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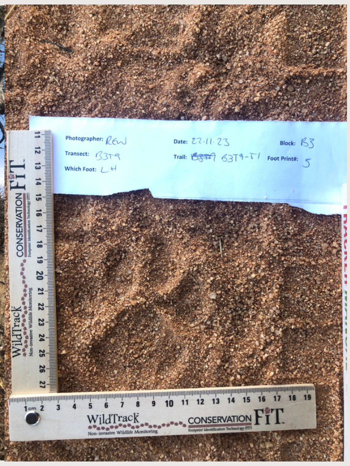
CROUCHING LEOPARD, HIDDEN CAMERA



Top: myself in the field - big smiles after wrapping up spoor surveys
Second: a young male leopard eyes us up as we're collecting footprints
Third: scanning for leopards from our field-vehicle
Bottom left: my field assistant Alice and I in front of a leadwood tree
Bottom right: a lovely left hind leopard footprint

My MSc thesis project for the University of Cape Town's Institute for Communities and Wildlife in Africa is a comparative methods study, comparing different methods for surveying for leopard (*Panthera pardus*) density in an enclosed reserve in Namibia. It has involved a gruelling three weeks of fieldwork tracking leopards in the bush, and countless hours of data-crunching in the lab sorting through camera trap images and IDing individual animals!

This report is a summary of this project, for the interest of those who very generously took the time to invest in this research and support my work. I'll also touch on the research themes that have guided the work, and what I hope we can learn from this research.

How to count cryptic cats?

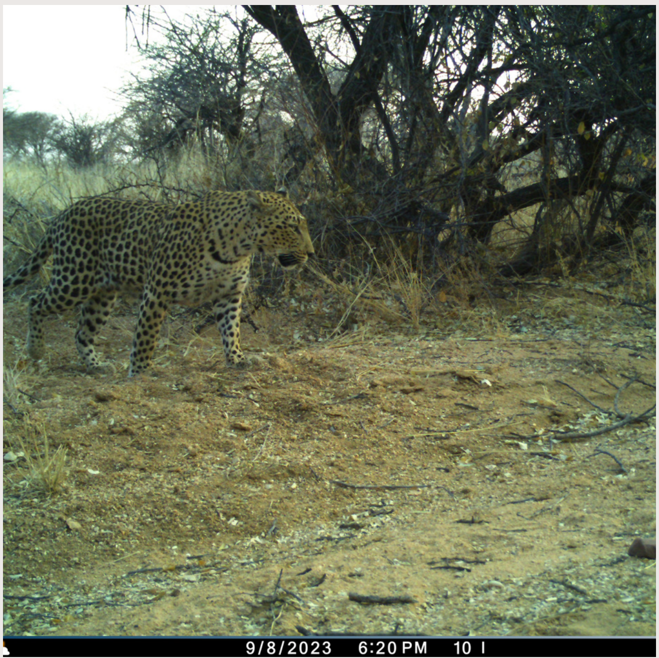
An estimate of leopard density is the most useful way to think about populations, as it positions number of live animals in both time and space. But, for leopards, and other cryptic cats with elusive habits, density is extremely hard to quantify. Accurate and robust density estimates require the population size to be known. In open ecosystems, for species like leopards, this is nearly impossible. However, enclosed private game reserves are small enough and intensely monitored enough for precise numbers to be known. Therefore, we can compare how accurate different density estimation methods are in enclosed reserves, and use these results to inform conservation in open areas.

My involved comparing density estimates produced by a standard camera trapping grid, a baited camera trap array, and a novel, AI-augmented spoor (footprint) survey, to test how these density estimates compare to a known population.

Camera traps have many advantages; they are entirely non-invasive, requiring no stressful handling or immobilisation of the animals, and can be deployed at scale. Camera traps are indiscriminate; they'll certainly record a leopard if it walks past, but they also detect everything else in the ecosystem, yielding valuable bycatch data that can present a clear view of the entire ecosystem. Furthermore, they're far cheaper than expensive collaring operations and require relatively little training to deploy and maintain.

However, they do have some drawbacks. Because no lure is used to attract leopards, the photographic capture rates of standard camera traps are relatively low. Furthermore, there are plenty of factors that might cause cameras to fail; battery shortage, poor weather obscuring the lense, vegetation growth, not to mention you will almost certainly be swamped with images of non-target species, which is the significant drawback to bycatch data.

Right top: an aardvark (*Orycteropus afer*), another cryptic species present in the study area
Right bottom: a caracal (*Caracal caracal*); camera traps are great at detecting other, smaller carnivores



A camera trap array is the conventional way to survey for leopards. Cameras are placed in a grid system across the landscape, with the distance between stations typically under that of a female leopard's home range. This ensures that individuals may be photographed multiple times at different stations. Having created a trapping grid, we then place cameras at the best location within 300m of the centre-point, selecting for trees overlooking wildlife trails, roads or other features that might represent a good spot for a leopard to walk past.

Left: one of my camera traps picks up a brown hyena (Parahyaena brunnea), the only other significant competitor for leopards in the study area.

Furthermore, camera traps may be biased towards detecting only certain kinds of individuals. Since we typically place cameras on wildlife trails or roads, it's possible we're biased towards detecting male leopards, which are more territorial than females and therefore may patrol trails more frequently. Similarly, we may be biasing against detecting dependent cubs, which are stached in dens by their mothers and are rarely seen. Understanding how different methods are biased is critical if we're to use them to inform leopard management and conservation.

Right: an adult leopard detected on camera trap during my study period

These two images, taken just days apart, show two different animals and illustrate the difference in size between males (right) and females (left).

In order to increase leopard capture rates, we can use a baited camera trap array. This involves hoisting bait into trees (out of reach of hyenas), and training the camera on the bait. In effect, this entices the leopards into view of the cameras and therefore may increase our chances of detecting individuals. This may also increase our chances of detecting dependent cubs, as their mothers lead them to easy food (as seen below). However, baited cameras are not without some issues. They may bias towards large, dominant males who can monopolise bait trees. They may also change the leopards dietary behaviour and entice them to hunt less frequently, potentially losing some of their natural behaviour. And, by placing baits in the landscape, we may unintentionally be placing the cameras in the centre of dominant animals ranges, that others are excluded from.

Bottom left: a mother leopard brings her cub to a baited tree in the study site
Bottom right: a mother and slightly older cub visit a baited tree at night.

Another method to survey for leopards – and big cats in general – is by using a footprint, (or spoor) survey. Spoor surveys share some of the advantages, methodologically speaking, with camera traps, in that they are entirely non-invasive, requiring no invasive and potentially harmful of the animals. Furthermore, footprints are the most ubiquitous signs that animals leave in the environment; potentially, every time an animal takes a step, there's the potential for it to be recorded. However, to get an idea of number, we need to be able to tell individuals apart – how can we do this with footprints alone? Previous methods have relied on highly skilled San trackers in Namibia and Botswana who are skilled enough to identify leopards as distinct from footprints alone.

Above: for comparison, a brown hyena footprint; note the visible claws

I was very lucky to work with collaborators at WildTrack to develop their FIT-identification programme. This is a computer algorithm that can distinguish between individuals based solely on prints alone. To do this, I collected prints from captive leopards with known sexes and measurements from zoos and sanctuaries around Cape Town, which complements the existing WildTrack database for leopards. Using this database of prints that relate to known traits like age, sex and weight, we can then record wild, unknown leopards footprints, and the algorithm can confidently assign traits of vital conservation interest such as number, age, sex and weight.

Right and below: one of the largest leopards sampled during my fieldwork

Above: fantastic left hind leopard print in near-perfect muddy substrate; note the lack of claws

Unfortunately, this skill is largely being lost from San communities, who are restricted to parts of Namibia and Botswana and therefore not available to use elsewhere. Other spoor survey have used complex equations that model the relationship between footprint retention, soil and prey to puzzle out density estimates from spoor, but with only tentative results. Spoor surveys are also hampered by the fact that footprints are typically only observable on man-made paths or roads, and are limited to good sediment. And if they are preserved, even the slightest wind or rain will obscure and degrade the prints, rendering them non-viable.

Using the WildTrack FIT method, I carried out a spoor survey at my fieldsite, driving repeat surveys in the dusk and dawn to collect footprints, which will be then sent to WildTrack for analysis. Hopefully, the FIT algorithm will be able to give a robust number of individuals in the study site; combine this with the GPS locations of the prints and the approximate time of collection, and we will have number + space + time = density!

Comparing the density estimates from these three methods of surveying is the next stage of this project. My MSc thesis submission will happen in early 2024, and the paper publication will emerge hopefully by the end of the year!

This project would not have been possible without very generous support ...

Even for early career conservation biologists who have the backing of an academic institution (such as myself), funding support for fieldwork is few and far between. Several organisations and people generously contributed towards funding this project, and I am sincerely grateful to them all.

As a long-time customer of Hawke Optic's binoculars for wildlife watching and research, I was very grateful for the support that Hawke provided me in order to carry out my fieldwork; their funding went towards maintaining and fueling our field vehicle, without which our spoor survey would not have been possible.

Biologists Without Borders are an excellent organisation who seek to provide support to small-scale conservation projects around the world. I was deeply thankful that they were able to support my work; their funding helped feed and water myself and my field assistant for a grueling three weeks in northern Namibia, and also went towards repairs when we (inevitably) went through four tyres! Their wonderful sister organisation Wild Tomorrow does vital work in supporting land conservation across the continent.

Special thanks must go to Peter and Meryt Harding who also very generously supported this project with funding. In wildlife work you so often must rely on the kindness of strangers and the chance friends you meet in unlikely places! We met in Zambia's Luangwa Valley and they were kind enough to remember me and help to fund my field vehicle and transport to Namibia. I am extremely grateful, and I hope we can meet again in the Luangwa Valley some day!

I am very lucky to have been supported by excellent academic supervisors for this project. At UCT's iCWild, Professor Justin O'Riain and Dr Zoë Woodgate have provided invaluable leadership, statistical and operational support, kind guidance and a faith in me as a scientist. I admire them both hugely. Also at UCT, this time at the FitzPatrick Institute for African Ornithology, I thank Emeritus Professor David Cumming for his continued guidance and thoughtful insight into all things leopards.

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I've also been very lucky to collaborate with Associate Professors Zoë Jewell and Sky Alibhai from WildTrack; it's been a real privilege to work with such humane, collegiate and interested partners overseas and I look forward to collaborating with them on the publication in the future! Dr Aletris Neils of ConservationCATalyst was a generous and insightful field mentor at my study site, and I greatly valued her taking the time to oversee the field aspect of my project.

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