do baboons tend to do on your property? (Leave blank if baboons have never been to your property)

_____
_____
_____
_____

Have baboon(s) ever gained access to the inside of your house?

a. Yes
b. No
c. Unsure

Approximately how many times in the last 6 months have baboon(s) gained access to the inside of your house?

_____

Approximately how many times in the last 12 months have baboon(s) gained access to the inside of your house?

_____

What have the baboons eaten from inside your house? (Leave blank if baboons have never been inside your house)

_____
_____
_____
_____

Please circle all of the baboon proof measures you have in/on your house:

a. Baboon proof bin on property
b. Baboon bars/burglar bars or window restrictors on windows that open
c. Trellidors/security gates on doors
d. Electric fencing on property
e. Electric wiring on portion or perimeter of house
f. Strict house rules to prevent baboon entry
g. Other:_____

Do you believe your dog(s) deters baboon(s) from visiting your property or entering your house?

a. Yes
b. No
c. Maybe
d. I do not own a dog

What do you do when baboon(s) come to your property?

_____
_____
_____
_____

What do you do when baboon(s) get inside your house?

_____
_____
_____
_____

Before you moved to Rooiels, how much experience did you have with baboons?

_____
_____
_____
_____

If you have prior experience with baboons, in general, your experience(s) were_____ in nature.

a. Positive
b. Negative
c. Neutral
d. Combination of positive and negative
e. Unsure
f. I did not have any prior experience with baboons

How do you feel about the baboons in Rooiels?

a. Like a lot
b. Like
c. Neutral
d. Dislike
e. Strongly dislike

Has your attitude towards baboons changed over the course of living in Rooiels?

a. Yes
b. No
c. Unsure

If your attitude towards baboons has changed, please explain why.

_____
_____
_____
_____
_____
_____
_____
_____

Do you consider the baboons in Rooiels a problem?

a. Yes
b. No
c. Unsure

Do you consider the baboons in Rooiels a nuisance?

a. Yes
b. No
c. Unsure

Do you consider yourself tolerant of the baboons in Rooiels?

a. Yes
b. No
c. Unsure

Do you view Rooiels as a community that is generally tolerant of baboons?

a. Yes
b. No
c. Unsure

Generally speaking, how emotionally stressful is it for you to live with baboons in Rooiels?

a. Highly stressful
b. Stressful
c. Somewhat stressful
d. Not stressful
e. Unsure

Do you believe the baboons in Rooiels are dangerous?

a. Yes
b. No
c. Sometimes
d. Unsure

If you believe the baboons are dangerous, please explain.

_____
_____
_____
_____

Are you afraid of the baboons in Rooiels?

a. Yes
b. No
c. Sometimes
d. Unsure

If you are afraid of the baboons, please explain.

_____
_____
_____

Do you consider the baboons in Rooiels an asset?

a. Yes
b. No
c. Unsure

If you believe the baboons are an asset, please explain.

_____
_____
_____
_____

Please select all that apply: In an ideal world, you would prefer if the baboons DID NOT:

A. Enter your house
B. Climb on your house, car or outside fixtures
C. Come to your property
D. Enter the Rooiels village
E. None of the above

Would you like the baboons to be removed from Rooiels?

a. Yes
b. No
c. Unsure

Please respond to the following statement on a scale of strongly agree to strongly disagree: "If a baboon gets into a house in Rooiels, it is the resident's fault."

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree
f. Unsure

Please respond to the following statement on a scale of strongly agree to strongly disagree: "Baboons should know better than to steal people's food or damage their belongings."

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree
f. Unsure

Please respond to the following statement on a scale of strongly agree to strongly disagree: "Baboons have been coming to Rooiels long before people lived here."

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree
f. Unsure

Please respond to the following statement on a scale of strongly agree to strongly disagree: “Baboons have restricted how I would like to live my life in Rooiels.”

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree
f. Unsure

Please respond to the following statement on a scale of strongly agree to strongly disagree: “Wildlife is important to me.”

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree
f. Unsure

Please respond to the following statement on a scale of strongly agree to strongly disagree: “In general, I like primates (monkeys & apes).”

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree
f. Unsure

Please respond to the following statement on a scale of strongly agree to strongly disagree: “I am concerned about the conservation of the baboons in Rooiels.”

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree
f. Unsure

Please respond to the following statement on a scale of strongly agree to strongly disagree: "I am concerned about the conservation of other wildlife in Rooiels.”

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree
f. Unsure

Please feel free to use the space below to share anything else about your experiences with baboons in Rooiels.

_____
_____
_____
_____
_____

Name (optional):
_____

Erf Number (optional):
_____

Thank you for participating. Please return the completed questionnaire to the RESA office.

APPENDIX 5. Examples of educational materials circulated in Rooiels as found on Rooiels.org.

BRAG & THE OVERSTRAND NATURE CONSERVATION DEPT PAMPHLET

- Exposed plumbing, basins, showers etc. must be properly secured with extra brackets. *TEST THEIR STRENGHT BY CLIMBING ON THEM YOURSELF!*
- Try to avoid thatch roofs. When these roofs are not maintained, they deteriorate over time and juvenile baboons love to pull the thatch out. If the house you have purchased has a thatch roof, get a professional to cover it with chicken mesh.
- Big six-roof sheeting is recommendable for the area since it is baboon and weather proof.
- TV antennas should be fitted in the ceiling and not on the roof. Secure a thorn branch or barbed wire along the arm of your exterior satellite dish.
- Avoid outside windowsills or window boxes. These provide a gripping and vaulting platform and serve as baboon seats.
- Install round doorknobs, as our baboons have not yet learned to open these.
- Discreet electric fencing may be used on upper storeys to keep baboons out of selected rooms or balconies.
- Try to avoid cultivating fruit trees, vegetable gardens and compost heaps, as these features will only attract the baboons to your property.

THEN SIT BACK AND ENJOY LIVING WITH BABOONS IN THIS BEAUTIFUL CORNER OF SOUTH AFRICA

Municipality of the Western Cape Province
OVERSTRAND

Contact the Overstrand Municipality for general advice on baboons at (028) 271 8100 (Hangklip/Kleinmond) or (028) 313 8000 (Hermanus) and ask for the local Nature Conservation Officer.

The Overstrand Nature Conservation Dept. designed this leaflet with the help of the Biosphere Reserve Action Group (BRAG) Dr. Jenny Stark can be contacted at (028) 273 8961 or Chris Burlock at (028) 273 8278

THINKING OF BUYING A HOUSE? BUILDING? MOVING?

BACKGROUND

Wild baboon troops occur in the Overstrand area at Rooi Els, Pringle Bay, Hangklip, Betty's Bay, Kleinmond and Hermanus.
The coastal plains is their home as well as ours. This sharing of common space often lead to conflict with local residents, holidaymakers and visitors. Baboons are not predators, but will exploit any opportunity, which promises them food.

SO WHAT IS THE PROBLEM?

Most houses in the region are used as 'jungle gyms' by the baboons and are either built in such a way that the baboons can cause extensive damage or they provide a welcoming resting place for the juveniles who just love to play!
As part of their games, young baboons

- swing on gutters
- break TV antennas or
- loosen roof tiles

...MORE PROBLEMS...

Adult male baboons can weigh as much as 36kg, are very strong and they are often able to:

- lift some makes of sliding doors off their tracks
- wedge windows open that have been left unsecured and slightly ajar

Remember that juveniles at play and adults in search of food can inadvertently cause extensive damage to your home. Avoid this by outsmarting them with intelligent design of new homes, or by taking some simple, preventative measures in existing homes.

WHEN BUILDING, BUYING OR RENOVATING, CONSIDER THE FOLLOWING:

- Select your outside lights carefully. Use bulkhead lights, which baboons cannot hold onto. And remember, there is a law against pollution in the area. Outside lighting must not spill onto neighbouring properties.
- All external sliding doors must be fitted with track guards and spring-loaded lugs to secure them in place and prevent them from being lifted off their tracks.
- Standard burglar bars will not keep baboons out of your home. Please ensure that no gap exceeds 80mm, or baboons will get through.

- Use aluminium window frames rather than wooden frames. These should be treated regularly to avoid deterioration. Baboons can gain entry by persistently chewing on deteriorated wooden frames.
- Install window catches on both sides of top-hung windows or the baboons will wedge the unsecured side up until the frame bends or the glass breaks. Ensure that your builder install glass panes according to the prescribed building regulations i.e. 3mm glass is only acceptable for windows smaller than 250X250mm.
- If you want a rock pool or swimming pool, you will have to cover it with netting. Baboons love to play in water, and these features will attract them to your property.
- Design new homes with concealed gutters and down pipes. Existing homes with outside guttering should have additional brackets, not more than 300mm apart.

2005?-2014 BIOSPHERE RESERVE ACTION GROUP (BRAG) POSTERS FOR RE HOMEOWNERS

BOBBEJANE!

Bobbejane is inherent deel van die Biosfeer en wei al millennia lank hier in die fynbos. Hulle het, egter, ontdek dat menslike nedersettings 'n bron is van maklik bekombare kos en het daarmee saam ontwikkel as meester buiters. Bobbejane op kaastroostogte het al skuifdeure van hul spore gelig, kleintjies deur openinge gedruk wat te klein is vir die grotes en geleer om deure met hefboomhandvatsels oop te maak. Hulle het ook al geleer hoe om motordeure oop te maak wat nie geslot is nie. (Hulle het NOG nie geleer hoe om slotte oop te maak nie!.) Hulle wil niemand leed aandoen nie: hulle soek net kos wat makliker bekombaar is as om heeldag te wei daarvoor. MENSE WAT NALATIG IS MET KOS is, eenvoudig gesteld, besig om sake te vererger.

WAT MENS KAN DOEN INDIEN 'N BOBBEJAAN BINNEKOM

BLY KALM...onthou dat die bobbejaan jou nie wil skade aandoen nie.
Indien jy **HARD GENOEG KAN BLAF, maak sal** Of dreig hom met 'n kettie of 'n stok. Dit kan hom heel moontlik van plan laat verander. **Hou die bobbejaan se ontsnaproete oop.**
LEER YOU KINDERS NOU AL – nie tydens 'n besoek nie – om stil te sit en nie rond te hardloop en skree nie. Indien jy skree of voorwerpe na die bobbejaan gooi of hom slaan, kan hy 'n venster breek of 'n stink gemaro agterlaat!

HOE OM 'n BOBBEJAANINVAL TE VERMY

WEES BEWUS van geluide om jou. 'n Geblaf of 'n geskree kondig hul aantog aan.
MOET NOOIT VENSTERS OF DEURE OOPLAAT nie, tensy hulle bobbejaanbestand is. **Onthou dat 'n bobbejaan nie deur jou blote teenwoordigheid afgeskrik word nie.**
MOET NOOIT VRUGTE BINNE SIG PLAAS NIE.
MOENIE KOS UITSIT VIR VOELS NIE.
MOENIE 'n INVAL AANMOEDIG deur jou kattebak oop te laat terwyl jy kruideniersware aflaai nie.
KRY **ASSEBLIEF** 'n **BOBBEJAANBESTANDE VULLISHOUER**

Published by Rooi Els Conservancy/Bewarea 2014

BABOONS AND THE LAW!

When baboons stop being 'nice' wild animals and start acting like petty **thieves,** some people's immediate reaction is to want them killed. It can be a natural reaction when someone feels threatened. But in reality, baboons have **fed** on the more nutritious plants of the coastal plains for millions of years... then man arrived and virtually wiped out this food source by building homes and roads on those coastal plains! We have robbed the baboons of their food!
But worse, by leaving garbage around and even deliberately feeding baboons, people have introduced them to delicious new foods...thus encouraging them to raid our homes for more!

We have chosen to live in a Biosphere where wild animals are are an integral part of the ecology. Baboons are protected by Western Cape Provincial Legislation from being hunted, shot, restrained or poisoned.(Nature Conservation Ordinance 19) And, being primates, baboons are protected internationally under the CITES CONVENTION.

SO WHAT MUST WE DO TO LIMIT OUR INTERACTIONS WITH NUISANCE BABOONS?
WE HAVE TO USE ALL OUR INTELLEGENCE TO ENSURE THEY DO NOT GET FOOD FROM OUR HOMES, BUSINESSES, COMPOST HEAPS AND GARBAGE BINS!

Baboons mean us no harm...they are only here for FOOD!

BOBBEJANE!

Bobbejane is al vir miljoene jare net so 'n integrale deel van ons biosfeer as die fynbos self. Hulle wei al baie jare op die fynbos, maar sedert die mens hier ingtrek het, het ons smaakvolle kos van kees 'n meesterlike dief gemaak.
As kaastrogers, het bobbejane ontdek hoe om skuifdeure uit hul spoortjies te lig, die kleintjies deur diefwering te druk en selfs hoe om deure oop te maak. (Gelukkig verstaan hul nog nie slotte en sleutels nie!)
Hulle word as sleims bestempel, maar anders as die menslike diet, is hul selde skadelik: dis net dat hul slegte maniere by agterlosige mense aangeleer het in 'n soektog na een ding...KOS!

MENSE WAT BOBBEJANE VOER OF TOELAAT DAT HUL GEREELD KOS UIT ONS HUISE STEEL, VERERGER DIE PROBLEEM VIR ALMAL!

Aangespoor deur suiseevolle strooptogte, word kees alhoemeer vermetel en vreeslose. Ons moet saamstaan en hul oortuig dat ons nie 'n bron van kos is nie. Dan sal ons bobbejane nie 'n probleem word (soos in Kaappunt waar bobbejane kos uit jou mond of hand gryp) en eendag nog iemand - moontlik 'n kind - hier beseer nie!

WAT OM TE DOEN MET KEES AS HUISBESOEKER

- BLY KALM, onthou hy wil jou geen leed aandoen nie. Maak seker dat daar 'n OOP ONTSNAPROETE IS. Nader kees versigtig en beveel hom met 'n fern stem, om te loop. Om 'n rekker rond te swaai werk wonders.
- LEER U KINDERS (NOU...nie gedurende 'n besoek nie!) om stil uit kees se pad te bly en nie paniekerig rond te hardloop of te skreeu nie. (As u angsbevange skreeu, hom slaan of gooi, mag kees homself aggressief verdedig, venstars in ontsnapping breek en stinkende getuienisse los!)

As kees kos 'n u huis kry word dit 'n "bobbejaantreffing" genoem.

HOE OM 'N BOBBEJAANTREFFING TE VERMY

- DIE BLAF VAN HONDE ASOOK VAN KEES EN GILLE VAN DIE KLEINTJIES is gewoonlik die eerste waarskuwingsteken dat 'n trop bobbejane in aantog is!
- MOENIE VENSTERS OF DEURE OOP LOS as hulle nie bobbejaandig is nie. Onthou u teenwoordigheid is geen waarborg dat kees u nie gaan besoek nie!
- MOET NOOIT VRUGTE OF KOS VERTOON NIE. Kees sal dit opmerk en planne beraam om dit in die hande te kry!
- Kos wat uitgesit word vir voëls, asblikke en komposhope wat nie bobbejaandig is nie, LOK ALLES BOBBEJANE.
- Wees versigtig as u kruideniersware, groente en vrugte uit u motor aflaai en hou die deure toe. BOBBEJANE SLAAN VINNIG TOE!

Vir advies oor bobbejaan-digtig van u eiendom, of om ongewone-gedrag te rapporteer, kontack asseblief Dr. Jenny Stark 028 273 8961

RERA/ REC/ BOATCLUB FUNDED ROOIELS BOOK 2018 EDITION SOLD IN RE SHOP

THE ROOIELS WEBSITE (REC 2017-2021)

https://rooiels.weebly.com/

Nature

Baboons

Baboons are not naturally aggressive towards humans or their pets. They are essentially focused on your food. For the sake of both the baboons and your sanity - remove all food opportunities. If confronted by a baboon drop the food you are carrying and they lose all interest in you. Don't give them a fright when they are in your house or they void their bowels - be sure you are not blocking their exit and calmly insist they take what they have grabbed and leave. Feeding, shooting or harming baboons is unlawful.

The healthy, shiny coat of our baboons that forage along the seashore (Photo by Sandra Peal)

Click the Photo for more about the the Baboons

Baboons in Rooiels are a source of amusement, wonder and joy but also of frustration as they can be a nuisance and destructive when you haven't been able to keep them out of your house!
Learn More about the Baboons

Joselyn Mormile was living in the village and is doing her PhD research on the baboons. She gained valuable insights into their behaviour. You can see some of the articles under Research

Click for information on what to do if they get into your house or car and for protecting your home to reduce conflict

Flora

The Cape Floral Region has been recognised as one of the most special places in the world for plants in terms of diversity, density and number of endemic species. It represents less than 0.5% of the area of Africa, but is home to nearly 20% of the continent's flora. The outstanding diversity, density and endemism of the flora are among the highest worldwide. Some 69% of the estimated 9,000 plant species in the region are endemic, with 1,736 plant species identified as

There is not yet a comprehensive species list of all

Photo by Paul Person

CAPE NATURE FOLD OUT EDUCATIONAL POSTER see ADDENDUM 3 for full poster

CURRENT RE WELCOME PACK TO NEW HOMEOWNERS- E LETTER AND PRINTED PAMPHLET
Welcome to Rooiels
Some information to introduce you to the special quirks and wonders of life here
Living in Rooiels
Some information to the special quirks and wonders of life in nature
BIOSPHERE RESEARCH ACTION GROUP POSTER
2017-2018 EDUCATIONAL TALKS AT HAROLD PORTER.
BABOONS!
Things that HOLIDAYMAKERS & VISITORS to PRINGLE BAY need to know!
1. BABOONS aren't angels, but they mean you NO HARM!
2. They are only interested in FOOD!
3. If they get inside...it can be a TERRIBLE MESS!
4. As long as baboons are getting FOOD... THEY ARE GOING TO BE HANGING AROUND!
NEED HELP? Call the Municipality's BABOON HOTLINE (028) 313 8111 or Pringle Bay BAG: Diana Head 273 8676, Nicolette Louw 273 8226, or Johan Grobler 273 8617
Produced by BRAG, (the Biosphere Reserve Action Group) (028) 273 8278
COMMUNITY EVENTS
Roojels Conservancy
Wildlife talks
CAPE NATURE FOLD OUT EDUCATIONAL POSTER
UNDERSTANDING BABOONS
FLYERS HANDED OUT TO VISITORS OUTSIDE PUB, RESTUARANT AND SHOP OVER FESTIVE SEASON 2020
CURRENT KOGELBERG BIOSFEE RESERVAAT BANNER & MUNICIPAL ROAD SIGN IN RE BUSINESS CENTRE

APPENDIX 6. Community action regarding the R44. Rooiels Breeze magazine 2017.

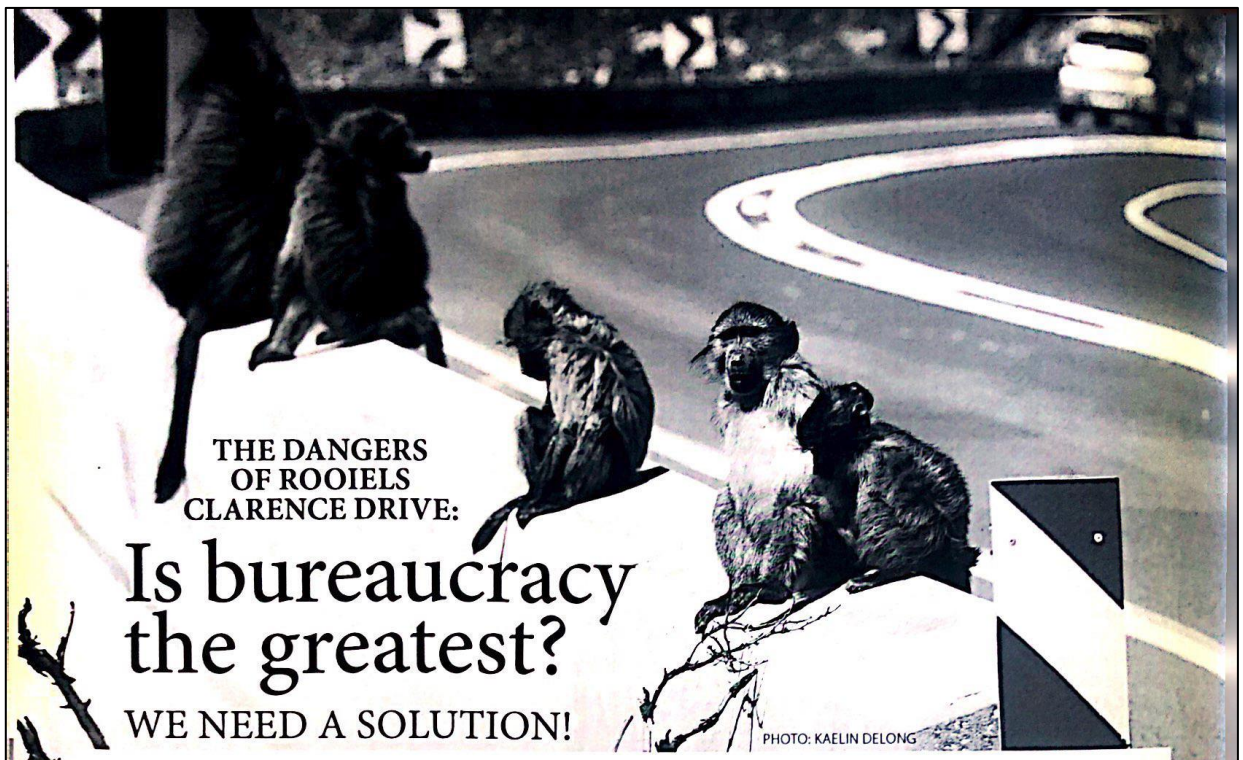


PHOTO: KAELIN DELONG

THE DANGERS OF ROOIELS CLARENCE DRIVE:

Is bureaucracy the greatest?

WE NEED A SOLUTION!

An open group of concerned Rooielsers met a number of times this year looking for ways to get the authorities to address the unsafe conditions of Clarence Drive (R44) as it passes through Rooiels.

Lets be clear about this: it is a mistaken perception that Clarence Drive bypasses Rooiels, it bisects our village. This portion of Clarence Drive (from the 60km/h sign on the hill on the Pringle Bay side to the end of the first parking area after the bridge over the Rooiels river), is really part of Rooiels village and can be considered to be the main road of our village, with homes in Rooiels situated on both sides of it. Some properties have been given Clarence Drive street addresses by the municipality, so that there are a number of Rooiels driveways directly onto the R44.

Unfortunately, many cars that travel along Clarence Drive through our village do not adhere to the 60 km/h speed limit. This speeding is a life-threatening danger to pedestrians – as there is no sidewalk and no pedestrian crossing. Many Rooielsers need to cross this stretch of road daily, some of which are elderly people, others families with young children, prams and dogs.

Even vehicles wishing to turn off are at risk, as there are no dedicated turning lanes. There have been around 30 accidents in the vicinity of the R44 bisecting our village over the last few years.

It is estimated that 90% of all road kill in Rooiels takes place here. Wild animals moving up or down the Rooiels River valley into the core zone of the biosphere reserve need to cross this stretch of road. Numerous baboons, snakes, water mongoose, otter, porcupine, dwarf chameleons and grysbok have all met a cruel and unnecessary death on this road. There are insufficient warning signs that there are frequently baboons in this area, or that this is a biosphere and that caution should be taken to slow down.

> Clarence Drive has been designated as a Scenic Drive and in 2015 was voted "Most Scenic Route in the World". Slow down. Appreciate.

We estimate that the temporary speed camera, has on average 100 speeding records per day – and this is only over a limited part of the day! Clearly a speed camera alone, is not enough incentive for motorists to slow down.

In February we started writing to Provincial Roads outlining our situation, however received no satisfactory response. Simultaneously to this, we were in communication with Clive Roos (Head, Ministry of Transport and Public Works). The outcome was a meeting with Harold Williams and Overstrand Traffic in March 2017, who told us the following:

- There would be monthly operations in Rooiels for the Sunday motor cycle challenges.
- Overstrand Traffic and Provincial Traffic patrol the area daily during peak hours and will, where possible, do it more frequently.
- Currently speed measuring operations are being done in the 60km/h zone through Rooiels with a non-permanent camera. The only reason why the permanent camera that used to be there was removed, was because the contract of the service provider expired. One of the instructions given to the new service provider was to erect a permanent camera on the R44 in Rooiels.

We indicated that while speed cameras were essential, they were not sufficient in solving the speeding problem and that we would like the authorities to explore structural solutions, to which Mr Roos replied that this is not an area the ministry gets involved with. He passed on the name of a head of department to whom we wrote, however with no response to our mails or follow-ups.

In the meantime we launched our "Hands and Crosses" project. The white crosses with the animal silhouettes and the brightly coloured hands of caution certainly attracted attention and had a positive impact in slowing down some cars at least.

We also managed to set up an unofficial meeting with one of the senior members of Hatchet Consulting, responsible for the maintenance of the road in our area. We gleaned from this meeting that:

- The idea of a subway under the road was not an option – there is solid rock which will make this exercise incredibly costly and unlikely. A bridge over the road would be in the region of R20 million, not a viable option either.
- Speed bumps are restricted by law on provincial roads.
- It was indicated as a good idea to investigate the viability and costs of a traffic circle.
- We would not be permitted to build a walkway over the drainage system on the side of the R44 as it would limit the drainage system.

In August, we met with Mr Titus, senior superintendent of Overstrand Traffic. We were told:

- Only one camera is planned for Rooiels.
- The Public Prosecutor grants permission as to where a camera can be erected.
- In the case of Rooiels, unfortunately the "rules of a bend" apply - a camera can only be erected on 80 meters of straight road. The new fixed camera will be erected where the old one was (i.e. where the portable camera currently is).
- The new camera will be a permanent fixture with night time capabilities. The commitment from the supplier/contractor for erection of this camera is mid November 2017.

We finally had a meeting with a private road engineer. While the meeting was useful, the outcome was that we really do have limited options in terms of a solution. Herewith a brief summary :

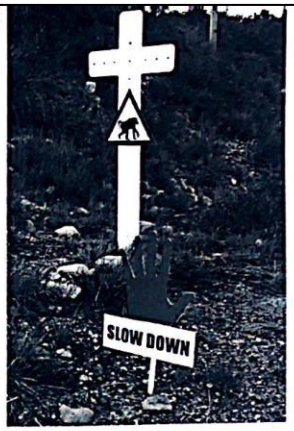
- The road engineer discussed our issues with the Provincial Roads department, who appeared to be fully aware of the speeding problems on Clarence Drive through Rooiels and was aware of previous correspondence in this regard.
- He informed us that the road authorities are not keen on fake cameras (one of our suggestions) and it would be unlikely that you would obtain approval to erect such a camera. (This is contrary to the information we obtained from Overstrand Traffic at our meeting.)
- In terms of our suggestion of traffic islands and circles, we were advised that with any such structure, street lighting would be required.
- Flashing lights at each approach would be a viable option. We are however aware of light pollution concerns.
- There was concern about the fact that there were at least five properties with direct access onto the R44 and whose addresses are formally listed as being on Clarence Drive.
- Speed bumps on provincial trunk and main roads are not permitted. Rumble strips can be considered, however the noise factor would need to be assessed.
- In terms of a pedestrian crossing, these would only be permitted where there is adequate sight distance on each approach, which the case of our village is definitely not available. The same comment applies to traffic lights, which would also require street lighting.
- Four way stops require sight distance (and also street lighting).
- Side walks with barrier kerbs are not possible as there appears to be inadequate space within the road reserve.
- With regard to large signs at each approach to the horse shoe bend, it was noted that the Provincial Roads Department is very strict in approving any signs that are not standard and are not included in the South Afican Roads Traffic and Signs Manual.

Our private road engineer suggested that we write a letter to Province highlighting our concerns, as well as approach Overstrand Municipality Traffic Department and suggest to them that a second permanent camera be installed on the Gordon's Bay approach to Rooiels. He also suggested we recommend erecting specially worded signs at each approach informing motorists that they are just about to enter an area with pedestrians and that there are wild animals crossing.

RERA also pursued this matter at Ward Committee level and a memorandum is being compiled about the problems on the R44, which the Minister of Public Works is willing to consider.

We have also drafted a comprehensive letter detailing our concerns, earnestly requesting assistance from Provincial Minister Donald Grant.

Shelly Blake and Kevin Phillips
(on behalf of the R44 Action Group)



Hands & **Crosses**

The R44 Action Group, in association with the Rooiels Conservancy, completed a project which was to serve as a measure to reduce speed on the trunk road that passes through our village. This was accepted as being a short-term measure while we fought our way forward towards permanent, structural solutions that would calm speed effectively.

With the kind and generous donations of Ben de Klerk, Willie and Denise Boltmann, Riël and Estelle Buys, and the tireless work of Wolfgang Steinbach, we had professional signage fashioned on white crosses representing and remembering the carnage of fauna on our roads. We also added some bright halting metal hands encouraging motorists to reduce speed on this stretch of road. We expected that these alerts would cause curiosity and draw the attention of motorists, naturally resulting in reduced speed. We also hoped that these signs would raise awareness and consciousness of the impact of speed.

An unveiling of these signs took place before the Easter weekend, with a lovely social gathering of the community. Indeed the project was a success and created much interest from curious road users. While some hands were slyly pinched, many motorists would stop and take photos, and we do believe there was an impact of sorts and awareness being created.

Sadly, following ongoing negotiations with Provincial Traffic in a move towards a more permanent solution, we had to agree to remove the signage, which we were informed was not legal.

Shelley Blake