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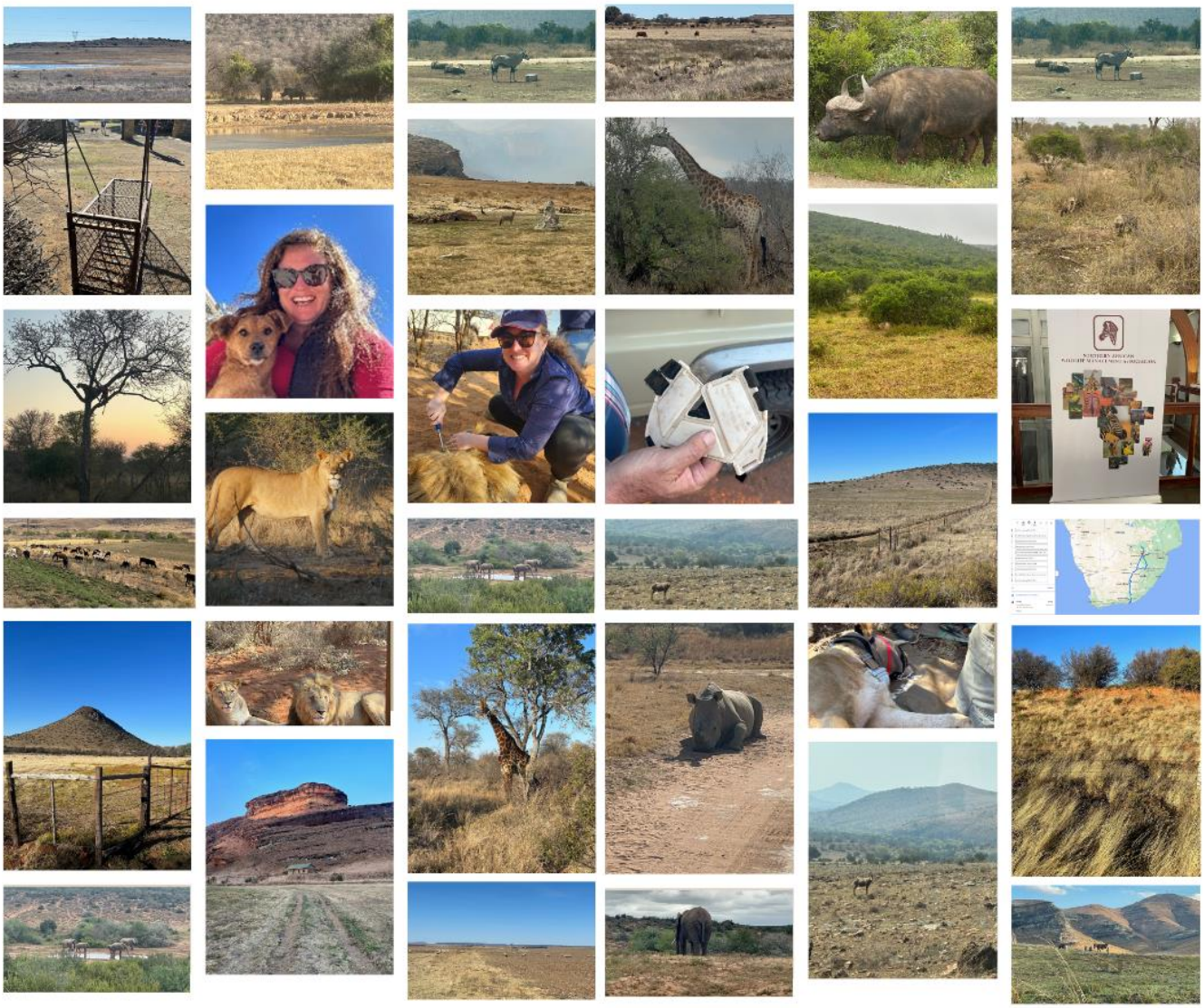

Report by Dr Tracey Kreplins, 2019 Churchill Fellow

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Churchill Fellowship to investigate predator management in a farming and agricultural context

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Respecting other people's opinions

I am very conscious that a lot of people might find the whole agricultural system confronting. Particularly if you are an urban residing person with little experience of farming life or the natural world.

In my experience, all farmers and pastoralists care very much about their animals and the environment around them. They are not numb to losses of native animals or livestock. They are just more accustomed to these experiences.

Everyone who lives on a rural or farming lifestyle tries their utmost to have the highest welfare standards for their livestock and wildlife. Farmers are often the biggest innovators of new ideas and practices to not only produce more food with little cost but with the best welfare outcomes for all species.

In the end our food must come from somewhere.

Acknowledgements

A very big thank you to Dr Haemish Melville for your continued support, guidance and assistance in leading up to my travel and being our guide in South Africa. I appreciate your friendship and trust in me.

Thank you to my family for being dragged around and enjoying our amazing trip.

Figure 1. Haemish and I whilst collaring a sedated lioness. My family and I with rhinos.

Thank you to my colleagues at the Department of Primary Industries and Regional Development and the Minister for Agriculture of Western Australia for allowing me to travel internationally to learn more about predator management.

A special thank you to Professor Trish Fleming and Dr Malcolm Kennedy for their mentorship throughout my career and in my application to the Trust. Your friendship is highly valued.

Many, many thanks to all those in South Africa who gave up their precious time for a chat or interview. It is most appreciated, and I hope I have represented all you said correctly in this document.

I appreciate all those farmers, pastoralists, licensed pest management technicians, executive officers, recognised biosecurity groups who support and endure my research on the ground at home in Western Australia.

Introduction

Worldwide predators impact agriculture, livestock production and biodiversity. Financial losses attributable to predators on livestock production farms and stations across Australia (McLeod 2016) and in other countries worldwide amount to millions of dollars per annum (Breck and Meier 2004; Kerley *et al.* 2018a). In addition to the financial losses of direct predation, costs of managing the predators, (Kerley *et al.* 2018b) and the emotional impacts on land holders are poorly understood.

Science plays a massive role in decision-making for predator management (Kerley *et al.* 2018a). However, politics and economics often overrule science, not to mention the role emotion plays in the decision-making process. Predator management is one of the most hotly contested and emotive discussions in environmental and agricultural sciences.

In Western Australia the legislation currently regards wild dogs (defined as free roaming dogs, dingoes, and their hybrids) as a declared species for control by all land tenures. Control traditionally has been baiting, trapping and shooting, all forms of lethal control. This legislation is an evolving space and some land tenures in Western Australia are wanting non-lethal and alternative control tools. In other words, some properties wish to leave wild dogs on their property. This is contentious as neighbouring pastoral stations are livestock enterprises and carry out lethal removal of the predators. Conservation and agriculture are often at logger heads (globally, but in Western Australia in particular) in respect to the management of predators, and we need to find more ways to work cohesively together. This includes the implementation of a variety of predator management solutions that do not rely solely on lethal control.

In my career as an ecologist, I started out studying native mammals and reptiles, focusing on endangered and vulnerable native species. In the last eight years my wildlife ecologist skills have been used for predator management in the agricultural context. My experience has given me a valuable perspective from both sides of the coin; conservation and agriculture.

By travelling around South Africa I hoped I could learn a range of alternative management solutions for the various land tenures (i.e. conservation, agriculture and Indigenous) in Western Australia which are associated with varying philosophies and desires around wild dog control. South Africa is far ahead of our state in terms of attempting to bridge the gap

between conservation and agriculture. All of South Africa's predators are native species; whereas wild dogs are a naturalised species introduced to Australia around 4,500 years ago. COVID delayed my 2020 travel plans so in the interim (until we travelled to South Africa in 2023) I have been trialling a range of wild dog management solutions in Western Australia (i.e. deterrents and guardian animals). During my travels the focus was not solely on alternative tools as I had anticipated. I instead learnt more about business models, ideologies and research projects that can bridge that gap between conservation and agriculture, or those controlling predators lethally and those finding ways to live with predators. Essentially, I discovered new approaches to managing predators in the evolving landscape of wild dog management in Western Australia. For example, an unfenced conservation reserve was having issues as a leopard was leaving the conservation property for nearby livestock farms. The conservation group were offered $30,000 USD by hunters for the opportunity to shoot the leopard. That $30,000 USD would have paid for a fence around the entire property and ensured the safety of all the other leopards. This was a conservation conundrum with some alternative ways to viewing predator management.

However, we must maintain a complete control toolbox for predators that hold lethal and non-lethal options for a range of scenarios. Unfortunately, sheep and wild dogs cannot coexist in any context and lethal control for sheep production is highly important. Not unlike the black-backed jackal and caracal who impact the sheep industry in South Africa.

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To investigate predator management in a farming and agricultural context - Churchill Trust

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Keywords

Agriculture

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Caracal

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Farming

Human-wildlife conflict

Lethal or non-lethal

Lion

Management

Predator

South Africa

Western Australia

Wild dog

Glossary and Afrikaans dictionary

- Ambush predators – sit and wait predators who capture prey by stealth.
- Blesbok - Blesbok
- Buffalo - Buffel
- Bush pig - Bosvark
- Cathemeral - an animal who is active during the day or night; irregular activity patterns.
- Caracal - Rooikat
- Cheetah - Jagluiperd
- CPE or M-44 – gifskieter- canid pest ejector – coyote getter- a static bait (i.e. lure head) with a poison capsule placed into the ground. When an animal bites the lure head the poison is ejected into their mouth.
- Corral - Kraal
- Diurnal - active during the daylight
- Eland - eland
- Giraffe - Kameelperd
- GPS clusters – In this context it is a method of using tracking data from animals to determine where kills sites are.
- Hartebeest - Hartebees
- Hyena - Hiena
- Impala - Rooibuck
- Jakkas - jackal
- Karoo – this term has two definitions. It is a semi-desert area or region of South Africa but it is also the term for a habitat type grassy shrub land.
- Kudu - Koedoe
- Leopard - Luiperd
- NDVI – normalised difference vegetation index. It is a remote sensing measure of vegetation.
- Nocturnal - active during the night
- Olifant - elephant
- Ostrich - Volstruis

- Porcupine - ystervark
- Rhebok - Rhibok
- Rhino - Renostar
- Springbok - Springbok
- Veld - paddock
- Velvert monkey - Fire watch
- Warthog - Vlakvark
- Wildebeest - Wildebees
- Zebra - Sebra

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Executive Summary

Churchill Fellowship to investigate predator management in a farming and agricultural context

Dr Tracey Kreplins, 2019 Churchill Fellow

Worldwide predators impact livestock production and biodiversity. Often livestock are easier prey to predators than naturally occurring prey and resulting livestock losses can be excessive. Human wildlife conflicts often result from the management of predators. Losses to predators are financial. However, predator management is one of the most hotly debated topics within agriculture and environmental management spheres. Losses are therefore not only financial but emotional.

In Western Australia dingoes, free roaming dogs, Australian dogs and their hybrids are collectively termed 'wild dogs'. Under current legislation the control of wild dogs by landholders commonly occurs. Many of the control tools for wild dogs in Western Australia are lethal and have not changed in many decades as they have been effective at reducing the impacts of predation and maintaining the profitability / viability of sheep farming. However, in recent times there is a push for more non-lethal forms of predator management in the state. My Fellowship aimed to investigate a range of management options for wild dogs that could be used in Western Australia. My travel plans were interrupted by COVID19. Despite this, from 2020 to 2023 I trialled alternative forms of wild dog control in Western Australia including auditory and visual deterrents and guardian animals.

In 2023 I travelled to South Africa to research predator management undertaken in a country where the predators are native species. A major difference between the two countries is the value of predators. In Western Australia dingoes (wild dogs) are valued by some cultures in the 4,500 years since they were brought to Australia by Asian seafarers. This naturalised species divides ecologists and communities in their love and hate of this predator species. In Australia wild dog numbers are not limited and their range has increased across the country with the placement of water points for livestock and the livestock themselves (i.e. food resources) since settlement. In South Africa predators were historically controlled due to

their impact on agriculture. However, in recent years they are valued for tourism and conservation, as many species are endangered due to the many years of hunting.

The larger low-density predators (such as lions, leopards, hyaenas etc.) have been identified as of conservation concern and very popular for tourism. However, there is no focus on conserving species like black-backed jackal and caracal on farming properties. Jackals and caracals are considered vermin. South Africa has undergone a culture shift in the past (not dissimilar to the one around wild dog values within Australia) whereby many predators are highly valued. Consequently, there is reduced support for lethal control approaches from the government and fencing subsidies are no longer available.

During my five weeks in South Africa, I interviewed a range of farmers feeling the impacts of black-backed jackals and caracals on their livestock enterprises, interviewed many academics, researchers and on-ground wildlife managers and attended and presented at the Southern African Wildlife Management Association (SAWMA) conference.

An interesting difference between the two countries is the number of predators and this was made abundantly clear at the SAWMA conference. In Western Australia farmers contend with wild dogs and the introduced European red fox (feral cats are also present on all properties). In South Africa the farmers contend jackals, caracals, and other smaller predators such as mongoose, baboons, crows, African black footed cats and others. Many of South Africa's predators are in reduced numbers in public spaces due to persecution but some are still present and impact livestock enterprises. Even in the current day many of their Indigenous communities, or those living subsistence lifestyles, lethally control predators such as black-backed jackals. Those on the ground looking at non-lethal management options are often researchers working with the farmers (commercial or subsistence) to conserve remnant predator populations or endangered species. A really interesting example of this is the Kenyan or Tanzanian lion projects, whereby the use of 'living walls' or compensation for losses has been reducing the farmer-predator interactions.

I had hoped to learn more alternative forms of management in South Africa as their country has very strong values on the conservation of its many endangered predators. Yet farmers in Western Australia and South Africa both rely heavily on the lethal options in the toolbox of predator management. I did learn to think outside the box when it comes to conservation and

control of predators and solutions are not necessarily in the form of new 'tools' but new outlooks and approaches. For example, in Western Australia, how do we approach the situation where Indigenous land where wild dog control is not implemented and is next door to a sheep station? A new approach may be taken from the Waterberg Wild Dog Initiative in Limpopo where some really innovative people are tracking the African wild dogs across one hundred private game and livestock farms and warning the farmers before they impact their operation. By supplementing the African wild dogs' diet with carcasses over the denning season, commercial tourists can view the native predators, providing funds to offset the impacts on the private farms. Perhaps working on the Indigenous lands in Western Australia to investigate the number of wild dogs and their movement can help reduce the potential impacts on the sheep farms next door and it may be possible to strategically implement management only where needed. This will also potentially create amicable relationships on either side of the conservation / agricultural fence. These learnings are now the early stages of a research project here in Western Australia led by myself.

Another aspect that became apparent from my travels overseas is the propensity of very intelligent predators to modify their behaviour to survive alongside humans. Predators persecuted over periods of time will change their behaviour to avoid humans and their control tools. This creates what the farmers call 'professor jackals' or jackals that have gone to university. Furthermore, ecological adaptation by black-backed jackals results in earlier sexual maturity on farms that produce larger litters of young. In Western Australia there are very few places where wild dogs are not controlled in some form. However, within the evolving space of wild dog values and the lessening of control on many tracts of Western Australian land it is a good opportunity to investigate changes in predator behaviour. Potential habituation to humans and changes in behaviour might require alternate forms of management that are novel and flexible to mitigate human conflicts and protection of livestock.

Guardian animals, such as the Maremma dog, are a lethal and non-lethal control tool for predators. Their presence deters (but does not exclude predators) from the livestock paddock. Direct interactions between predators and guardian dogs can result in the death of the predator. Guardian animals are an effective tool in both South Africa and Western Australia. They are used to reduce loses to cheetahs, hyenas and other African predators. In

South Africa they use other breeds of guardian dogs to the Maremma, like Anatolians and non-traditional guardian dogs breeds. A major difference between the use of guardian dogs between the two countries is the guardian dogs reside in the paddock with the livestock and no humans in Western Australia, whereas in Africa they are working in the paddock with people and livestock. Chatting with researchers investigating guardian dogs and farmers that own them in South Africa there are a wide range of experiences with guardian dogs. This provides a good perspective on my two trials in Western Australia where I am examining the use of guardian dogs to protect sheep in the Murchison and weaner cattle in the Pilbara against wild dog predation.

Lethal control will always be warranted in some contexts and environments. In Western Australia the approved tools are poison baits, trapping and shooting. These tools get a lot of support and criticism, not unlike the species they control. In South Africa the use of poison is illegal as they do not have the coevolution of native mammals, birds and reptiles the naturally occurring poison 'sodium monofluroracetate' (1080 is the synthetic form). 1080 is a poison specific to three predator species – wild dogs, foxes and feral cats – as they have not evolved with the native vegetation and are an introduced species. Its use is other countries would not be target specific. Trapping does occur but on a smaller scale in South Africa. Shooting is the preferred method, particularly with a thermal scope so animals can be easily spotted at night. Many farmers and professional shooters sit outside for long periods of time to reduce predators on farms. In Western Australia there has been a recent increase in interest in this tool as the use of a thermal scope would ensure higher welfare standards as shooting rates the best for welfare standards in lethal control. I look forward to the outcomes from some trials using a thermal scope to control predators in Western Australia under the Wild Dog Action Plan 2021-2025.

Management can be proactive and reactive. It was evident after interviewing a range of South African farmers that those who had the time and funds to be proactive in their control efforts (e.g. trapping before losses occurred all year round) had fewer losses to predators. Many producers overseas that I interviewed, only had the ability to control predators after losses occurred. Here in Western Australia, we have "landscape scale nil tenure" control across large tracts of the country. This is a proactive form of controlling predators and their impacts on agricultural properties. The downside to this is we become complacent and forget why we do

this control and how effective it is. We actually don't remember how many losses can be sustained in the absence of the proactive control nor have we measured the losses effectively. With the reduction in properties carrying out control in Western Australia we will potentially experience changes in our livestock productivity and predator behaviour providing an opportunity to learn.

Travelling overseas to learn about predator management in a different context and landscape, with different predator densities and cultural pressures has led to some out of the box thinking that can be used for managing predators in Western Australia going forward. I plan to incorporate much of my learning into the next Western Australian Wild Dog Action Plan 2025-2030 which will incorporate a strong emphasis on providing options for all properties.

2023 Itinerary

Date	Place	Institute or organisation to be visited
3-9th September	Johannesburg	Dr Haemish Melville, Dr Kerry Slater, Dr Anne Wilson and others at the University of South Africa (UNISA)
10-17th September	Golden Gate National Park	Southern African Wildlife Management Conference. Interviewed a range of researchers
11th September	Clarens	Dr Nico Avenant, Mammalogy Department, South African National Museum
17-19th September	Free State	Interviews with farmers and land managers with predation issues
20th-22nd September	Eastern Cape	Interviews with farmers and land managers with predation issues
21st September	Eastern Cape	Niel Viljoen, Livestock and Predator Management
23rd - 24th September	Eastern Cape	Addo Elephant Park
25th – 27th September	Port Elizabeth	Dr Anne Pandraud, UNISA post-doctoral research fellow Professor Graham Kerley, Nelson Mandela University
27-28th September	Travel to Johannesburg	
29th September	Travel to Qwabi Game Reserve	
29th September- 4th October	Qwabi Game Reserve	Lion field work with Ludi Kern, Dr Andre Uys and Qwabi team Reilly Monney, Water Wild Dog Initiative
4th-9th October	Greater Kruger	Safari travels

Introduction

For over one hundred years wild dogs have been lethally removed from the Australian landscape because of their predation on sheep and cattle. Trapping, shooting and baiting are commonly used tools and these tools haven't deviated much for many decades. This is because the tools worked. Wild dogs were removed locally from a lot of Shires and districts country wide, and livestock enterprises were profitable.

More recently the attitude to wild dog control is evolving. This is where we need to discuss the naming of wild dogs. In Western Australia wild dogs is a collective term for dingoes, feral dogs, free-roaming dogs, Australian dogs and their hybrids (Kreplins *et al.* 2018a). Dingoes in Western Australia and Australia are one of the most controversial environmental issues I have ever come across. Everything about wild dogs is hotly contested, debated and argued, often more emotively than a scientist would like. The myths and theories around dingoes are wide ranging and cover all elements of dingo biology, ecology and control. A lot of my role as a research scientist on wild dogs in the Western Australian government is to investigate many of these myths and distil any truth behind them using the best available science. This allows appropriate control tools to be used for predator management and, more recently, to ensure all types of land tenure have a variety of alternative control methods. Understanding all areas of wild dog ecology also ensures that the government has the highest standards of knowledge to connect with the community.

Originally from Asia, dingoes arrived in Australia by Asian seafarers' boats between 4,500 and 8,000 years ago. Domestic dogs were brought to Australia in 1788 by European settlers. However, all types of dogs in Australia are classified as one species - the domestic dog, *Canis familiaris* and the dingo is a breed rather than a separate species. The dingo can interbreed with domestic dogs and produce fertile offspring, further blurring the distinction between wild and domesticated canines in Australia. So, in short, the dingo is a type of dog that is naturalised to Australia (Jackson *et al.* 2017).

Wild dogs' cost $89.3 million on average, per year in lost agricultural productivity. Not only do wild dogs directly prey on livestock causing losses through death and bite marks but the stress and mis-mothering from potential predation impacts on livestock also causes significant losses (McLeod 2016)**.** A national survey of livestock producers have demonstrated

that the emotional impact of wild dog predation events is the equivalent to that of a soldier returning from a war zone (Binks *et al.* 2015).

It is well known that wild dogs and small stock cannot coexist. Sheep and goats cannot be produced in a landscape with wild dogs (Thomson 1984). However, the relationship between cattle and wild dogs are more difficult to understand. In places with plentiful resources and well-nourished cattle, predation impacts are reduced as stronger cattle can withstand predation and the stress of wild dogs being present in the paddock. However, in times of drought when natural resources for wild dogs are depleted, they commonly prey on cattle. These are only generalized concepts about wild dogs in the cow paddock. Predation by wild dogs on healthy cattle occurs commonly also so the story is not straightforward.

Dingo genetic purity is not of conservation concern in Western Australia (or Australia). After the Northern Territory, Western Australia has the highest number of pure dingoes (Stephens *et al.* 2015). Genetically pure dingoes are present in Western Australia in areas where despite 40 or more years of lethal control they are still dingoes. The theory that lethal control breaks pack structure and will endanger dingo genetics is false (Stephens *et al.* 2023). European settlement has increased the range and numbers of wild dogs or dingoes by provisioning more resources (more food (e.g., sheep and open grasslands for kangaroos) and water (i.e. agricultural water points; Allen and West 2013). In Western Australia there are four genetically distinct dingo populations: Inland, Northwest, Mid-west and South-west (Figure 2) with minimal geographical impediment to gene flow.

What defines a genetically pure dingo is very controversial. Here in Western Australia the definitions of a pure dingo are 100 to 90% purity, 90 to 80% is an almost dingo and anything below 80% is a hybrid (Stephens *et al.* 2015). Other studies have lower cut-offs for purity and often this is where the confusion arises as to what is and isn't a dingo, or the higher numbers of dingoes in other areas (Cairns *et al.* 2021).

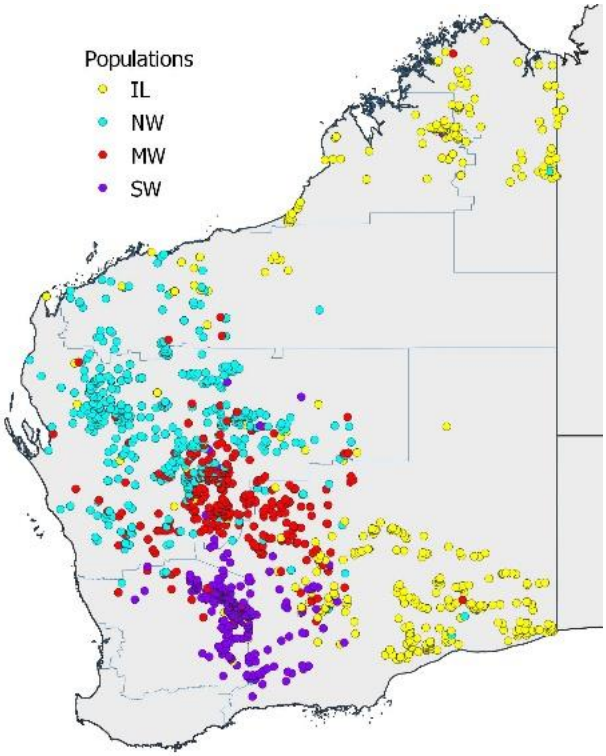


Figure 2. The four populations of dingoes within Western Australia: Inland, Northwest, Mid-west and South-west (Danielle Stephens- Zoological Genetics).

Wild dogs impact or threaten 14 endangered or vulnerable native mammal, reptile and bird species listed under the Environment Protection and Biodiversity Conservation (EPBC) Act in Western Australia. For example, studies have linked wild dog predation to declines in populations of threatened species such as the black-flanked rock-wallaby and the western quoll. However, the extent and nature of these impacts may vary depending on factors such as habitat type, prey availability, and the presence of other predators or threats. The management of wild dogs in relation to conservation of endangered or vulnerable species is a complex issue that requires careful consideration of multiple factors and perspectives.

There is no scientific evidence for Western Australia that the presence of wild dogs will lessen feral cat presence and therefore reduce predation on native species (Kreplins *et al.* 2022; Kreplins *et al.* 2020). Wild dogs and feral cats coexist at a landscape scale, but they do not spend time at the same location simultaneously. One predator does not exclude the other from habitats, landscapes or resources. Western Australia is a bottom-up ecosystem, meaning that when rainfall events promote primary productivity, there is an increase in prey

availability and more predation (Morgan *et al.* 2016). The environment drives the number of prey and predators, the predators do not drive the ecosystem (i.e., top-down ecosystem).

There are a range of tools that landholders and livestock producers have used on rural or regional properties for many years implementing the highest possible animal welfare standards, discussed below.

A synthetic compound, 1080, is used for vertebrate invasive species (foxes, rabbits, wild dogs, feral pigs and feral cats) control in Australia. It is chemically the same compound as sodium mono-fluoroacetate found in the Gastrolobium and Oxylobium plants that naturally occur in Australia. This odorless compound is found in 33 plant species in Western Australia. Australian native species are highly tolerant to the poison and when used in baits it is target specific to species not native to Western Australia. There is a lot of misinformation around the poison and a lot of that comes from its use in the United States and New Zealand where the native species do not have a tolerance. The use of 1080 poison is highly regulated and requires a license and specific training in Western Australia.

In addition to baiting, trapping and shooting is implemented by Licensed Pest Management Technicians or trained land managers in areas where wild dogs are known to be present, such as along fence lines or near water sources. Fladry (flappy tape or other coloured flags or strips of fabric), auditory deterrents (squawker boxes) are motion activated boxes that emit loud, high pitched sounds and guardian animals are other tools available to landholders in Western Australia. The last three tools are less commonly used throughout the state and are effective at a smaller spatial scale.

The State Barrier Fence plays an important role in protecting landholders in the agricultural region of WA by preventing the movement of animal pests from the pastoral areas into the agricultural areas of Western Australia. It is approximately 1209 km long and starts at Zuytdorp Cliffs north of Kalbarri through to Jerdacuttup east of Ravensthorpe. Its primary purpose is the prevention of incursion by wild dogs and we know that the fence is indeed successful at this role (Stephens *et al.* 2023). Cluster or cell fencing an entire property or several properties is also being trialed in many places in the state.

In South Africa there are a range of predators that can impact livestock. Some of these predators include lions, hyenas, black-backed jackals, cheetahs, leopards, caracals, servals,

and Cape fox. These predators are found in private game reserves, protected areas and on farms. It is legal to control certain predatory species on farms when they are causing damage to livestock (i.e. black-backed jackals and caracals). Livestock predation costs more than R1 billion annually (~$82 000 000; Balfour and Kerley 2018).

A lot of South Africa was historically farmed. There are few places in the country that have not been farmed at one point or another. Even Kruger National Park was once a cattle station. The Free State is the breadbasket of South Africa where a lot of the farming and food production for the country occurs today (Figure 3). Visually the Free State closely resembles the wheatbelt of Western Australia. The three capes, Western, Eastern and Northern do also have farming areas. Today across those farming areas 38, 500 commercial livestock farms produce about half of South Africa's agricultural GDP and provide 245,000 jobs (Kerley *et al.* 2018a). Most sheep and goat farming takes place in the Free State and Eastern Cape, cattle production is predominately in the Western Cape. Not unlike Western Australia the number of sheep and goats being farmed is steadily dropping but cattle numbers remain stable. More similarities between the two countries are the reduction in farm workers living and working on property due to larger farms amalgamating and the liberalisation of labour laws. Many farmers who I interviewed outlined how they are increasingly relying on technology to simplify and streamline livestock production. However, this results in a reduction in the number of labourers being employed on the farms.

Figure 3. Municipalities of South Africa

Black-backed jackals and caracals are responsible for high levels of predation on small stock in South Africa. Not unlike the wild dog and the Western Australian sheep industry. It is legal to control black-backed jackals and caracals that impact livestock production in South Africa. Cattle producers rarely feel the impacts of black-backed jackals or caracals on their livestock, except for the odd story of black-backed jackal hunting in large packs. Cattle production is usually impacted by lions, hyenas and leopards but in South Africa those species are rare on farms nowadays.

There are a range of tools available to South African farmers and land users to control damage causing individuals. A major difference between the two countries is that it is illegal to poison predators in South Africa. Historically (up to the mid-1960's) bounties were held and strychnine was subsidised for the control of jackals. Then more recently vermin proof fencing was promoted as a useful method for keeping jackals and caracals out of livestock zones (Bergman *et al.* 2013). Poison use and hunting clubs were both used and popular in the past but are both now banned. Shooting predators on farms is the primary means of predator control while fencing and trapping may be a secondary method.

Professional hunters are also commonly employed to control problem predators, but many farmers also sit out at night with guns equipped with thermal scopes to remove predators in

the paddocks. Driven hunts with dogs and aerial shooting from helicopters are some of the other ways in which predator control is implemented in South Africa.

South African fences are very diverse in height and use across the country. Some are very high, often over 1.8m, and up to 2.4m and electrified. However, there are also a lot of shorter fences (i.e. 1.2m) around livestock. There is a lot of effort put into checking fences regularly. Other activities used to reduce predation on farms is kraaling the livestock (defined as a small livestock holding paddock). This only happens on smaller farms or farms with enough workers to kraal the livestock daily during lambing season. Guardian animals such as donkeys, llamas, and dogs are also employed but typically only on smaller farms.

Theft and poaching on South African farms are an on-going problem. There was a crazy story of a judas goat that 'convinced' all the other goats to follow it onto the thieves' trailer and allow themselves to be stolen.

Much of South Africa has undergone a culture shift in respect to its perspective of the value of predators, whereas in the past all predators were considered vermin some species are valued highly for tourism and conservation. Many of the native predators were almost hunted to extinction (e.g. African wild dogs, or otherwise known as painted dogs) due to their impact on livestock production. However, presently tourism provides four times as many jobs as farming in South Africa. Tourism enterprises support jobs in a variety of fields including caterers and cleaners for accommodation, tour guides, and land managers. Furthermore, many private or public reserves make money from selling wildlife. In South Africa anybody can own wildlife. There is a lot of trade between parks and reserves to ensure the genetic integrity of species. Some say this is has been too effective as many reserves are limited by space for wildlife, not the numbers of wild animals.

Much of the research in South Africa focus on behaviour science and habituation of wildlife. This allows conservationists and tourism operation to know their animals and habituate them to tourists. There is much one can learn whilst in South Africa around behavioural ecology and how human activities influence wildlife. However, this has led to an under reliance on technology within wildlife ecology of Africa (this is also related to differences in the economics of each location).

Experiences and findings

University of South Africa presentation, 5th September

On the 5th of September I presented an overview of my research portfolio to the University of South Africa (UNISA). There were many present, both in person or online, which included students, university researchers, Dr Kerry Slater, and the chair of the Animal Ethics committee, Dr Ann Cheater. All attendees were associated to the College of Agricultural and Environmental Sciences of UNISA.

A range of topics were discussed after my presentation. For example, when analysing predator activity there are a range of environmental variables that can impact predator activity. One of which is lunar (moon) phase. Generally, when doing these analyses we use coarse categories for moon phase, full moon, new moon, waning crescent and waxing gibbous. However, the brightness of the moon light and when the moon appears is a more continuous variable, that is more applicable to the analyses conducted.

In South Africa control methods for human and wildlife conflicts do not use poison. However, in Western Australia we are fortunate that native species are tolerant to a naturally occurring poison, sodium mono-fluoroacetate. This poison is synthesised and put into a range of baits for control of non-native predators in Australia. These predators include wild dogs, feral cats (*Felis catus*) and European Foxes (*Vulpes vulpes*), all of which are readily susceptible to the poison as they have not evolved with the poison. The group in attendance were interested in the use of this poison and its evolutionary history with the predators. It also leads to the discussion around whether wild dogs are a native species or not. Naturalised is a probably a preferable term as wild dogs are something in between; they have been here for a long period of time but not as long as the native species that have coevolved in the presence of sodium monofluroacetate.

There was a suggestion to trial the training of domestic dogs as guardian dogs instead of using the usual guarding dogs breeds (Maremmas and Anatolians). Many in South Africa who utilise guardian dogs actually use breeds that are not traditional guardian dogs. The propensity for the dog to bond with the livestock rather than the type of dog was important.

It was suggested that another researcher in South Africa might be working on relevant and similar topics around the black-backed jackal. Black-backed jackals are of a similar size and

biology to wild dogs (i.e. breed annually and prey on small stock enterprises). Dr Liaan Minnie conducted his PhD on jackals in and around farming properties in the Free State. Dr Minnie discovered that lethal control of jackals on farming properties resulted in changes in the predators' reproductive biology when compared to jackals on conservation estates nearby which were not exposed to lethal control. Jackals on the farming property were not only maturing sexually at a younger age but also producing more offspring to compensate for the lost individuals due to the farmers conducting lethal control (Minnie *et al.* 2016).

In Western Australia there are up to 30 licensed pest management technicians who implement lethal control on wild dogs on farms and stations. They collect data such as coat colour, age, GPS coordinates and other variables when they control individuals. A control site with the same variables would be hard to collect data from in Western Australia as per Dr Minnie but there are a range of control efforts (i.e. amount of baiting and trapping) done on properties.

Figure 4. Some of the attendees to my presentation at the University of South Africa (UNISA).

Mount Nebo property 9th-10th September

Whilst driving around South Africa it was evident there is a range of fencing types. Some fencing is to reduce theft and invasion of homes. Others are to keep predators out of properties. What is really evident is the effort put into fence maintenance in South Africa.

Figure 5. Types of fencing seen in South Africa.

Interview with Dr Nico Avenant from the National Museum of South Africa, Bloemfontein. 11th September

Dr Nico Avenant has been working with farmers in the Free State for twenty years on the impacts of black-backed jackals and their sheep enterprises. The farmers approached Dr Avenant as he was working in the area on small mammals, particularly rodents, and asked him for help with the predation by black-backed jackals on their sheep. This all started back in 2003 with a farmer contacting Dr Avenant for help with black-backed jackal traps.

Predation on livestock has impacted the number and type of livestock farmers run in South Africa. In some areas farmers stopped running livestock or changed enterprise to game or cattle farming as these livestock fair fewer losses than sheep. Other farmers have decreased

their flock size to 200 sheep, in order to kraal them every night as a depredation safety measure. The downside to kraaling your sheep is trampling, increased parasite load and a negative impact on wool quality. In many other areas, such as the southern Free State and the Karoo farmers still have large flocks roaming in large camps, at ratios of 2ha/small stock unit in the southern Free State (in other words, c. 1,500 sheep on the average 3,000ha farm, or 1,200 sheep on a c. 2,500ha farm); other farmers may run up to 10,000 sheep across multiple farms (these farms may be next to each other, or spaced at some distance). These farms carry out more predator control efforts than the smaller properties that kraal livestock.

Those farmers residing closer to nature reserves (where little to no black-backed jackal control occurs) report higher losses to predation than those further from the nature reserves. This purports the common perception, and claims, that most of the black-backed jackals not only breed in the reserves, but that it is also mostly "the reserve's jackals" that are responsible for most small stock damage on these neighbouring farms. Such jackals are believed to return just before first light to the "safety" of the reserve (where they are not controlled or hunted) and continue to damage livestock on the surrounding farms the next night. According to these farmers the fences around many of the reserves are no longer up to standard. They are also not regularly patrolled for new holes in the fences that are regularly caused by the destructive warthog and tunnels underneath the fences caused by burrowing aardvark.

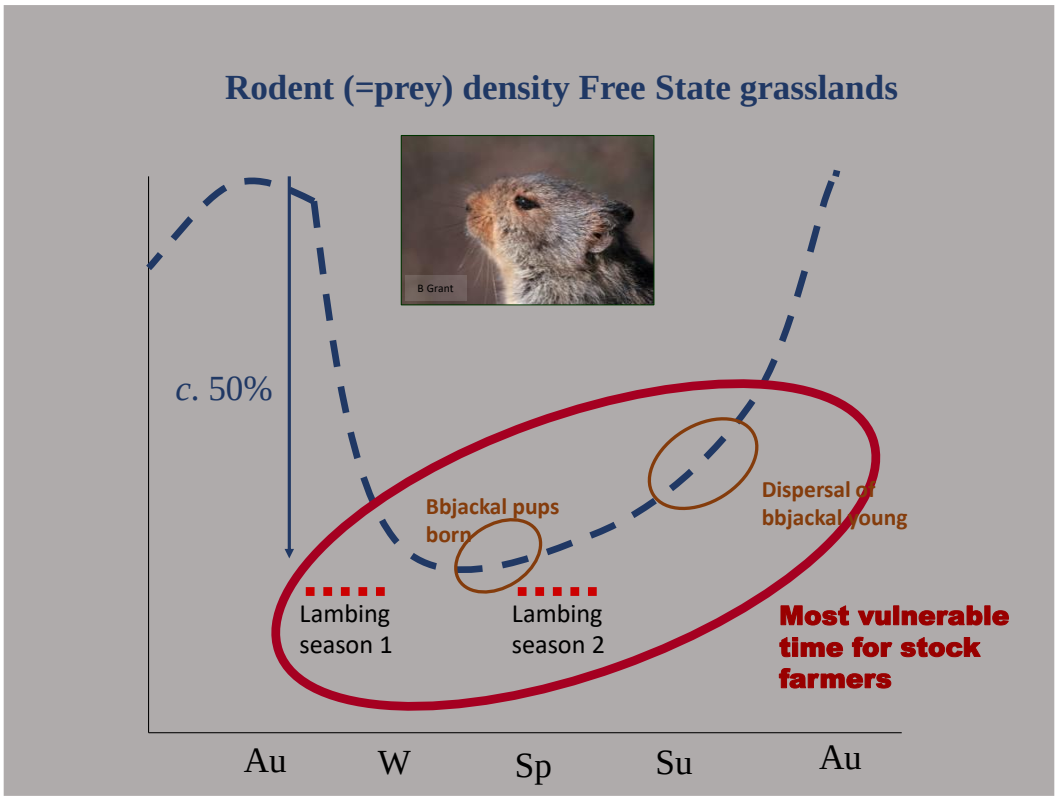
A range of fencing types are used in this area. A relatively small percentage of farmers use electric fencing (≈ non-permanent kraals) that can be moved to protect especially the younger lambs in the open field at night. The popularity of the movable electric fencing is expected to be increasing, despite the extra work involved that accompanies them.

The sheep drop lambs twice annually in this area usually around March/April and September/October (Figure 6a). This unfortunately coincides with when the black-backed jackals are also more active and have higher energy demands. In September-October new jackal pups are born. During this first period the energy demand increase as lactating females need the extra nutrition, and the younger lambs are relatively easy to catch and for the males to carry back to the den. Similarly, during the second phase (September and October) is when young jackal pups learn to eat meat. The farmers' belief is that a jackal pair and their (up to seven) pups devour at least 2=two lambs per night. Then in February-March the jackal young

disperse from their parental care and may be prone to look for the “easy prey on which they were reared”. Lambs less than 2=two months old are very easy prey compared to natural prey or older lambs.

Other prey items such as rodents, birds and antelope are available when lambing is not occurring. Small mammal reproduction decreases from March and is complete by the end of April (Figure 6a). This means small mammal density is at its highest at the end of April (Figure 6b). As winter approaches there is a small mammal die-off due to a lack of food available in the frost and cold temperatures, not dissimilar to the dasyurid die-off in Australia. The young and old rodents also do not survive the winters. Reptile and insect density also decreased from March. In summer there are still some mice, springhares and birds available as jackal prey. However, fruits are more readily available and increase within the jackal diet during this time of year.

a.



b.

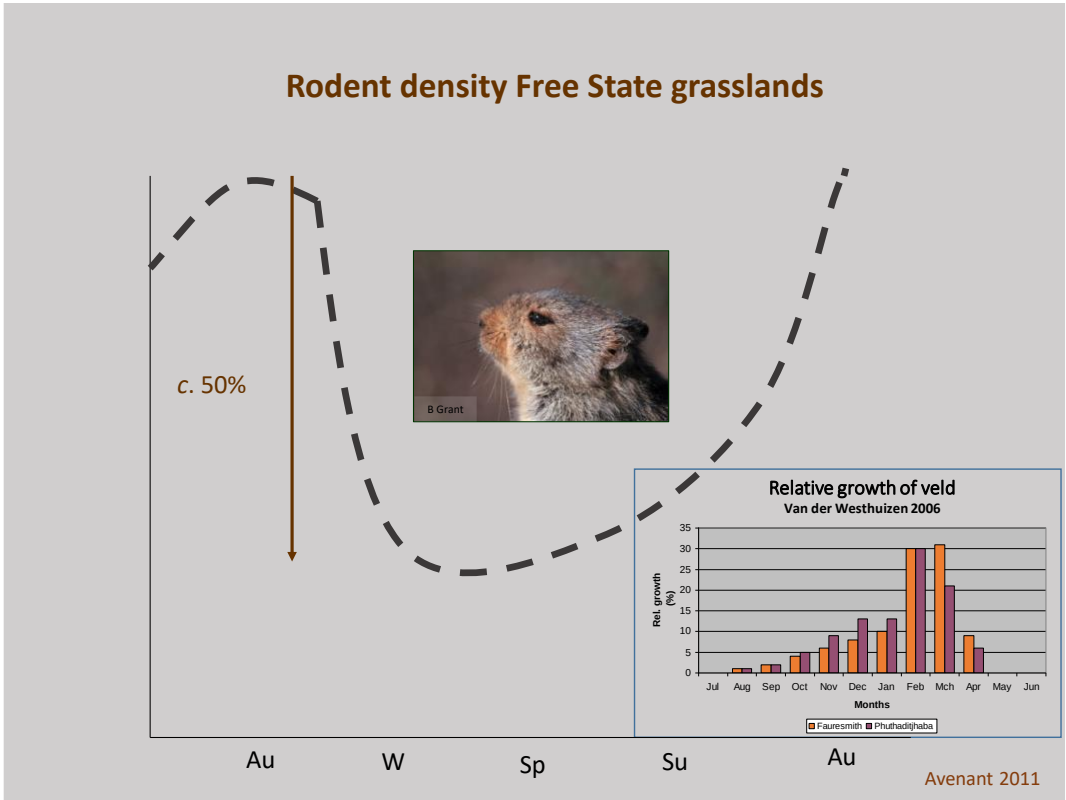


Figure 6. Small mammal (rodent) reproduction in relation to lambing and black-backed jackal activity (a), and small mammal (rodent) density in relation to veld (field) growth (b) over a year in the Free State grasslands. Provided by Dr Nico Avenant.

Many farmers employ a professional hunter to assist with predator management. These hunters usually work over several properties to remove damage-causing jackals which is very difficult as identifying the specific culprit causing losses is almost impossible. Instead, many farmers employ 'blanket control methods' such as call and shoot (i.e. playing the sounds of an animal in distress to lure the black-backed jackals, which are then shot by spotlight). There are many 'reports' of "super jackal" that cannot be caught – they have learned from others, are sly, and simply will not approach such call stations, traps, leg-hold devices, coyote-getters or any situation that may be a potential risk for them; the young, less experienced jackal instead gets taken out. Efforts put into the capture of jackals can sometimes be very unsuccessful. For example, one experienced professional hunter working in the two research study areas managed to capture only two jackals in the Eastern Cape, and one jackal in the Free State over a period of 60 days. A recent paper (In press) by Green *et al.* have indicated that helicopter net-gunning may be a more successful method with which to capture (and collar) black-backed jackals.

A PhD Student, Alistair Green, worked with Dr Avenant and Dr Melville in these two areas to explore jackal and caracal movements. He is currently writing up his work on the two predator species and their population size, seasonal diets and movement patterns.

Dr Avenant explained that this area differed from the next area in which we will travel to. These farmers run 1,000 head of wool producing sheep and leave their sheep in the field overnight. Rainfall also differs between the two locations with the farmers in the current area receive 400mm annually and distant farmers receive 650mm of rainfall.

Black-backed jackal biology was also studied over the time period. It demonstrated that jackal's do not have a strong pack structure, but a territorial pair. This dominant breeding pair and one or two helpers (usually daughters from the previous breeding seasons) rear the pups. Litters can be large and have up to seven pups. Such breeding pairs, including their helpers, can easily share water points with other breeding pairs or packs without a dispute as long as submissive behaviour is shown towards the pair whose territory it belongs. Other predators of livestock in the southern Free State include bush pigs, warthogs, baboons and domestic dogs going "on an outing". All which impact livestock productivity.

Figure 7. Dr Nico Avenant and Dr Haemish Melville, and Dr Avenant with the author

Dr Avenant outlined that shooting, trapping and poisoning of predators in South Africa was also common in the 1980s and earlier. Many years ago there was government assistance and subsidies for large control efforts, such as the region of Oranjejag, and for jackal proof fencing. Even bounties were offered as a component of the control efforts requiring that a specific earpiece, tail or skin be submitted as proof that the animals had been killed (and to qualify for the payment of the bounty). However, government and social support for this decreased over time as complaints from pressure groups and costs increased, and under the new political dispensation (since April 1994) official government support for farmers was phased out. This massive change in attitudes to predator management meant the farmers were not supported any more.

Another interesting side note is that many subsistence and or communal farmers do not tag their livestock, and that many of these farmers lose some of their stock after quarrels between their herders.

Southern Africa Wildlife Management Association Conference, Golden Gate Highland National Park. 11th-14th September

The Southern African Wildlife Management Association (SAWMA) is an independent, voluntary, non-profit professional body, founded in 1970. The association represents a multi-disciplinary membership and is involved with the science and management of wildlife and other renewable natural resources. It includes the various disciplines, such as wildlife research, conservation science, ecology, genetics, animal science etc. The conference's main theme focussed on "partnerships", aiming to reflect on the full spectrum of partnerships, be it private / public, conservation area / community, researcher / landowner, or any partnership where mutual interests contribute towards conservation outcomes.

The conference location was held at the Golden Gate Highlands National Park which is located in the northeastern part of the Free State, near the Lesotho border. It covers an area of 340 km². The park's most notable features are its golden, ochre, and orange-hued, deeply eroded sandstone cliffs and outcrops, especially the Brandwag rock. The vegetation in the Golden Gate Nature Reserve consists mainly of wooded ravines, gullies and grasslands.

Figure 8. Presenting my use of non-lethal tools for wild dog management in Western Australia.

There was an array of talks that I attended whilst at the conference;

- from management of the protected areas of South Africa by SANParks,
- drivers of occupancy and space by mammalian species, including a range of analyses for measures of ecosystem processes in a range of habitat types across Southern Africa,
- comparison of wild prey and livestock availability for lions and leopards using scat analysis,
- prey separation by larger apex carnivores such as lions and cheetahs,
- deterring elephants from treed areas and elephant diet,
- merging citizen science with camera trapping,
- physiology of sable antelope,
- genetic diversity of kudu,
- vegetation degradation within SANParks and how this relates to species activity,
- small mammal and bat diversity within the Waterberg district,
- the importance of vegetation surveys,
- mountain and plains zebra distribution,
- corridors for zebra and leopard movement,
- railway line impact on elephant and impala populations in wet and dry seasons,
- Bayesian modelling of leopard movement post-translocation,
- movement of species post-reintroduction (e.g. lions, elephants, and cheetahs),
- baboon impacts on plantations,
- habitat selection for bats,
- giraffe physiology, nutrition, and acoustics,
- Pangolin rehabilitation,
- genetic dispersal and gene flow of leopards across the Western Cape,
- mining impact on leopards, hyenas, cheetah and pangolin, and
- varying on-ground methodologies and technologies for data collection including tracking, GPS clusters, carcasses inspection, camera trapping, scat analysis.

Some of the talks that were useful for ideas to take home were;

1. Prey selection of lions and cheetahs by Dr Liaan Minnie. This work investigated the difference between fundamental (what predators choose to eat) and realised diet (actual foods and species consumed). This study used GPS clusters, camera traps and observations to examine the diet of cheetahs and lions. Some limitations were nocturnal and diurnal predators and observations of their activities, witnessing very few kills, unknown prey density in the area and attempting to take into consideration the age and sex differences of predators. For example, female lions do much of the hunting in comparison to male lions.
2. Using car driving and observations to detect lion density in Pilanesburg after reintroduction by Rob Davis. Identification of individual lions was through scars and whisker patterns. Analysis of this data was through spatial capture and recapture which determined the lion density and effort required to get an accurate density estimation.
3. The African wild dog ecotourism project (Reilly Mooney and Clinton Venter) on 55 private farms within the Waterberg district over 125,000 ha. African wild dogs are an endangered species in South Africa with less than 600 individuals remaining due to their persecution by farmers when predating livestock and game on farms. In the Waterberg district north of Johannesburg there is a small team who collar individuals from two resident, free-roaming wild dog packs. This allows several things to occur;
    a. That GPS tracking of the African wild dogs allows the team and farmers know there the animals are in relation to the stock to determine losses by the animals and halt potential predation events occurring on high-value animals. The community communicate by a WhatsApp group when the African wild dogs are in the area allowing farmers to kraal their livestock and/or check their fences when the predation threat is in the area.
    b. Monitor and record all carcasses found in the area to determine the diet of African wild dog diet in the Waterberg.

    The team also have habituated the African wild dogs to a lure call. When the wild dogs come in they are rewarded with a carcass. Some packs took one week for habituation and others took a year. The packs only come to the carcasses during denning periods

when their food requirements are at their highest for care of the young wild dog pups. This allows the pack to be monitored but also allows tourists to see the animals. Then farmers are rewarded by the financial benefit of tourists (R162000 raised over three years; just over AUD$13,100) and see a positive outcome to the African wild dogs inhabiting their properties. Not all farmers have a positive relationship with the wild dogs but some farms love the predators. Funnily, it is often the farms where the wild dogs are not loved where they spend more time.

This program has led to 100% survival of the pups.

There was also a game donation of 75 impalas to the area to compensate the farmers for lost game animals by the African wild dog predation.

This project is funded by donations and Toyota.

4. The relationship between the Masai people of Kenya who herd cattle and lion predation was studied by Masters student Iain Oliver but presented at the conference by Dr Craig Tambling. In this pastoral community there are about 500-1,000 lions and 200,000 Masai people. There is human-wildlife conflict in this arid area between the 17,000 cattle herding Masai and their 90,000 cattle. This study occurred over 2016-2018 with seven lions being GPS tracked. In this time frame there were 205 lion kill sites identified from GPS clusters, of which 119 had evidence of a prey item being killed and 112 of these the prey species could be identified. Lion prey items included giraffe, warthogs, ostrich, hartebeest, wildebeest, zebra and the most common species being domestic cattle. Potentially due to the relative abundance of prey species, an aerial survey demonstrated that prey biomass was 75% cattle, outweighing the native prey species hugely. In order to reduce conflict they trialled a compensation program to the herders who lost cattle. Herders were classified either negligent or non-negligent, those that were negligent did not receive the full compensation as the predation event might not have occurred if they were being fully observant. When examining the data from the herders and their predation events in relation to the NDVI, lag rainfall (three months) and encounter rate of lions. Over the 36 months cattle predation was higher for all herders (negligent and non-negligent) after the three months post-rainfall and just for non-negligent herders and lag rainfall. This is

most likely related to the flush in vegetation or feed post-rainfall that disperses the native prey and increases the potential hunting opportunities for lions using ambush tactics, and changes in husbandry.

5. Investigation of communal farming and the predation impacts by black-backed jackals was presented by the Masters student Thabang Motaung. In the Eastern Cape there are communal farms in the Mhionhio and Nyanderi principalities which produce wool sheep. A survey of the communal farmers asked the demographics of the farmers themselves, sheep management and predation impact and the predators present. They were one-on-one interviews. On average they were older farmers (average 60 years; range 33-92 years), mostly male (5,583 male, 4,417 female), highest education was secondary, 72% unemployed (this did not consider farming as a type of employment), 19% self-employed and 9 % employed.

   The average farm had a herd size of 57 sheep (range 8-360 sheep). The total number of sheep were 9,187 in the principalities. 47% of the farms had been running for more than 20 years. Adult sheep grazed with the lambs 62% of the time and only 30% of the time the adult sheep were separated from the lambs. Generally, the flocks had no herders but were kraaled at night to deter predators.

   It is likely the predator presence and impact was exaggerated by the participants. Disease would have also played a role but was underestimated. 5834 and 116, respective participants reported predation and no predation impacts. Generally, five sheep were lost annually by the farms but the highest loss in one incident was 38 sheep. Free roaming domestic dogs, rather than native predators) were responsible for most of the predation events on sheep. Most of these events occurred in the veld rather than in kraals. Most of the farmers want permission to use lethal control, they hate native predators like black-backed jackals, more so even than domestic dogs which they acknowledge are responsible for many predatory events.

   There is a divide in South Africa between the black and white farming communities- a wicked problem. Money generated through commercial: ZAR1390 million in 2010 and R2710 million in 2019- (the excludes communal farmers). Most research around farming is based on white commercial farms (Kerley *et al.* 2018a).

6. Urban black-backed jackals in Johannesburg are becoming an increasing issue. This was presented by Dr Kelly Marnewick and Nellie de Crom. The estate on which the

jackals are becoming more active is a closed estate with a golf course, a wealthy ownership and 1,245 homes. The jackals are recorded breeding within the estate, feeding on guinea fowl, pet cats, and other wildlife. The survey on homeowner's opinions on the jackal presence was confusing as many loved the jackals and the wildlife (e.g. hedgehog, mongoose, otter, porcupine, genet and the jackals, 74%) but didn't want them in the area. The older owners usually were a two-person household and 73% of them had pets. Rabies is an issue in this area.

Kelly's student noted the emotional responses of the homeowners. A lot of the urban resident were disconnected with the realities of nature. An PANAS analysis demonstrated that 21% and 79% of respondents hated and loved the jackal presence, respectively.

7. The use of scats for monitoring individual predators was an interesting methodology used within several talks on black-backed jackals and African Black-footed (small spotted) cat. The use of scent dogs (short haired pointer) for collection of the scats by Michelle Schroeder was described within the Northern Cape. In the pilot study in the winter of 2020, they compared scat surveys with the scent dogs and spotlighting for the small cat. 65 scats were detected by the dog and only 12 spotlight sightings were recorded. When systematic surveys were carried out 63 and 123 scats were collected in the winter of 2021 and 2022, respectively. The genetic work carried out on the scats to identify individual African small cats had high accuracy (>82%) and identified 65 individuals. On average the scent dogs detect scats at a rate of 5/hr and are an exciting alternative method for density estimation. Meagan Roberts was also proposing to use DNA metabarcoding to examine black-backed jackal diet in her upcoming Masters.
8. Mesopredator release theory is of worldwide significance to predator science. It is a theory about the apex- and meso- predator relationships that is hotly contested and often has very poor data. Elwenn Le Magoarou presented her work on apex predators such as hyenas, leopards and lions, and mesopredators black-backed jackals, badgers, African small spotted cat, mongoose and civets. Camera trapping revealing temporal separation of all predators spatial separation. They favour coexistence using mechanisms such as;
    i. Structural niche differentiation (i.e. arboreal v terrestrial),
    ii. Facilitative interactions (i.e. sharing kills),

iii. Fine scale reactive avoidance, and
iv. Environmental migrations.

One interesting thing I noted was the assumption that the native predators prefer native prey (i.e. antelope species) rather than livestock. One criticism of mine is that it is relative to the prey abundance in the area and the aversion of predators to human persecution. The assumption that predators dislike livestock as prey may not be an actual preference by the predators but an outcome of prey availability and understanding of perceived risk. South African predators typically have low hunting success in comparison to wild dogs in Australia. Lions', leopards and cheetahs hunting success is 19-25%, 38% and 58%, respectively. One species that achieves relatively high hunting success, closest to that of the Australian wild dog, is the African black footed cat. A tiny cat weighing 2kg that have a hunting success rate of 60% (Sliwa 1994). Wild dogs prey on sheep and have 66% success rate but only a 16% success rate for kangaroos (Thomson 1984). This may relate to the higher number of predator species present in South Africa? Perhaps the South African predators' dislike of livestock prey is actually a risk aversion behaviour to persecution by humans.

Dr Liaan Minnie, Black-backed jackal demographics on conservation and farming estate, 14th September

Dr Minnie compared the demographics, body score condition, diet and genetics of black-backed jackals on conservation and farming estate. He found that hunted populations of jackals on farming properties reproduced at a younger age (11 months) and produced larger litters than those on conservation estates. Terming this 'compensatory recruitment'. It is very evident from conversations like these in South Africa that Australia has not enough focus on the social structure of dingoes and their changing behaviour (Minnie *et al.* 2016; Minnie *et al.* 2018).

Professor Aliza le Roux, University of the Free State, Small carnivore research, 14th September

Dr le Roux works on a range of small mammal and predator projects in the Free State. She completed her PhD in the Kalahari on yellow mongoose where she habituated the animals

over time to be able to observe them. She also noted that bat eared foxes are another species that can be habituated, which Dr le Roux did over six weeks, habituating 22 individual foxes.

Dr le Roux's work on black-backed jackals was a little more complex. Black-backed jackals are risk averse and much harder to habituate. If there is a perceived risk they will not return to the same location.

At the conference location, Golden Gate Highlands National Park, black-backed jackal issues were occurring as the animals were taking food and hanging around the camp sites. To a wildlife ecologist this is exciting but to an everyday citizen it might be intimidating. There is a vulture restaurant and hide where they drop roadkill. Then tourists can watch the two species of vultures (Bearded and cape vultures) come into feed. However, black-backed jackals are more common at the roadkill carcasses. We indeed discovered by sitting in the hides for a few hours and watching a large group of jackals feeding on an eland carcass. Dr le Roux, Dr Melville and I discussed a range of collaborative projects that could be possible where information could be shared about predators across countries.

While traveling around interviewing farmers we stayed at a place that had a book talking about Churchill's past.

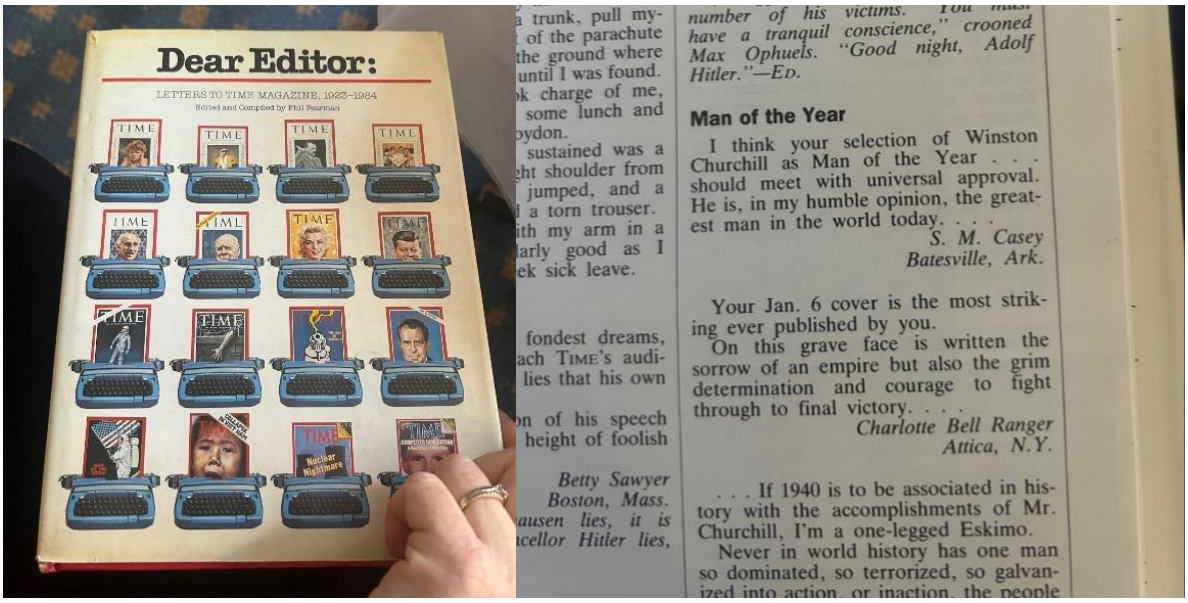


Figure 9. Time 'letters to the editor' including a piece on Winston Churchill- Man of the Year?

Southern Free State Farmers 18th and 19th of September

Over two days we travelled to eight farms and interviewed nine different farmers within the Free State. This area is known as the 'breadbasket' of South Africa where a lot of livestock and grains are produced for the country. It is typified by grass land vegetation and between 300-400mm of rainfall annually. It looks a lot like the Western Australia wheatbelt!

Many of the farmers we interviewed are intergenerational. For example, one fellow was a 6th generation farmer. Overall, his family has spent 200 years in the Karoo. There was a strong bond to their land and their ability to farm it. Many outlined they were not on property to make a lot of money but for the love of the lifestyle and land.

The average property size here is 3,000ha and each farm runs sheep (around 500 head) and a few cattle (around 50 head). Most properties have jackal proof fencing that was subsided in the 1990s by the South African government. The fence type stands at about 1.2m high with diamond mesh and several strand of straight or barb wire at the top.

Most properties have a solar power set-up and run off bore water. Each property is divided into 'camps' (i.e. paddocks) where the livestock can be kraaled at night, there is a water point

and bore. Each camp is 50-100ha. This allows for rotational grazing. Each farmer had a slightly different set-up, some rotationally grazed leaving stock on a camp for 10-14 days and then rested that camp for 12-16 week. Others utilised two different farms and shifted stock between them annually. These are ideal conditions and rotations, that do not occur during drought events. One farmer bought the ewes and lambs into a feedlot before weaning and the lambs went straight from the feedlot to the market.

The average price of livestock at sale is not that dissimilar to Western Australia with a lamb being worth R1200 ($100 AUD) and an ewe is worth R1800 ($150 AUD). However, the farmers all felt the Western Australia gets a premium price for their sheep.

There is an array of wildlife species that impact productivity of the sheep industry in South Africa. Black-backed jackals and caracals prey on lambs and adult sheep. It is legal to remove these species. However, African wild cat, warthogs, bush pigs, yellow mongoose, baboons, Cape and bat eared fox, and otters have been known to prey on and injure lambs (i.e. injury to the face so the animal cannot drink) or sheep (i.e. baboons rip open adult sheep to drink the milk), as well as scavenge on lambs. It is illegal to remove any of these other native species.

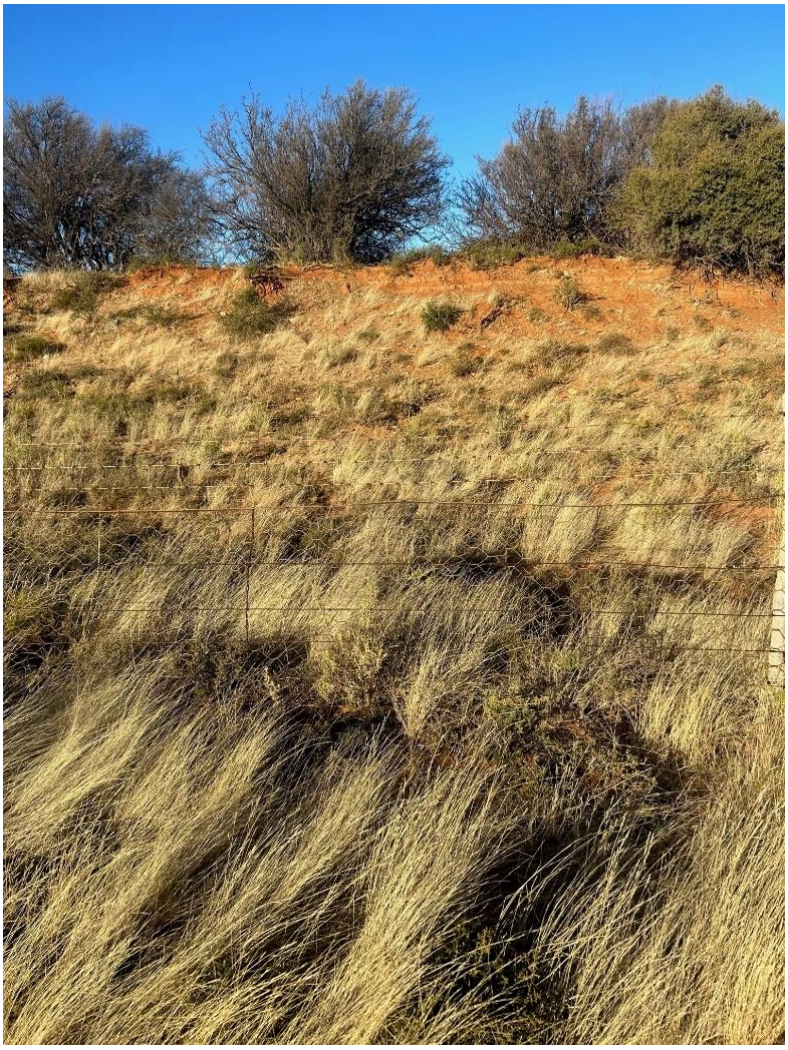


Figure 10. An example of black-backed jackal proof fencing and an intersection of black-backed jackal proof fencing and other fence types.

Predator density varied between the municipality and within it. For example, in the Free State it was noted that the northern area of the Free State still had a high population of black-backed jackal remaining and if you went shooting you could remove 15 individuals per night. However, in the southern area of the Free State you would be lucky to remove a jackal a night as so much control work has been completed. This relates back to work investigating the changed behaviours of the jackals in different areas of control effort (Minnie *et al.* 2016). In heavily persecuted areas those individual jackal remaining are likely to be more secretive in behaviour and produce bigger litters to compensate for removed individuals. However, one sheep farm interviewed reported 74 jackal removed off one farm in 2023 so far demonstrating that these farms are a sink for incoming jackal. Every farm had slightly different predator species issues and numbers.

Figure 11. The caller device used by many professional hunters or farmers.

The most common current approach to predator control is shooting with a rifle fitted with a thermal scope (~R80000 for the scope; often used with a silencer). The scope uses an animals' body heat to visualise it through the scope for removal from the landscape. It works very well in full moon or the cooler season. However, in warmer months the difference between the background ground temperature and the animals' body temperature is not substantial making identification of individual animals tricky. Most of the time the shooter uses the characteristic movements of the animal to identify it before shooting; since there are an array of native species that are found on these farming properties. For example, jackals trot and aardwolves are lazy walkers. A caller device with a range of noises to attract black-backed jackals is used to lure the animal close to the hunter and then it is removed from the landscape (Figure 12). The noises used on the caller depends on the time of year. Some farmers use this method themselves and others employ a professional hunter. This method is only useful for jackals as caracals will not come into a call. Caracals instead are trapped, or opportunistically shot.

Figure 12. An example of a caracal trap and a taxidermy caracal that was displayed by one farmer.

Leg hold traps and cage traps can be used to control jackals and caracals, respectively. Many of the farmers had workers do the trapping for predators. Each worker is provided an income, home, water, food and a bonus for every animal captured. However only a few properties do preventative trapping and generally only trap when losses are detected. Caracals are very hard to capture in cage traps. One farmer who is now retired reported that in his lifetime he has captured two caracals in traps. Warthogs are a menace when it comes to the traps as they destroy them as a result the traps are made from very heavy-duty materials now.

Driven hunts have also been used in the past where hunting dogs drive jackals onto lines of hunters positioned on the other side of the mountain. Helicopter aerial shooting has also been employed but at R6000/hr this is a costly exercise. The first attempts at aerial shooting were more successful than the recent attempts suggesting that the predators have learnt to avoid the helicopter and the predator density has decreased. Additionally, the number of jackals removed was dropping over time so the price per jackal increased above what the famers were comfortable paying.

Professional hunters are paid a call out fee, kilometres travelled and a rate per animal removed. There are courses individuals can take to learn the different methods for predator management. Many of the farmers only used the professional hunters reactively when losses had already occurred. The call out fee is equivalent to the price of a sheep. For example, a jackal that was causing problems on one of the properties was remove by a hunter at R1800 ($150 AUD). The hunter stayed out from 6-10pm. Licensed pest technicians in Western Australia are paid a daily fee despite their travelling and number of animals removed.

Many of the camps have electric fences around the lambing yards. This works very well to protect the lambs from jackal and caracal predation the farmers reported. Until warthogs push underneath the fence and create holes for the predators to get into the yards. During lambing time (while we were there) farmers do daily checks on the yards. The downside to these yards of kraals is that the wool quality decreases and the parasites loads of the sheep increases.

Interestingly, several farmers used the term ‘professor jackal’ or ‘jackals have gone to university’. This implies that when you attempt to remove a jackal from the landscape using shooting, calling or other means but are not successful the jackal learns your tools and how

to avoid them. Removing that jackal from the landscape in the future will be very difficult. The jackals can habituate very quickly to humans and their activities. They are particularly alert to the caller noises so a rotation of noises is required by the shooters. Wild dogs in Western Australia have shown some aversive behaviours to control tools where the same methods have been implemented for an extended period, unchanged (Kreplins *et al.* 2018b). Both countries note that predators are smart and hard to outwit.

The use of poison in South Africa for predator control is illegal. Historically, canid pest ejectors or M-44s, as well as poisons were used in South Africa. Poisons used in the past were organophosphates. The canid pest ejectors were set with a with blank .22 but the cartridges are no longer available. Canid pest ejectors have been trialled in Western Australia as a landscape tool (Kreplins T.L. *et al.* draft).

Farmers next to nature reserves felt the impact of predation more strongly than those farther away. In the current year one farmer has lost 140-150 adult sheep equating to R270000 ($22600 AUD) in losses. When controlling jackals in the neighbouring reserve 35 jackals were removed in a few nights. This farmer now runs cattle adjacent to the nature reserve and the sheep are kept on another part of the farm. Generally, jackal only prey on sheep. However, in the 90s there were cases of jackals working in packs to predate cattle. Despite having less predation issues with cattle enterprises, the farmer makes more profit from sheep production than cattle. However, in drought times the property struggles to carry cattle and does better with sheep.

Many farmers in the area had switched to cattle as sheep were getting harder to produce due to predation pressure. However, many reported that it was not cattle country (i.e. didn't have the carrying capacity for cattle) and the market to sell cattle was minimal. During drought conditions the country is better suited to sheep rather than cattle. Another area nearby in the Free State reported that jackals had begun hunting in packs and could take down smaller cattle and calves. Many in Western Australia have also changed enterprises from sheep to cattle where wild dog predation is high. This market is heavily reliant on the ability to export to other countries to stay afloat.

Figure 13. The author and a pet dog. Every farmer had an array of working and pet dogs at their farms.

A major difference between Western Australia and South Africa is the cooperation between the Western Australian government and the state's farmers. In South Africa the predator control is solely the farmers' responsibility, there is no funding, in-kind support for advice or cooperative on-ground management programs. In the current program for invasive species control in Western Australia we have Recognised Biosecurity Groups (RBGs) that cover large areas. The landholders within that group are rated based on their land value. The funding raised by that group is matched 1:1 by the Western Australian government. The RBGs have a committee who decides how and on what species that money is spent. Of the 14 RBGs across Western Australia 11 prioritise wild dog control.

Not only is predation of livestock an issue but there are other impacts to production farms. This is an area that has waves of rabies come through the wildlife. It can infect the livestock and cause losses. This is an area in which we can learn from South Africa if an outbreak does

ever occur. To date Western Australia has not had any major disease outbreaks (like rabies) on wildlife or livestock (perhaps *Ehrlichia canis* is the only recent one). Investigating the disease and parasite loads in Western Australian wild dogs over the last decade has revealed very few cases of diseases. Theft is not uncommon in South Africa. On some bigger farms with 20,000 sheep the workers are subject to polygraph tests to ensure that stock theft are not the result of an 'inside job'. Harsh environmental conditions such as high rainfall or very low temperatures result in low lamb survival. Many of these issues have been reported to me in Western Australia apart from the disease and theft side of things.

Other forms of income the farmers have in this area is crop production (particularly maize) much of which is under irrigation using centre pivots. South Africa and Western Australia both experience losses to pig species (South Africa: warthog, bushpig and Western Australia: feral pigs) in cereal and grazing crops.

Eastern Cape farmers, 21st September

Farmers on the Eastern Cape ran enterprises and were set-up very similar to those within the Free State. They all reported more issues with warthogs than those in the Free State with warthogs actively preying on lambs. Warthogs also destroyed or, at the very least, put holes in the jackal proof fencing subsided by the government. Farmers were checking their fences daily for holes and incursions. Eastern Cape famers went down the same path as their counter parts in Free State by buying thermal scopes for their rifles or employing a professional hunter with a thermal scope.

Some trapping was carried out by workers on the farms as a preventative measure. Not much of this happens anymore as shooting is the preferred method of predator control. Professional hunters are called in during the jackal peaks each year, usually before the pupping season and before dispersal of grown pups.

This area also trialled aerial shooting from a helicopter. However, they felt its efficacy declined from year to year. This area was actually part of a research project where some jackals were GPS tracked. Tracked jackal hid when the helicopter was heard, again demonstrating a learned aversion to human control efforts.

The farmers felt they were becoming more conservation focused over time. Historically, famers removed all predators from their farms. These days they only remove the jackals and caracals. For example, some species like the serval cat are appearing the in area. However, you would be more likely to see a jackal in a zoo than on their property many of the farmers stated.

Predator distribution is often determined by habitat structure and topography. Jackals were commonly found in the more open plains areas whereas caracals frequent the more mountainous regions.

The estimated average annual losses of newborns lambs is 10% in this area. These losses are attributable to a range of issues including predators. These famers have similar issues with losses to other things such as harsh weather and experience about 2-2.5% theft.

Figure 14. Scenery and mountains of the Eastern Cape.

We did not travel to the Western or Northern Cape where more cattle farming is carried out, but some sheep production still occurs. Here lions and hyenas may impact the production of cattle. It is more mountainous and shrub habitat than grassland. These areas have larger farms but less food on offer for the livestock, similar to the Western Australian pastoral stations. Some farmers move fences around to ensure adequate grazing but also protection from jackals. These areas have similar rainfall the Free State.

Niel Viljoen, Livestock and Predator Management, 21st September

Niel is not only a farmer but runs a professional hunting business (https://nielviljoen.co.za/). Niel has a passion for predators, understanding them, not just killing them. He supports the use of lethal (i.e. shooting and trapping) and non-lethal (i.e. collars for sheep, lights and sounds as deterrents) tools.

Niel has a monitoring set-up on a range of farms in South Africa to look at predator numbers and to assess whether tools are effective. Of 32 farms 27 have acceptable management in place for the topography. On one of his 'study' farms Niel had a reference for the year prior to his involvement when no predator control was implemented. The landowner suffered 46% losses in 2008. Now in 2023, subsequent to the implementation of a variety of predator management approaches, this has been reduced to 3% losses. Across Niel's own farm he has 42 camera traps for monitoring.

Non-lethal tools are only useful on a small scale and are temporary according to Niel's work. Those carrying out the control whether it be lethal or non-lethal must remember that all predators can adapt very fast to the tools and are quick learners. For example, using a light and siren (powered by a solar panel) to deter jackals lasted for 12 days before the jackals became habituated to the deterrent. Fladry was not effective at all as a deterrent for jackals. Some farmers use livestock guardian dogs or alpacas to protect stock. These protectors must have a line of sight to the livestock and predators. Niel has seen two alpacas protect 250 ewes across 250ha effectively. The alpacas take turns to guard the sheep while the other sleeps. Donkeys have also been used and they herd the sheep flock together a lot. Jackals learn to adapt to this behaviour and spread the flock out. On the flip side jackals have been removed from paddocks in between guardian animals.

Niel is also involved in the trialling of a variety of collars designed to prevent predation of small stock. One such collar has reflective tape to act like eyes to deter caracals, nails on the collar to deter jackal from biting the sheep necks and the bell in the can to scare jackals also (Figure 15).

Figure 15. Collars for sheep to wear as deterrents for black-backed jackals and caracals.

After 16 years of monitoring and controlling predators Niel believed that electric and jackal proof fencing was the most effective tool for deterring jackal and caracal from livestock, the alternative is calling in the predators for shooting. Niel reported many properties simply kraal their livestock and use predator proof fencing against black-backed jackals and caracals. To a lesser extent for curbing predation of small lambs by the Cape fox and African wild cat.

The best way to control your predators is simply 'boots on the ground' according to Niel. Trapping is another tool commonly used by farmers and professional hunters. Less so than shooting. Before commencing a trapping program you need to spend at least one week walking the property to get to know the predator activity and den sites to build up a picture of where the animals love to go.

Fencing is a non-lethal tool that will only work with lethal control within the fence line. If you can remove all predators within your fenced area of livestock then you will most likely have no predation events for one year or longer if the fence is impermeable.

Jackal behaviour was of high interest to Niel and he hoped many land owners were knowledgeable about their predator activity on their farm. Niel recorded that jackals were scavengers on reserves, sharing other predators kills but hunters on farmland as they need to survive. On farmlands it is particularly important to make sure farmers do not lamb near to the dens or core areas of the jackals – this reduces the losses to predation. Niel had many hints about lures and methods to capture the predators that impact livestock production on farms. Overall, effective predator management requires good knowledge of the jackals (and caracals) on your property.

Jackals are very intelligent and Niel has recorded them avoiding camera traps. This is a common occurrence for predators (canid in particular) around the world (Kelly *et al.* 2008; Meek *et al.* 2014) and in Western Australia.

Environmental variables will impact the success of livestock production enterprises from year to year. Niel noted that in 2021 there was higher than average rainfall with 820mm falling after a drought of 12 years on his property. Usually, rainfall is only around 400mm per annum. Lambing was happening 400m from known jackal dens on his farm. However, as the rainfall had provided lush resources, mice numbers were in plague proportions and jackals chose the easy rodent prey rather than preying on the lambs that year. This is also a common story for the wild dogs of Western Australia. The ecosystem is a driven by bottom-up processes. For example, in the Gascoyne when it rains there is lush grass and plentiful prey. Feral cats and wild dogs activity based on camera trap data were related to the rainfall and prey activity rather than each other's activity from an occupancy analysis. After rainfall events feral cat and wild dog activity was positively related to one another. Jackals, not unlike wild dogs, are opportunistic predators and prefer easy prey.

Other environmental variables that impact jackal behaviour include temperature, humidity, and wind direction according to Niel. Barometric pressure, in particular is a good predictor of predator activity. When barometric pressure drops before a rainfall event it is a great time to

shoot and trap predators. Once the rain had started it was a waste of time. If there was lightening trapping and hunting were a waste of time.

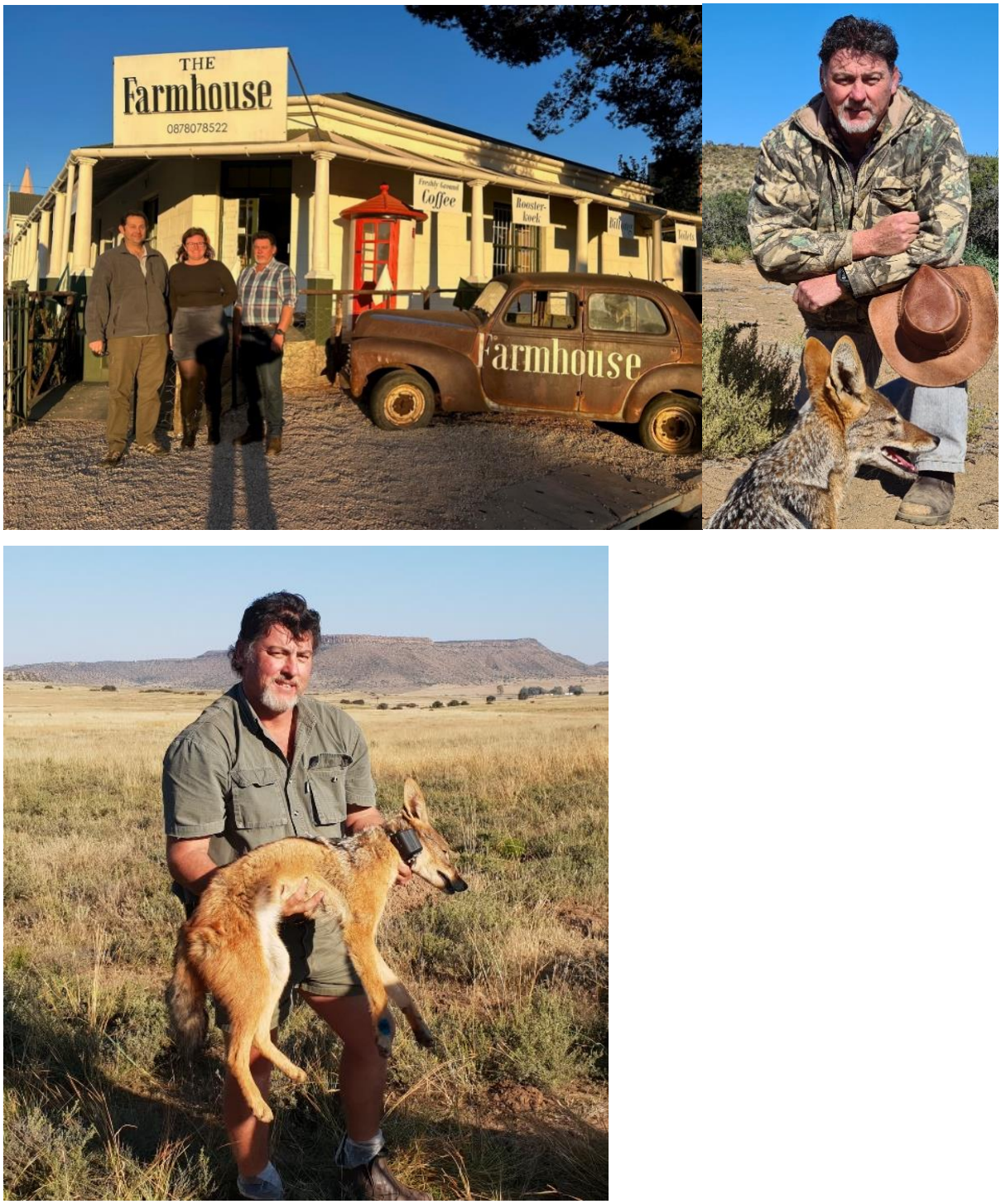


Figure 16. Haemish Melville, the author and Niel after interviewing farmers of the Eastern Cape; plus two action shots of Niel working with black-backed jackals in the field.

A study in 2005 investigated 433 black-backed jackal stomachs to assess their diet. Of these stomachs, 34% contained mice, 8% insects, 21% hare and the rest were empty. Other items within the stomach that were found but in very small amounts were springhare, sheep, birds, eggs, lizards, termites and some spiders. In some cases, there is evidence of intraguild predation of jackal on caracal and vice versa. This is probably due to scavenging, but this has also been seen for dingoes and feral cats (Fleming *et al.* 2022).

Interestingly, Niel found that the collaring of predators (i.e. GPS tracking) for science was resisted by many land managers (not dissimilar to some areas in Western Australia). However, once the value of the information that could be gained from these collared animals was demonstrated it 'tickled the mind' and the land managers tolerated the collared individuals.

Aerial predators are also a problem in South Africa, not unlike Western Australia. Native bird predators take lambs, but control of these predators is illegal as they are native and often protected species. Another protected species that has a noticeable impact of lamb survival was the African wild cat. On one night drive a farmer noted 17 individual African wild cats.

Another interesting side note from Niel was the amount of termite mounds in grazing land. We had indeed noticed them driving around. The more termite mounds on your property the less grazing land you had. There was sure a lot of mounds!

Niel was shortly travelling to Argentina to teach his predator control course to a group of land managers there. He has travelled around the world to deliver the course based on his many years of experience.

Figure 17. Farms around the Free State and Eastern Cape. The first image illustrates the number of termite mounds in a paddock.

Dr Anne Pandraud and Craig Sholto-Douglas, Kwandwe Private Reserve, 26th September

Anne and Craig reside on Kwandwe in the Eastern Cape. Kwandwe is a private reserve run for tourism and conservation. Anne is a post-doctoral researcher at the University of South Africa and Craig is a manager at the reserve. Craig and Anne discussed a whole range of wildlife management techniques and tools when Haemish and I visited. The discussion ranged from different wildlife tracking collars to diet of predators, camera trapping and habituation of animals for attaching the wildlife tracking collars.

Anne is working on a range of projects with Haemish on brown hyenas, rhinos and other exciting species. Anne is a specialist in the analysis of tracking data from satellites collars on animals (both accelerometer data and GPS location data). Habitat selection, home and core range and diet of certain animals are some of the areas she is currently working on. Kwande is being extended by another 7,000ha in addition to the current 22,000ha and we discussed the range of possible research questions around this expansion, such as the changes in prey and predator density.

Craig outlined how wildlife management is run on reserves around South Africa. In South Africa individuals can own wildlife. Most of the wildlife is behind predator and people proof fencing within private or government reserves (e.g. SAN Parks). This avoids the loss of prey species to predators (e.g. lions predating on livestock) and poaching of value wildlife species (e.g. rhinos for their horns). Many species have also been subject to habitat loss with the expansion of agriculture. However, within these reserves the success of the native species has been huge to the extent where reserves are now very full. For example, elephants need a large area from which to consume a variety of food plants (between 100-200 species). A lot of the reserves are full to capacity in respect to elephants (a variety of other species) and it is proving difficult to find new locations for them in the country.

Other species such as lions, cheetahs, leopards and African wild dogs are considered endangered species and conserving the genetic integrity of their populations is important (i.e. avoiding genetic bottle necks) and may be pivotal to their survival. Many of these predator species disperse from their natal ranges when they are old enough to avoid breeding with their parents. There is metapopulation management of these species driven by non-government organisations and what essentially amount to 'stud books' have been created for each species, not unlike valuable sheep or cattle breeds. For example, reserve managers with

lions have a lion management forum annually to guide best practice management for the world's apex predator. This group has gone so far as to create a National Lion Strategy (Department of Environmental Affairs. Republic of South Africa 2015). Leopard management is slightly different to the lion program as each province within South Africa has varying legislation around leopards. Leopard conservation is being heavily promoted by organisations such as the Cape Leopard Trust. African wild dogs have been heavily persecuted for their predation on livestock. There are some fantastic programs trying to merge agriculture and conservation (e.g. Waterberg wild dog program; see the section on Qwabi).

I thoroughly enjoyed reading the book on Addo Elephant Park's history the weekend before visiting Anne and Craig. We had just spent the weekend at Addo before seeing the couple. The book provides a range of examples about the trials of managing an enclosed reserve. Originally, when the Addo Elephant Park was first established there were less than 20 elephants on the reserve. Elephants were hunted as they destroyed farms and water resources regularly. Hunters, back then, were regarded as superheroes much like sports stars are now. Nowadays there are closer to 660 elephants and SAN Parks had to buy more estate to house all the elephants. Another interesting side note relates to the lion management in the park. The park earns R12 million annually, R2 million to tourism and R10 million on the sale of buffalo. Buffalo are commonly seen on the park but not as commonly as elephants. Lions, which are as much of a tourist draw as the large elephant population, eat almost half a million rand in buffalo annually. There is a trade-off between tourism and profit somewhere in there (Reardon 2021).

Figure 18. Addo Elephant parks elephants and buffalo. We did not spot lions on this part of the trip.

Professor Graham Kerley, Director of Centre for African Conservation Ecology, Nelson Mandela University, 27th September

Professor Graham Kerley was the lead force behind the PREDSA book; Livestock predation and its management in South Africa: A scientific assessment (Kerley *et al.* 2018a). This book discusses a range of issues around predator management and agriculture in South Africa.

Some chapters that Graham authored within the PREDSA book revolve around policy within the country. Graham outlined that the cost to society of removing predators and the losses to predators in agricultural contexts are poorly understood. Farming is a tricky business with changing livestock market prices, government assistance and increase in predators. The sheep

and goat markets are on a downward trend but cattle prices seem to remain the same. There are also two million communal or subsistence farms in South Africa that have no commercial imperative but provide food for the community. By comparison there are 138500 commercial livestock farms in South Africa. This equates to half of South Africa's agriculture GDP (agriculture is 2.47% of South Africa's overall GDP), creating 245,000 jobs.

A common thought by friends and colleagues was I was simply going to find that the cost of labour in South Africa is cheaper than here so the outgoing costs to farmers was lower than Western Australia. However, the use of labour is also on a downward trend in South Africa. Stronger workplace laws have meant the cost of employing workers has risen and farmers are looking for options to reduce the need for labourers. Niel and several of the farmers I interviewed also commented on this; farmers are investing in machinery and technology instead of people.

Graham discussed the fencing subsidy that was run by the Central Government may years ago to keep farmers happy and the government of the day in power. It covered materials and labour. However, the government would be unlikely to fund something like this now. Nowadays many farms are large having enveloped many smaller farms. The South African government, not unlike Western Australia' government, has changed focus to ensuring the rights of the Indigenous communities. Graham outlined how we often don't ask the Indigenous communities their feelings on predators and predator control and that is where we should start. However, South African and Western Australian Indigenous communities are likely to have very different relationships with predators. South African predators are likely to eat humans whereas there is no risk of that in Western Australia.

There is provincial predator control in the Eastern Cape where hunting dogs are used. The dog kennels are recognised worldwide for their hunting efforts. These groups target jackals, caracals and bushpig. These groups are very busy as Graham along with all others I interviewed note that the number of predators is constantly on the rise. For example, bush pig range has expanded and they are known for their predation of lambs on farms. Feral pigs are definitely increasing in numbers within Western Australia but lamb predation is uncommon.

Livestock has been present in South Africa for many years. Traditionally, livestock was protected by humans living with the livestock as herders or shepherds. As time went on predator issues has pushed them into fenced reserves or fencing livestock away from the predators. There have even been local extinctions of some predators. For example, on Graham's family farm the last black-backed jackal hunt was in the 1960s and they had not been seen for many years. However, in recent times a jackal was heard howling and it jerked the farms' managers into action. There are places in Western Australia which once were home to wild dogs but have long since been seen in the area (e.g. Eastern Wheatbelt zone).

Carbon farming is increasingly common in South Africa, and it is certainly increasing in popularity in Western Australia. This reduces the need for the landowners to conduct predator control for their own income in the absence of livestock, only as a good neighbour activity.

During my trip we didn't visit many cattle farms but they are found more to the eastern side of South Africa. Nearby is Kruger National Park, in the grassy areas of the country. Leopards and African wild dogs are issues for these cattle enterprises. African wild dogs are disliked by farmers, probably due to their hyper-aggressive predation style (i.e. a pack of African wild dogs can eat an entire impala in two minutes) and nomadic habits. For example, a project recently blew their entire budget in three months trying to keep African wild dogs away from cattle properties that residing on conservation estate. Compensation for the prey eaten by the African wild dogs' appetite was a high cost to cover.

Graham and I discussed the management of parks and reserves also. As Craig had taught me, conservation reserves trade wildlife to ensure genetic integrity and provide tourism income. However, Graham added to that discussion around the costs of shifting wildlife. It is often R10000 plus R9000 to catch and shift an animal as large as an elephant (i.e. tranquilise and transport). Graham termed it a 'saturated market'. Particularly as tourism would have taken a hit over COVID19 when no international travel was happening.

Graham is definitely thinking of predator management at a big picture level and in a philosophical context. We tend as humans to only focus on predators when we have losses. Graham told a very good story of how a farmer was going broke. He had three issues the drought, his wife (spending money) and the jackal predation on this livestock. However, the

only element he could manage was the predation and that is where the blame was laid. In another context sheep production saved many individuals in times of exploration from starvation. In addition to the PREDSA Graham suggested many more books to read to get a bigger picture story.

Figure 19. Professor Graham Kerley and Tracey at Nelson Mandela University, Port Elizabeth

Qwabi Private Reserve, 29th September to the 4th October

As I walked into the reserve office at Qwabi I noticed my favourite Winston Churchill quote on the whiteboard. Apparently, every day the team put a different quote on the board at the meeting. I took that as a sign I was supposed to be there that it was a Churchill quote on the day I turned up!

"I NEVER WORRY ABOUT ACTION, BUT ONLY INACTION"

We had travelled to Qwabi to learn more about wildlife management behind fences. We were given the great honour of being allowed to participate in a lion recollaring program.

The reserve team included a range of knowledgeable and awesome members. Haemish and I worked closely with Ludi Kern, the ecologist, and Dr Andre Uys, the CEO. Ludi was kind enough to show us around the reserve go through what an average day looks like for her and show us a range of exciting wildlife species. We spent spare parts of our day in between the early starts and late finishes for lion collaring, driving with Ludi to find a cheetah and her cubs, feeding the Southern Ground Hornbills and discussing all things South Africa.

Lions are Africa's largest cat and were reduced to a small range by the 1900s. Only 2,300 wild lions remain today in South Africa. You would rarely find them outside a fenced reserve in South Africa (Department of Environmental Affairs. Republic of South Africa 2015). In the last 45 years 800 individual lions reside in managed reserves which as I have mentioned earlier is difficult to maintain prey, habitat and genetic integrity of these species. In Qwabi there are six adult lions (two males and four females) with 7 cubs between three of the females. All six adult lions are now wearing new collars to gather GPS and accelerometer data. Haemish and I will be working with Qwabi on some of the data that comes from the collars with a Master's student Lindsay Whitton.

Figure 20. Attaching a GPS tracking collar to a male lion, and a female lion wearing a collar (source: Ludi Kern and Reilly Mooney)

In addition to the exciting lion work we were also introduced to one of my personal favourite projects, the reintroduction of the endangered Southern Ground-Hornbills. More lovingly know, on Qwabi, as Ludi's 'chickens'. Ludi's hornbills originate from the Mabula Ground

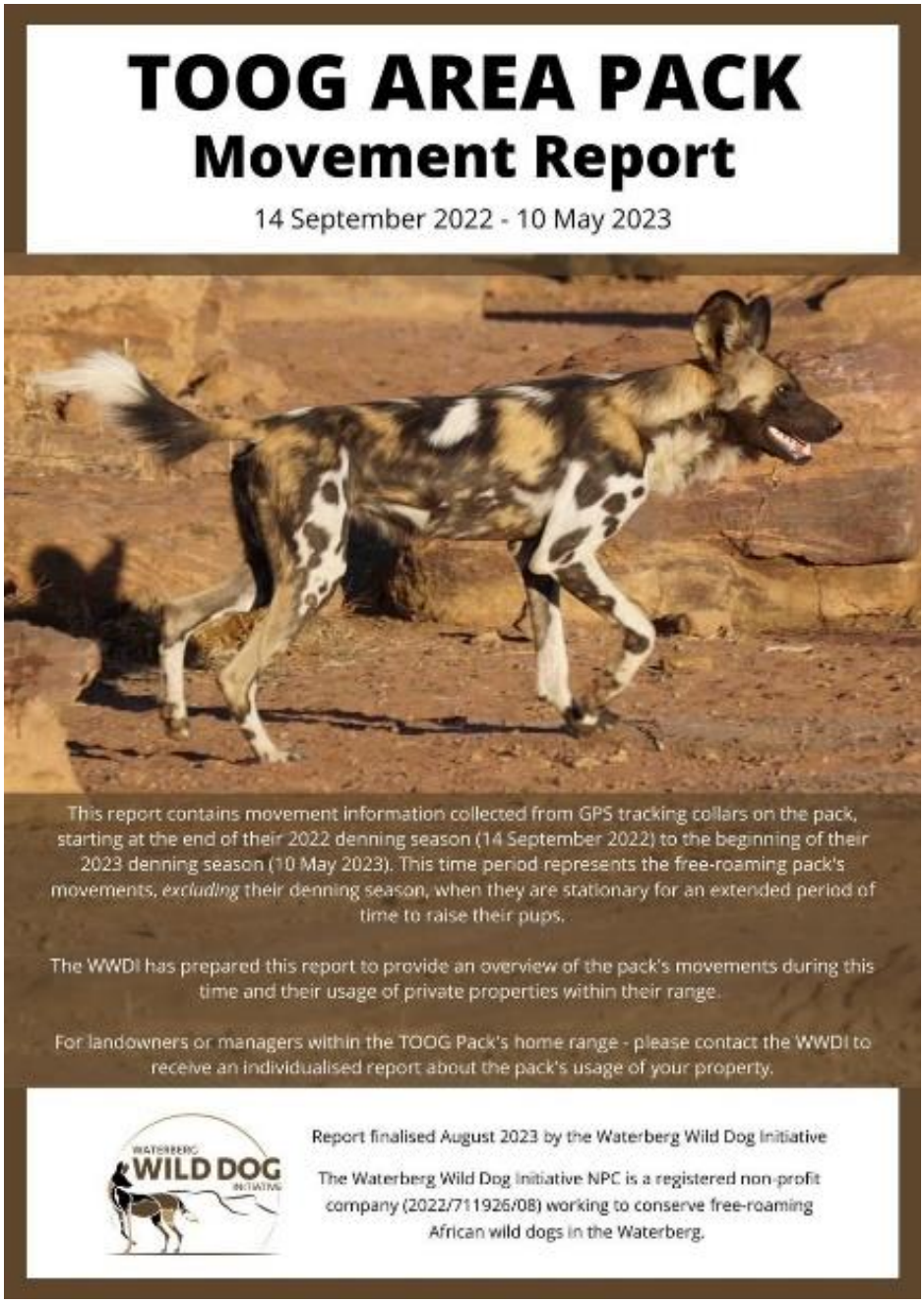
Hornbill project (https://ground-hornbill.org.za/). They are a very large bird susceptible to land clearing, loss of nesting trees and lead poisoning (i.e. from lead spent ammunition). They have a very unique biology when it comes to egg laying and rearing. They lay two eggs, five days apart. If the first egg succeeds in hatching then the second egg is thrown out of the nest. Essentially the second egg is a redundant egg used as a backup. These redundant eggs or chicks are rescued by the team and raised for reintroduction. At Qwabi there are three adult Southern Ground Hornbills that Ludi feeds, morning and night, with chicken heads. They hear Ludi whistle after she parks and come running for breakfast and dinner.

Not only is the biology of these birds unique but they require very specific nests. At Qwabi there no appropriate trees for the hornbills to make their own nests. A Master's student at University of Pretoria has scanned and examined existing Ground Hornbill nests elsewhere to design artificial 'super' nests for the hornbills at Qwabi. Temperature loggers were even used to ensure that the artificial nests had the correct thermal properties for the hornbills to raise their own chicks.

Figure 21. Southern Ground Hornbills at Qwabi getting breakfast.

As Reilly Mooney, the coordinator of the Waterberg Wild Dog Initiative, resides at Qwabi with her husband Brad the reserve manager. During my stay at Qwabi I took the opportunity to liaise with Reilly in the hope that I can collaborate with her in the future. Particularly, I would like to integrate some of her ideas around conservation and agricultural conflict when

managing predators in Western Australia. Especially as there is a move, in Western Australia, to integrate Indigenous land management into certain conservation estates. On these properties, the Indigenous communities are disinclined to pursue active wild dog control at this time. I am investigating alternative solutions for neighbouring properties with differing attitudes to wild dog control in Western Australia, particularly those on which sheep production is pursued. I work with some station owners who have little to no lamb survival due to wild dog predation. Perhaps some aspects of the African wild dog business model can be applied in Western Australia.



TOOG AREA PACK

Movement Report

14 September 2022 - 10 May 2023

This report contains movement information collected from GPS tracking collars on the pack, starting at the end of their 2022 denning season (14 September 2022) to the beginning of their 2023 denning season (10 May 2023). This time period represents the free-roaming pack's movements, *excluding* their denning season, when they are stationary for an extended period of time to raise their pups.

The WWDI has prepared this report to provide an overview of the pack's movements during this time and their usage of private properties within their range.

For landowners or managers within the TOOG Pack's home range - please contact the WWDI to receive an individualised report about the pack's usage of your property.

Report finalised August 2023 by the Waterberg Wild Dog Initiative

The Waterberg Wild Dog Initiative NPC is a registered non-profit company (2022/711926/08) working to conserve free-roaming African wild dogs in the Waterberg.

THE TOOG AREA PACK

The TOOG Area Pack is a free-roaming African wild dog pack in South Africa, ranging entirely across formally unprotected, private farms located between Vaalwater and Lephalale. The WWDI has been monitoring the pack since August 2020 and has a well-developed base of knowledge.

Why are they called The TOOG Area Pack?

The pack was nicknamed the "TOOG Pack" due to the name of the community area they were found ranging in. TOOG stands for Tambotie-Overyssel Ondersteunings Groep and is an Afrikaans acronym that represents the community in the Tambotie River - Overyssel area. Since monitoring the pack, the WWDI has confirmed that only half of the pack's range is in the TOOG community area, however, the nickname has stuck.

Pack Structure

The pack currently consists of **18 dogs**, including 4 adults, 6 yearlings, and 8 pups born in May 2023. In the past year, 3 females and 5 males have dispersed from the pack upon reaching sexual maturity.

Tracking the Pack

The pack is fitted with GPS tracking collars. The collars have an Iridium-Satellite GPS component that allows the pack to be tracked remotely. The collars are programmed to update at set intervals corresponding with when the pack is active. A total of **1,154 GPS locations** were received from the pack during the 2022-2023 monitoring period.

All collars on the pack for the monitoring period were manufactured by African Wildlife Tracking in Pretoria.

Home Range Size

The pack's home range size during the 2022-2023 movement monitoring period was **125,356Ha**, calculated as a minimum convex polygon. This is a **60% increase** from the home range size calculated during the 2021-2022 movement monitoring period (78,371Ha).

Thank you to Micaela Venter, University of Pretoria, for assistance calculating home range size and creating range maps for the WWDI.

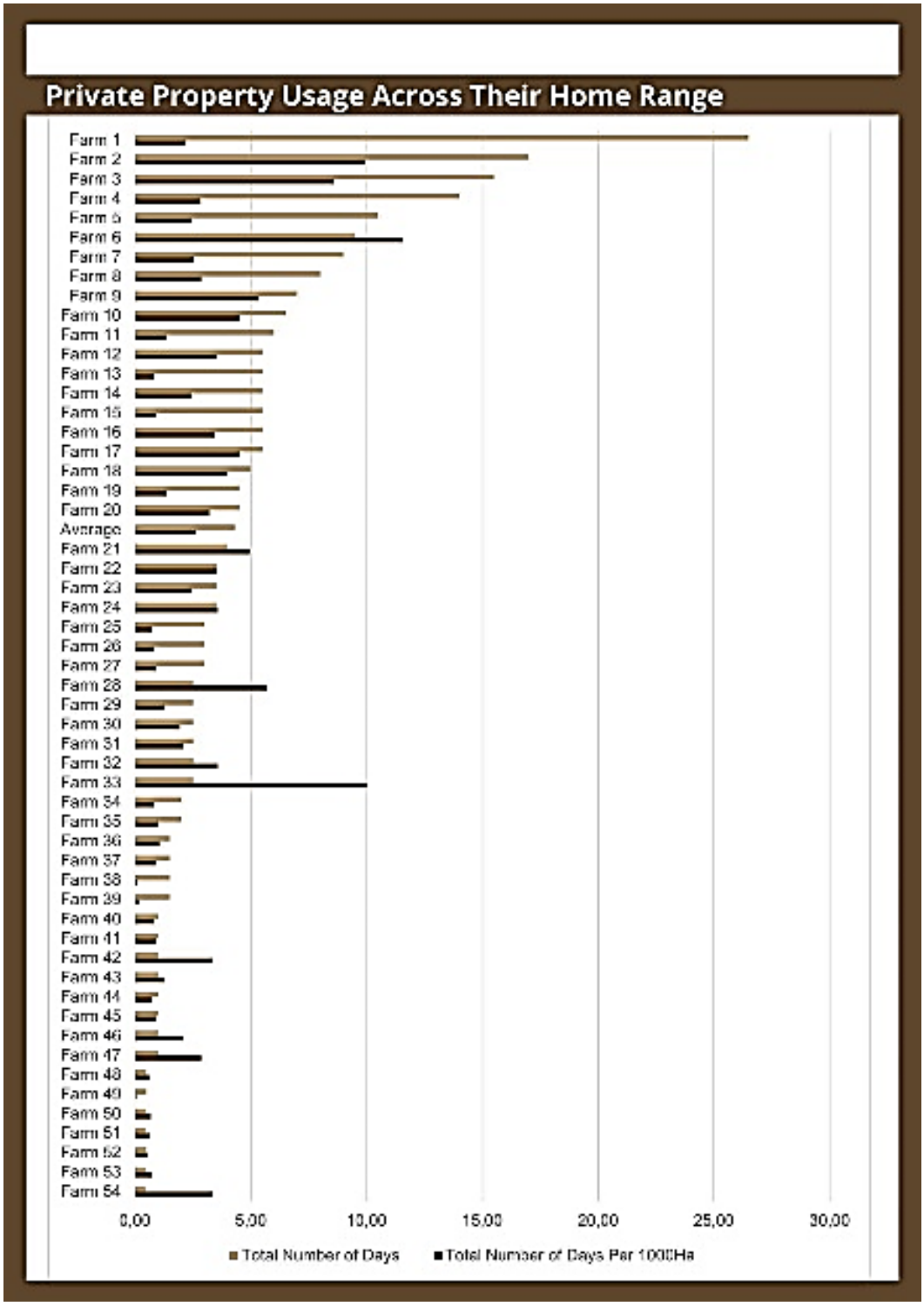


Figure 22. Some of the media online for the Waterberg African Wild Dog project

Alison and Nigel Nicholls

Towards the end of our trip we holidayed at a few reserves within the Greater Kruger Area. At one of the reserves we met a couple who lived for two years in Zimbabwe and six years in Botswana. Alison is an artist who works with Africa Geographic to led art safaris. In Alison's travels, while living in Southern Africa, she has met a few experts in wildlife management.

One interesting area Alison has been involved with was the Living Walls project by African People and Wildlife (africanpeoplewildlife.org) and Dr Laly Lichtenfeld. In some areas of Africa, predators prey on cattle, sheep and goats which are kept in thorn-bush bomas. Lions are often blamed for the predation, even though other predators are often responsible, and retaliatory killing of lions sometimes occurs as the livestock is valuable culturally and economically. Living walls are a stronger boma design, made of wire and using local commiphora as fence posts. They were designed in conjunction with local people in Tanzania. Not only do the walls protect the livestock from lions and other predators but it improves the attitudes of the local people towards predators as they see that predators do not have to be killed to keep their livestock safe (Lichtenfeld *et al.* 2015). Other work carried out by African People and Wildlife are improving rangeland health and using bees to deter elephants from areas to reduce crop raiding and trampling.

Dr Lichtenfeld's PhD assessed human attitudes towards carnivores. Due to human population pressure and conflict over natura resources, Many of the Maasai communities in Kenya and Tanzania dislike native predators such as lions, hyenas, leopards and African wild dogs for their predation of livestock (Mkonyi *et al.* 2017). In some areas compensation is given to the local people who have lost livestock to predation, but this can be problematic as sometimes the compensation for losses encourage owners to practice bad animal husbandry including leaving older cows out to be killed in order to gain the compensation. Proof of losses is also hard to provide.

Cheetah conservation in Botswana was another area Alison had been involved with. In Botswana there is one of the world's largest population of cheetahs. One way to mitigate the conservation of cheetah and agricultural livestock production conflicts is the use of livestock guarding dogs. The use of local Tswana dogs (a local type of dog) protects the livestock from cheetah predation and from other smaller predators. Furthermore, there are education

programs for the local farmers, a response team and demonstration farm that demonstrates that cheetahs can coexist with livestock and guardian dogs.

Jane Horgan, Cheetah Conservation Botswana

Once home I was lucky enough to catch up with Jane Horgan who works for Cheetah Conservation Botswana. Jane is now home in Australia after working in Botswana on the cheetah project for 12 years. Jane completed her Master's studies on the use of livestock guardian dogs to protect small stock from cheetahs and other predators such as jackals, leopards and caracals. She worked closely with the Tswana dogs on the group's farm camp in Botswana.

Botswana is the size of France with a human population of 2.5 million and approximately 2.1 million cattle. There are huge areas of the country with few people around and it is a very rural place. Most farmers in Botswana run cattle on large, unfenced, communal pastoral lands, but there are also cattle (and game animals) stocked on fenced ranches, with few of these game or livestock properties smaller than 6,000ha. Most of the cheetahs in Botswana (78%) live outside the protected areas and roam these farming areas. Botswana differs to South Africa in that there is less small-scale fencing, and very little predator-proof fencing in the country. Even the large expanses of foot and mouth veterinary fences are permeable to cheetahs and other carnivores. Cheetahs are free roaming and move long distances and in Botswana this movement is largely uninhibited by fences. This means there are no issues with inbreeding, stud books or metapopulation management, as cheetahs can roam freely to find each other. But it does mean that cheetahs are moving uninhibited through farming landscapes on a regular basis. It is also legal to defend one's life or livelihood in Botswana as per their country's Wildlife Act, and this includes in defence of livestock (as a primary income source for most rural Batswana). If you do shoot a wildlife species defending your life or livelihood, you must report it to the government and bring the trophy to the office within seven days. This has meant that many lions, leopards, wild dogs, and other predators have been shot over time. As an indication of the scale of this lethal control, one single farmer legally shot 20 lions in one month on a single farm and claimed he had shot 150 lions on that same farm in the previous decade.

Cheetah Conservation Botswana has a camp on the commercial fenced farms in the Ghanzi District in the west of Botswana. This is an area with some fenced ranches that often utilise lethal control against livestock losses. The conversation group is trying to promote the use of guardian dogs by not only offering trained Tswana dogs but also by being a showcase for how to use the Tswana dogs themselves in an area with high predator-human conflict. On the group's demonstration farm they have a herd of goats that the Tswana dogs protect. Each night the goats come into the livestock enclosure ("kraal") from the veld with the dogs. Pregnant goats are made to stay inside the shed before they give birth. However, if a goat decides to give birth in the veld, then the Tswana dogs hang out with her during the process. In the years Jane worked there only three predation events occurred (this is incredible!). Two predation events were when female goats were giving birth in the veld, rather than in the shed at night, and the other events was an older limping goat.

Tswana dogs as mentioned above are local landrace dogs. They are built like a kelpie, around 17kg and are very hardy. The Tswana dogs seem to be trained younger and faster than other pure breed types of livestock guardian dogs. Tswana dogs also probably need less training and required less effort in terms of management. Jane and I discussed how potentially this could solve some problems with the lack of uptake by farmers for guardian dogs. Often getting a guardian dog like a Maremma or Anatolian takes many months and even years of training before they can be left with livestock. If a dogs' lifespan in 10-12 years and the few first years are spent 'in training' then the working lifespan of a guardian dog is reduced. However, Tswana dogs are trained in a shorter period then their use by farmers might be increased. Tswana dogs anecdotally live longer than purebred dogs.

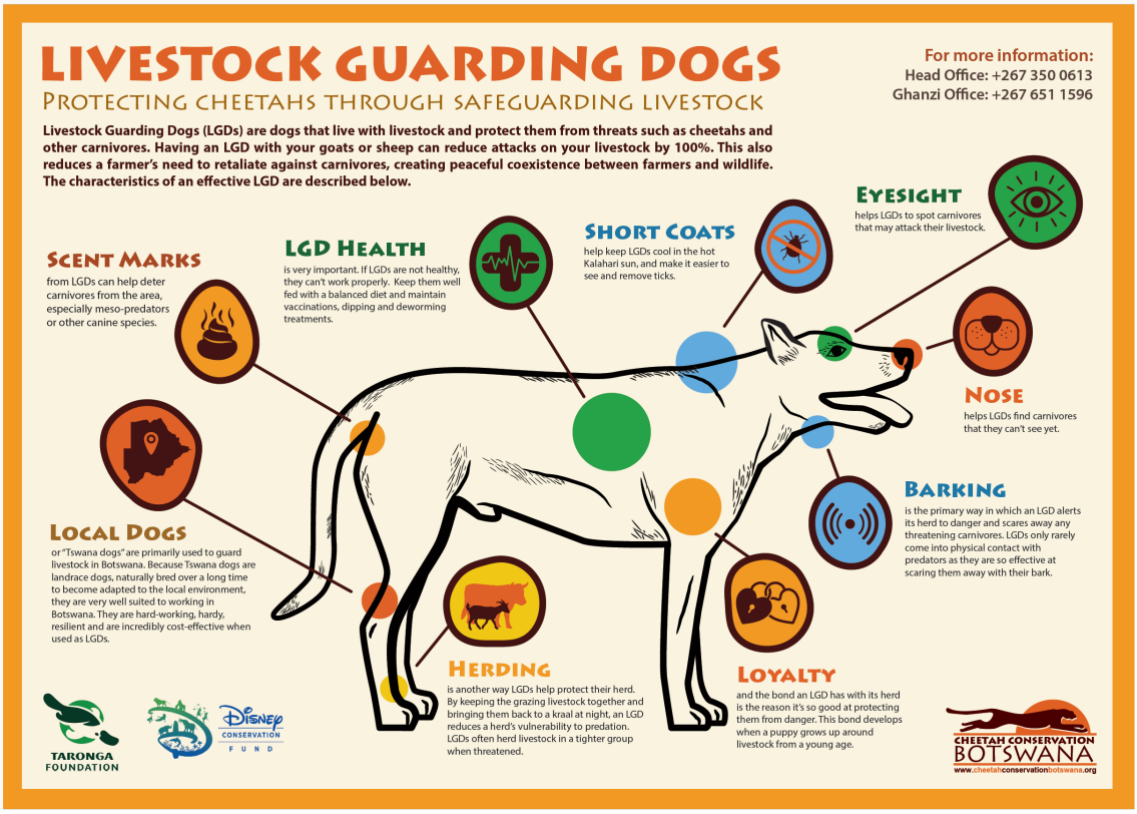
The Tswana dogs raised by the conservation group are also given to the farmers to promote their use. This means the Tswana dogs have a good start to life with adequate health care and then regular checks by the conservation group to ensure the farmers and guardian dogs are working well together.

Jane also noted not unlike my trials here in WA the guardian dogs don't stop the predators entering the paddock they just stop the predation events. On camera traps within the conservation group's farm cheetahs, brown hyenas, jackals and caracals were recorded in the areas where the livestock often roamed, including at waterpoints within 100m of the kraal where livestock were kept overnight. Plus, guardian dogs can impact wildlife species in both

countries, no solution is perfect. Furthermore, Jane's work found another similarity with my work here in WA, that the ratio of livestock to guardian dogs is important. Too big a herd of livestock makes it very hard for the dogs to protect their lot.

Compensation as mentioned above is available to farmers experiencing losses to predators. You receive two thirds the value of a standard animal lost to a predation event. Sometime this is not worth the drive into town for the farmers. For a short period of time, the Department of Wildlife and National Park offered 100% of the value of livestock lost specifically to lions. Letting old and unvaluable cattle roam for compensation was a cheeky way in which some farmers made money from the 100% compensation offer.

Botswana differs to South Africa as poison is legal to use for agricultural purposes and as such is easy to obtain. Poison in Botswana can be brought at the hardware shop. Unfortunately, this can mean that poisons are used to control wildlife and there is little control or reprimand for those using poisons to target large carnivores like leopards and lions. Poachers when taking down a large animal like an elephant poison the carcass so vultures are killed on site and will not be seen taking off again and circling the carcass. This removes the visuality of the carcass to police and other authorities, reducing the likelihood that the poachers will get caught. However, other wildlife species fall victim to the poison, especially scavenging species such as hyenas and jackals. There have been instances of more than 600 vultures being killed at a single carcass because of poisoning.



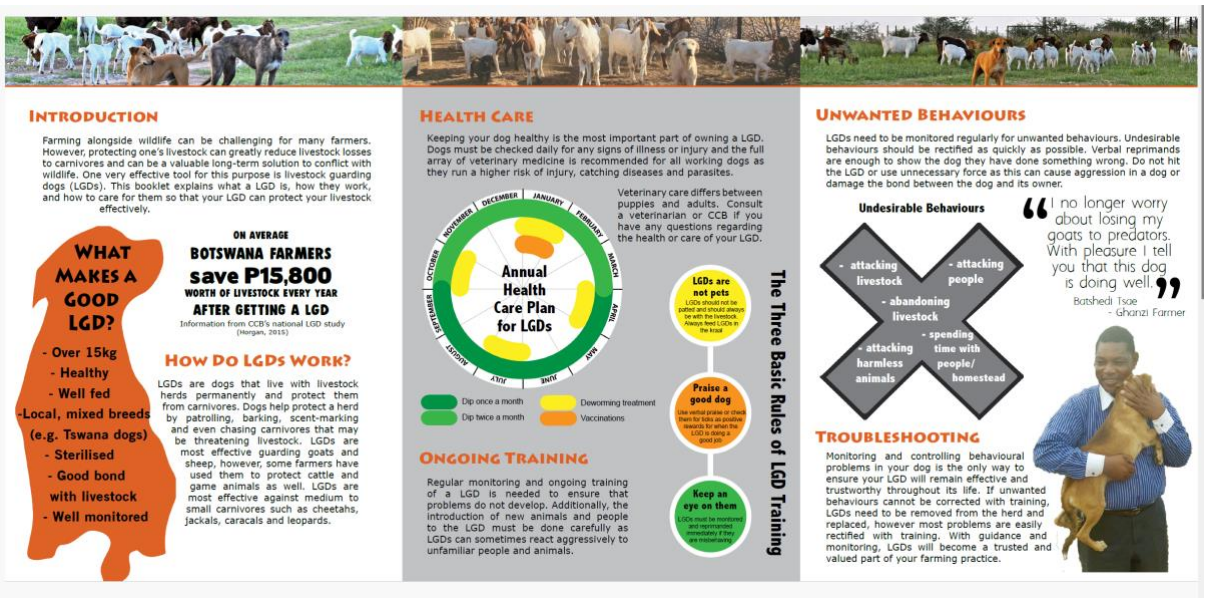


Figure 23. Livestock guardian dog information flyers produced by the Cheetah Conservation Botswana group.

Conclusions and findings

Predator management is important worldwide to mitigate losses to agriculture and to conserve biodiversity. In Western Australia we have traditionally relied on tools such as trapping, shooting and baiting. In more recent years the management of wild dogs has been evolving. There are land tenures where lethal control is not wanted and alternative tools are encouraged.

COVID19 halted my travel plans in 2020 so I initiated many alternative management research programs including visual and auditory deterrents (Kreplins and Kennedy draft-a) and guardian animals (Kreplins T.L. and Shephard draft). I also explored the success of landscape scale lethal tools (Kreplins T.L. *et al.* draft; Kreplins and Kennedy M.S. draft; Kreplins and Kennedy draft-b) that are utilised by many properties and recognised biosecurity groups. These alternative tools are now well used by some land tenures in Western Australia (i.e. squawker boxes) and others continue to use their traditional control programs in a successful manner.

Travelling to South Africa in 2023 I learnt about the range of tools used by South African farmers, include cage trapping, leg hold trapping, aerial shooting, driven hunts and the most popular tool, shooting with a firearm equipped with a thermal scope. This was commonly used by professional hunters and the farmers themselves. This is a good welfare choice as shooting has the highest welfare rating in the Australian system (Sharp and Saunders 2011). In addition to these lethal tools many famers use guardian dogs, sheep deterrent collars, kraaling, electric fencing and other non-lethal deterrents. A combination of lethal and non-lethal tools within a landholder's toolbox is important for success. For a successful livestock enterprise in any country a landholder must be dedicated and active on their property in relation to predator activity. More 'boots on the ground' to continually monitor and improve management programs.

Furthermore, consistent innovation and novelty in control programs whether they are lethal or non-lethal is essential to the effectiveness and longevity of the program. Predators in all countries around the world are intelligent and need their wits for survival. Underestimating predators is an easy way to lose livestock or native animals. Predators on many properties have learned the managers' activities, tools or programs and have circumvented them. We

know that wild dogs can avoid camera traps altering the population estimates. Some control tools used consistently for long periods of time are avoided by predators. Ensuring whatever program you carry out or put in place on your property is novel, is imperative to it being successful.

A major difference between South Africa and Australia is the reactive vs proactive nature of predator management. Western Australia with its current Recognised Biosecurity Groups funding model and wild dog control programs are proactive compared to the South Africa model where individual farmers carry out control on their property. This is potentially related to the losses seen. Those farmers in South Africa that were conducting trapping and shooting before losses occurred had fewer losses than those famers than did control only when losses were observed in the veld. Whereas in Western Australia we forget how bad losses to wild dogs can get because we have a consistent program across huge landscapes that reduces the wild dog population.

What I unexpectedly learned about were the different ideologies and projects where agriculture and conservation can work together to let predators exist and livestock production be successful concurrently. As mentioned previously, wild dog control and management in Western Australia is undergoing a paradigm shift. There are properties which no longer value lethal predator control as they either don't have livestock, run another enterprise, are absentee landholder or value wild dogs culturally. What is needed, in addition to alternative forms of management for these properties, are ways to coexist with neighbouring properties where landowners experience livestock losses and carry out a lethal wild dog management. Programs such as the Waterberg Wild Dog Initiative and some of the lion programs in Kenya or Tanzania are fantastic examples of people thinking outside the box to find solutions for all enterprises conservation and agriculture.

Whilst lethal control is becoming increasingly unpopular within parts of the community it will always be necessary component of the predator management toolbox. Many of the programs in South Africa are conservation based but locals, farmers and community members control the native predators as they are a threat to lives or livestock. It is not just limited to predators; elephants have been historically controlled for their destruction of crops or water resources. South Africa has already been through this paradigm shift as hunters were once the super stars like sports stars are today. Now the killing of any native species, such as an elephant,

lion or leopard is publicly condemned. There are sections of the Australian community that display a similar dislike of wild dog control, and increasingly a voice is being given to the cultural value of wild dogs. However, the cessation of lethal control is probably unwise as wild dog populations now exceed natural densities because of resource provisioning by humans. The spread of livestock and water points across the state has increased the resources available to wild dogs and consequently their numbers (Allen and West 2013; Forsyth *et al.* 2014). Although, lethal control is not a topic liked by all it is a necessary welfare tool for the protection of biodiversity, livestock and lives.

In the evolving socio-economic milieu, it is unlikely that the philosophical rift between those who promote lethal predator control and those who find it unacceptable will narrow. Perhaps the best that we can hope for is that factions on either side of the argument attempt to understand one another. Predators are part of the world's ecosystem in all landscapes and habitats. Agriculture provides food resources and income. The increasing push for alternative tools and value of predators is changing the world of predator management. No matter what choice you make about predator management on your property you must accept your neighbours' choices on the same topic even if opinions differ.

Future research into predator management of Western Australia will not only explore the ongoing welfare and success of management programs that incorporate alternative and traditional tools but projects that will merge conservation and agricultural enterprises. Many of the programs South Africa undertakes to conserve the native predators will be adapted to the Western Australian systems. For example, a future wild dog project could examine how wild dogs that will be left uncontrolled next door will impact the neighbouring sheep station and how to bridge those opposing desires for predators on neighbouring properties. Research that focuses on predator behaviour in a changing landscape could examine if wild dog behaviours change in a region where lethal control no longer occurs. Other questions that can be answered may include - when do the resources run out (i.e. native prey and no sheep present) when a predator is left unmanaged? Many of the ideas from my travels are currently being drafted into a research program that could take us through to 2030.

The knowledge and relationships I gained from my South African travels are career changing and have ongoing positive repercussions. I continue to find ways in which I can incorporate my findings into my current career and role as a research scientist focusing on predator

management. I strongly value my wildlife ecology career and believe my travels have only made it stronger and more valuable to provide options and opportunities to those I work with on the ground.

Dissemination and Implementation

The future of predator management in Western Australia is changing. Learnings from my South African travels are shaping the Research and Development portfolio for the 2025-2030 Western Australia Wild Dog Action Plan. The focus will change from 'how to control' predators to 'how to navigate neighbouring properties with different relationships with wild dogs'.

A project proposal for the nearby future will focus on bridging predator management for conservation and livestock production. This large multi property project that is in the early planning stages will investigate a range of predator management intensities and stocking levels. Learning specifically about predator movements and density in the presence and absence of lethal control. Incorporating early detection of predators moving onto livestock properties to deter wild dog predation events, thereby removing the need for lethal control and learning how wild dog behaviour might change when no persecution occurs. The project experimental design is an adaptation of the African wild dog program and many of the academic studies on other South African who focuses on how lethal control impacts predator behaviour.

Another emerging idea is the comparison of Australian and South African wild dogs. The types of 'dogs' who have very different places in the ecosystem in which they reside. These differences could be used to educate the community on some myths and ideologies that create a lot of false information about predator management in Australian ecosystems whilst increasing the awareness of the Waterberg Wild Dog Initiative.

These are only a few of the bigger ideas resulting in new projects as a direct outcome from my travels. In my current day to day research I have incorporated many learnings to improve my science, questioning and experimental design. This is in addition to the ongoing relationships and international projects with my many South African collaborators. I would really like to return to the country to build on those relationships and project ideas.

Since my return from South Africa many of the project ideas and travel stories have been presented to my colleagues at the Department. Future presentations will be to the range of stakeholders that I work with and that have shaped my research aims such as the Recognised Biosecurity Groups, Industry Funded Schemes, other government departments and landholders. At a national scale I plan to again present my funding and ideas to create stronger relationships with my eastern coast collaborators.

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