

One Health, One Mission: Cheetah Conservation Fund fighting against rabies to protect wildlife, domestic animals, and communities in Namibia

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Abstract

Rabies is a zoonotic disease endemic in Namibia, which affects animals and people worldwide and is fatal if not treated in time. Due to its cross-sectoral implications for human health, animal health, biodiversity, and livelihoods, rabies constitutes a major One Health challenge. Effective control strategies against rabies require a multi-disciplinary approach to create awareness, educate the public, vaccinate dogs and cats, and maintain continuous surveillance.

To contribute to national and global rabies control efforts, and protect wildlife, the Cheetah Conservation Fund (CCF) initiated a mass rabies vaccination campaign in the four eastern communal conservancies of the Greater Waterberg Landscape, Namibia. These efforts aim to reduce rabies transmission at the human–domestic animal–wildlife interface, maintaining the health of domestic carnivores and reducing the risk of disease spreading among people and vulnerable wildlife populations (such as cheetahs, *Acinonyx jubatus*, and wild dogs, *Lycaon pictus*).

Since 2019 the CCF team has operated in underserved, remote areas, administering over 10,000 rabies vaccinations to dogs and cats over six years. Through concurrent educational efforts CCF has also raised awareness about rabies and other common diseases affecting both domestic and wild animals, such as canine distemper and canine parvovirus.

CCF remains committed to continuing this essential work, not only for the safety of wildlife, but for the health and well-being of the people living in these communities. By addressing rabies with a One Health strategy, this approach can support both biodiversity conservation and community resilience.

Introduction

Rabies is a zoonotic disease, endemic to Namibia, and carries significant One Health implications, affecting wildlife, domestic animals, and humans (Hikufe et al. 2019). One Health is defined as a unified, multidisciplinary approach that promotes human, animal, and environmental health by recognising their interconnectedness to improve disease surveillance, control, and ecosystem wellbeing (WHO 2023). Rabies is caused by a

rhabdovirus, which is transmitted through saliva from bites or scratches of infected animals (CDC 2024b). It affects the central nervous system, and, left untreated, leads to death in humans and susceptible domestic and wildlife species, posing a significant burden on public health and economic systems (Fooks et al. 2014).

Rabies causes an estimated 70,000 human deaths worldwide annually (CDC 2024), of which over 21,000 are attributed to African countries in which rabies is endemic (WHO 2023, 2024). In these regions marginalised

communities with limited access to healthcare and resources are particularly affected. Most rabies victims are children between the ages of five and 14 years (Hampson et al. 2015; WHO 2024). In Namibia 242 human deaths have been attributed to confirmed rabies cases over the past two decades (Tenzin et al. 2025). This number is likely an underestimate, despite rabies being a notifiable disease in Namibia, as access to diagnostic services in remote areas remains limited.

Rabies also affects humans indirectly through its impact on domestic and wild animals. Loss of livestock can have grave economic consequences, particularly for rural communities that depend on livestock for their livelihood (Jibat, Mourits, Hogeveen 2016). Rabies in wildlife affects humans in multiple ways. Wildlife can act as a reservoir for the virus, playing a significant role in rabies transmission (Stuchin et al. 2018). Additionally, wildlife can be highly susceptible to rabies with far-reaching ecological consequences, disrupting ecosystems and biodiversity (Hikufe et al. 2019; Stuchin et al. 2018).

Domestic dogs play an important role in rabies transmission. They are the primary reservoir for the rabies virus in many parts of the world, particularly in developing nations that have lower vaccination coverage, and over 99 per cent of human deaths have been attributed to dog bites (WHO 2024, 2013; Dürr et al. 2023). Transmission of the virus between domestic dogs and wildlife can also perpetuate rabies within natural ecosystems (Rajendra et al. 2017; Constanzi et al. 2021). Therefore, controlling rabies in domestic dog populations plays a major role in protecting wildlife and humans, and has an important One Health component.

An effective rabies vaccine is available for dogs and typically involves a single 1.0 ml subcutaneous or intramuscular dose of an inactivated vaccine (WHO 2018). Rabies boosters in dogs are administered every one to three years depending on the manufacturer's specifications, national regulations, and life stage of the animal (WHO 2018). In high-risk areas with limited surveillance and high animal turnover, annual vaccination of at least 70 per cent of dogs is strongly recommended to interrupt rabies virus transmission (WHO 2018; Wallace et al. 2017; Hampson et al. 2009). Mass dog vaccination campaigns, especially when combined with rabies awareness, have proven to be one of the best ways to decrease rabies cases in humans (Hampson et al. 2015; Lavan et al. 2017; Wallace et al. 2017). This has been demonstrated with the success of Latin America in reducing the incidence of human rabies by 96 per cent in the course of 30 years, by focusing their efforts on the above-mentioned strategies, complemented by a strong surveillance programme (Velasco-Villa et al. 2017; Del Rio Vilas et al. 2017). Vaccination campaigns of domestic carnivores have also been successfully used to reduce spillover events of the virus into wildlife and to protect endangered species from rabies outbreaks (Barnett & Civitello 2020).

Altogether, dog vaccination, wildlife surveillance, and public education are critical pillars to a One Health approach for rabies control and eradication (Cleaveland et al. 2006). This approach focuses on strategies that consider the health of people, animals, and ecosystems together, as well as their relationships, to optimise the impacts on everyone's health through a holistic approach involving a multidisciplinary workforce. The

vaccination and awareness campaigns not only protect dogs from the disease but also create a barrier against its transmission to humans and wildlife.

Vaccination campaigns for domestic dogs and cats are therefore especially important in areas where endangered species coexist with human settlements (Cleaveland et al. 2006; Hughes et al. 2013; Fitzpatrick et al. 2012). One such interface exists in the communal areas in Namibia, where rabies cases are regularly reported but vaccination for dogs is not easily accessible. The Namibian government has initiated major vaccination efforts focused on the northern communal areas, where the majority of confirmed dog rabies cases (82%) have been reported (Hikufe et al. 2019). In 2019 the Cheetah Conservation Fund (CCF) launched a rabies vaccination programme aimed at domestic carnivores (predominantly dogs and cats) in the eastern communal areas to complement government efforts.

CCF's rabies vaccination programme

The primary goal of CCF's programme is to improve the health and welfare of domestic animals while also providing indirect protection to people and wildlife, particularly vulnerable and endangered species such as African wild dog (*Lycaon pictus*) and cheetah (*Acinonyx jubatus*), which can come into contact with rabid dogs.

A wide geographic reach

The programme operates within the four eastern communal conservancies of the Greater Waterberg Landscape conservation area, located in the central-eastern part of Namibia (Figure 1). These four conservancies – Otjituuu, Okamatapati, African Wild Dog, and Ozonahi – are adjacent to the Waterberg Plateau National Park. Together they cover approximately 16257km² and are home to an estimated 30987 people (Namibia Statistics Agency 2023). The habitat is characterized predominantly by scrubland, woodland, and grass savannahs. This landscape is important for wildlife movement and for maintaining the genetic diversity of species of conservation concern, such as African wild dogs, leopards (*Panthera pardus*), cheetahs, and several endangered birds and antelopes. The Namibian conservancy model is considered a success story, as it grants local communities the right to manage and benefit from their natural resources, including wildlife. It exemplifies the potential of community-based natural resource management and integrates community needs such as cattle farming with tourism strategies and conservation. This model reduces poaching, supports wildlife protection, and generates economic benefits for the communities.

A collaborative endeavour

To maximise the reach and effectiveness of its rabies programme, CCF works closely with state veterinarians, local authorities, community leaders, and conservancy chair members. Locations (villages or homesteads)

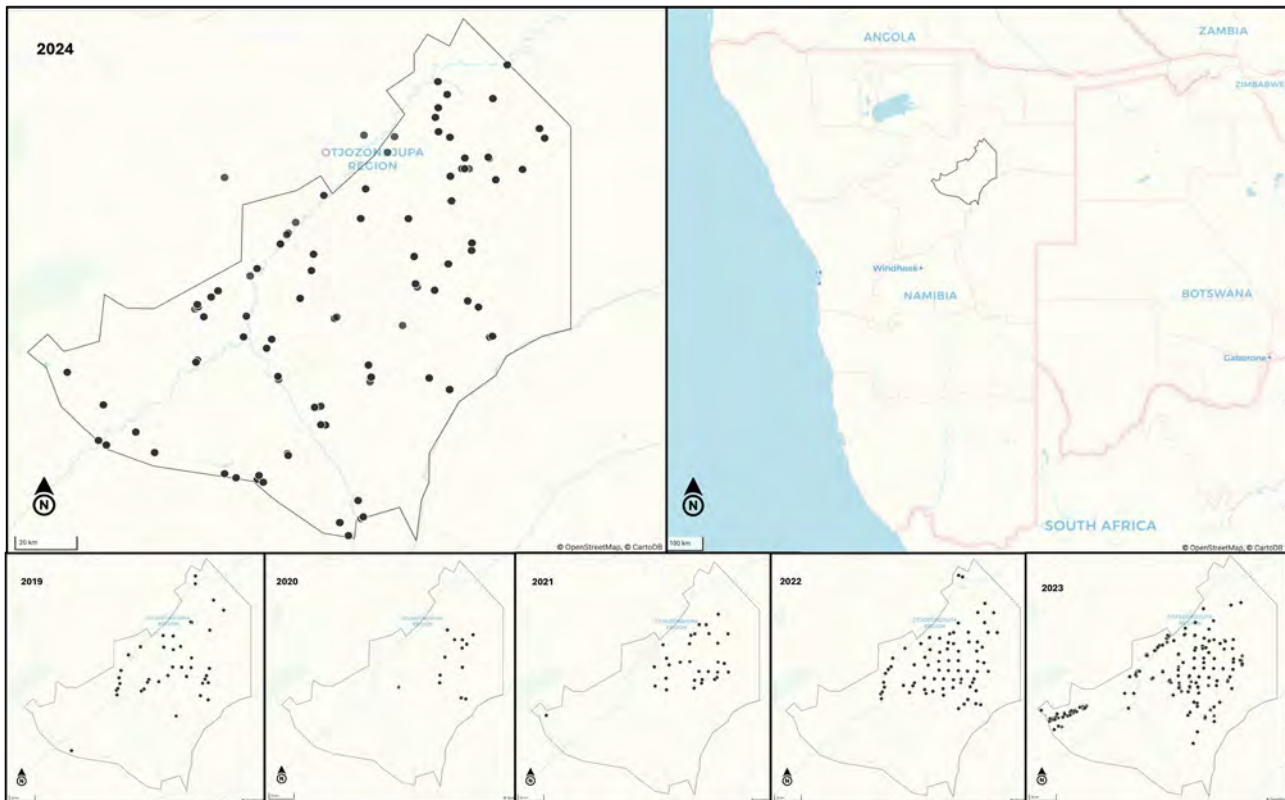


Figure 1: Map of the locations (villages or homesteads) visited by the CCF team during the years 2019 to 2024 as part of the rabies vaccination programme. The map of Namibia highlights the location of the four eastern communal conservancies of the Greater Waterberg Landscape within the country.

covered during each vaccination campaign are initially selected based on the time elapsed since the previous visit. The list is then revised to prioritise areas with recent reports of dog bites, suspected rabies cases, or localised health priorities identified by the state veterinarian. These partnerships help overcome logistical challenges and streamline the process, ensuring that vaccination campaigns run effectively and in alignment with local needs. Additionally, local conservancy rangers are contracted to navigate challenging landscapes, assist with translation, and facilitate communication with local communities.

A great logistical effort

Conducting a successful rabies vaccination outreach programme requires meticulous planning, co-ordinating, and communication. The process begins with a visit to the four conservancies prior to the start of the field season. During this visit, the CCF team meets with each conservancy chairperson to review the previous year's accomplishments and outcomes, as well as to discuss plans for the upcoming field season (April to October). This initial visit is important, as it allows CCF to share programme data with the communities to show the extent of the programme and discuss any issues that may have arisen. For instance, we investigate deaths that may have occurred shortly after vaccination if community members are concerned that they may be linked to the vaccine. The rabies vaccine is very safe and so far all suspicious cases could be attributed to other causes (frequently parvovirus or poisoning); but

it is important to take concerns of the communities seriously, and to address those with our rabies education efforts.

Prior to each vaccination trip, the relevant community chairperson is contacted again to confirm the areas covered by the scheduled trip. The chairperson then informs their community through word of mouth, local radio announcements, and public gatherings. Ongoing communication is maintained throughout the trip to ensure communities are aware of their scheduled vaccination opportunity.

Trip planning includes budgeting, securing vaccines, and preparing vaccination cards as well as educational material. The field vehicle needs to be checked and packed with all the essential camping equipment, as well as food for the entire trip, which is purchased on the departure day.

For the vaccination trips our mobile veterinary team spends up to ten days in the field at a time, camping on communal land in proximity to a homestead located centrally relative to the locations to be visited. This approach allows the team to reach communities living in remote and underserved areas, ensuring that even the most isolated communities have access to rabies vaccinations for their dogs and cats. At each village or homestead the team sets up the vaccination station and explains the process to the owners or carers to obtain informed consent and gather the data required for our programme. The data are recorded in the GARC (Global Alliance for Rabies Control) app, and vaccination cards are issued for each vaccinated animal.

The vaccinations themselves can be challenging as many dogs and cats are not accustomed to being

handled, but our team is experienced in physical restraining, quick vaccination techniques (Figure 2), and safety precautions for the owners or carers and the vaccinators, ensuring a good success rate. In 2023 and 2024 CCF conducted ten trips each year, administering 6002 vaccinations in only two years, and reached a total of 152 and 190 locations respectively (Figure 1).

Once the trip has concluded and the team returns to CCF the vehicle and equipment are cleaned and disinfected to minimise the risk of disease transmission to CCF animals, and to ensure that the equipment remains in good condition. Following return to the office, a report is compiled, some well-deserved rest taken, and often preparations for the next trip begin soon thereafter.

Community engagement

In addition to vaccinations it is important also to educate the public. Therefore, CCF conducts education and awareness sessions in parallel with the vaccination campaigns and distributes educational materials related to rabies (Figure 3) and other relevant diseases (e.g., parvovirus, canine distemper, livestock health issues; Figures 4 and 5). The educational materials were developed by CCF and are available in English as well as in local languages. Particular emphasis is placed on rabies education to promote disease awareness and teach community members about the importance of rabies prevention, including how to recognise the signs of rabies in animals (Figure 3). These initiatives empower local populations to play an active role in rabies prevention, contributing to the overall success of the programme and increasing protection for community members and their families. By targeting the intersection of animal, human, and environmental health, the

programme not only combats rabies but also strengthens the resilience of local communities to future zoonotic threats.

Promising outcome and outlook for the future

Since the inception of its rabies vaccination programme in 2019 CCF's annual vaccination campaigns have played a key role in rabies control efforts across the Greater Waterberg Landscape. Despite operational limitations in 2020 and 2021 due to the COVID-19 pandemic, more than 1000 dogs and cats have been vaccinated each year (Figure 6), with an increasing trend in both numbers and geographic reach, exceeding a total of 10000 vaccinations administered in 2025.

As of 2024 the Okakarara State Veterinary Office began vaccinating dogs and cats in main settlements with high population densities within their jurisdiction. This development allowed CCF to redirect its efforts towards more remote areas. As a result of greater logistical challenges in remote areas, fewer individual animals were vaccinated by CCF in 2024 compared to 2023 (2701 in 2024 compared to 3302 dogs and cats vaccinated by CCF in 2023). However, this shift has expanded access to underserved populations and increased overall impact of the programme by including animals that, under other circumstances, would likely not have had access to vaccination.

Building on the progress and success of the programme, CCF plans to continue expanding its reach and impact across the region to protect domestic dogs, wildlife, and people against rabies.




Figure 2: Vaccination of (a) a domestic dog and (b) a domestic cat, under manual restraint.

Rabies Awareness

Rabies is an infectious disease transmitted by **animal bites** and by **infected meat**.

The disease is always fatal
There is no treatment or cure



It can go from dogs or jackals to other animals or to people

What to do if you get bitten?

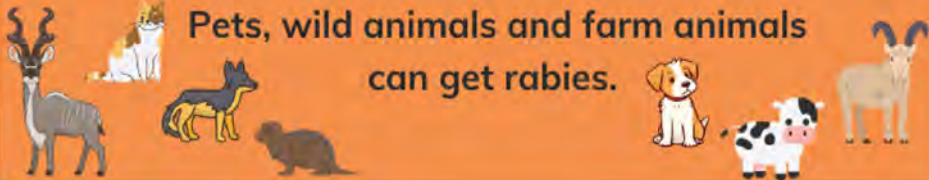


Wash the wound immediately with soap and water.

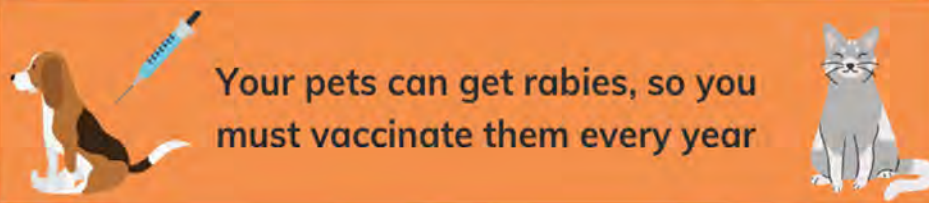


Go to a doctor and tell them you might have been bitten by a rabid dog.


Pets, wild animals and farm animals can get rabies.




Your pets can get rabies, so you must vaccinate them every year



Sick animals will have unusual behavior, excessive salivation and have difficulty walking.



Report bites and animals with unusual behavior to the State veterinarian.



Farmer Carnivore Help Hotline
081 603 0683
067 306 225

Figure 3: Rabies awareness poster. Available upon request from CCF.



Figure 4: Flyer on canine distemper and canine parvovirus distributed to communities. Available upon request from CCF; in English (pictured) and local languages.

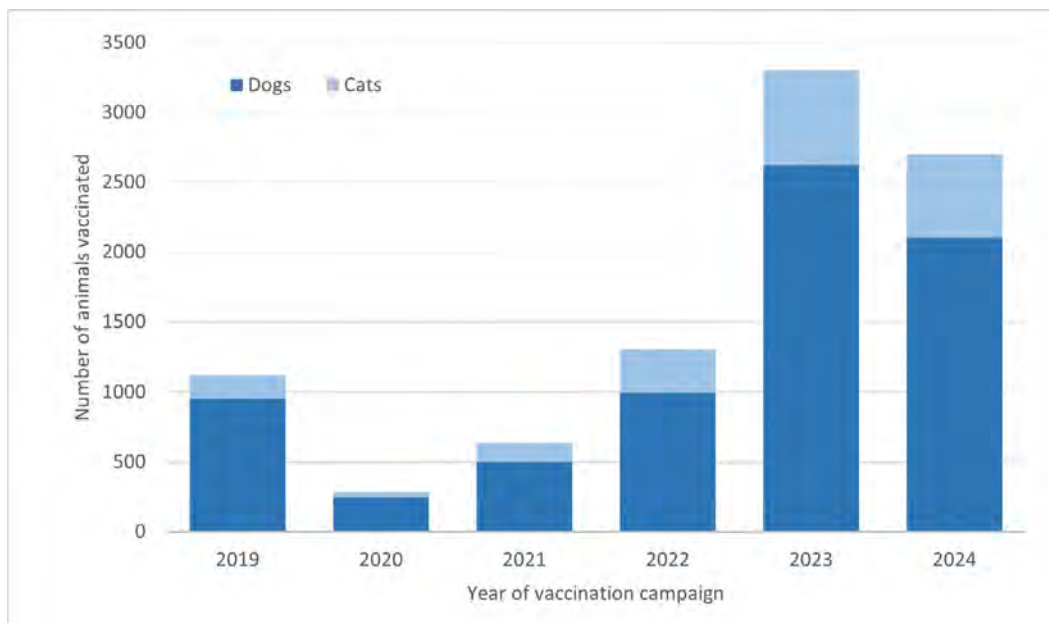


Figure 6: Numbers of dogs and cats vaccinated against rabies by CCF between 2019 and 2024.

In 2024 and 2025 CCF's efforts were recognised by the Namibian government through an invitation to participate in the National Rabies Planning and Review Meeting and Workshop. CCF and other stakeholders presented the successes and challenges of their respective vaccination programmes. CCF's efforts stand out, as it is a non-profit, non-governmental organisation, primarily funded by individual donations and driven by conservation goals, while most other vaccination campaigns are implemented by national institutions or government-funded programmes. This further highlights the value of coordinated efforts for One Health initiatives.

At the national level Namibia has demonstrated substantial progress in rabies control, with reported human rabies deaths dropping from 23 in 2015 to only two in 2023 (Tenzin et al. 2025). This decline highlights the effectiveness of collaborative strategies combining public education, state and NGO-led vaccination campaigns, and community engagement.

CCF's rabies vaccination programme supports the Namibian efforts toward the Global Strategic Plan 'Zero by 30' of the World Organisation for Animal Health (WOAH), the Food and Agriculture Organization of the United Nations (FAO), and GARC, which aims to eliminate human deaths from rabies by 2030. Through

its collaborative approach CCF ensures both the sustainability of the programme and alignment with



DISEASE MANAGEMENT

Common diseases that can be prevented by vaccines

- Black quarter
- Botulism
- Tetanus
- Rabies
- Pasteurella
- Pulpy Kidney
- Chlamydia

Ticks

- Can transmit diseases like Erlichia, Babesia and Anaplasma.
- Can lead to anemia and animal losses.
- Use tick sprays or dips during rainy season.

Toxic Plants

- Bloat, poisoning and death of animals.
- Giving activated charcoal during rainy season can help prevent losses.

Foot care

- Footbaths can prevent footrot in the rainy season.
- Hoof should always be trimmed.

If you would like more information contact our outreach team and livestock manager
061 237 294 - 081 603 0683



SAVING CHEETAHS, ONE DOG AT A TIME

Figure 5: Flyer on livestock diseases and disease management distributed to communities. Available upon request from CCF in English and local languages.

the national strategy. Data from the CCF vaccination campaign are shared with the Namibian government and officially contribute to the national rabies eradication efforts.

To complement the campaign's efforts with quantitative data, CCF co-supervised a Master's student from the University of Bristol (United Kingdom) to evaluate the impact of the rabies vaccination programme. The project is expected to provide evidence supporting community-based rabies control programmes and may inform future national and international strategies.

CCF remains committed to sustaining these efforts, as rabies control is crucial for both wildlife conservation and public health in Namibia. Together with the local and national authorities we aim to continue protecting Namibia's diverse wildlife and ensure the well-being of its communities.

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About the authors

Dr Anahi Hidalgo (DVM) served as One Health Advisor for the Cheetah Conservation Fund (CCF) in Namibia in the second half of 2022, to lead the rabies vaccination and community outreach campaign of that year and develop the strategic plan for 2023. She is a wildlife veterinarian and researcher from Ecuador with a focus on One Health, wildlife medicine, and the interface between domestic animals and endangered species. In 2025, Anahi rejoined CCF as Biomedical Research Associate, currently leading the Rabies Outreach campaigns and contributing to biomedical research on rabies prevention and One Health interventions. Before joining CCF, she worked on wildlife medicine and population management initiatives in Ecuador, leading sterilisation campaigns of dogs and cats in high-priority conservation areas with Fundación Cóndor Andino and participating in wildlife health projects in the Galápagos Islands. She has worked across Africa – including Namibia, South Africa, Kenya, and Somaliland – on conservation programmes involving cheetahs, elephants, lions, leopards, and birds of prey. She is also an amateur wildlife photographer and science communicator committed to promoting animal welfare, conservation, and gender equality in the veterinary profession.



Dr Ana Figueiredo Basto (DVM) worked as Research Veterinarian at the Cheetah Conservation Fund from 2021 to early 2024, part of which she managed and planned the One Health initiatives, contributing to the growth of CCF's rabies vaccination campaigns. Ana is a wildlife veterinarian from Brazil, who did her residency at a rescue centre that holds the largest research centre for neotropical felids in South America and her master's degree working with free-ranging mountain lions in California. Overall, she worked internationally with zoos, conservation organisations, government agencies, and field research teams in countries like Brazil, Namibia, United States, India, and Somaliland; in most of these places, she worked with CCF on her favourite species: the cheetah. Since mid-2025, she is a Lecturer in Exotic and Wildlife Medicine at the University of Lancashire, in England.



Dr Laurie Marker (DPhil) is the Founder and Executive Director of the Cheetah Conservation Fund (CCF), internationally recognised as a leading authority on cheetah biology, conservation, and human-wildlife conflict mitigation. With over four decades of experience working across North America, Africa, the Middle East, and India, she has pioneered holistic, science-driven approaches to save the cheetah in the wild. Dr Marker established CCF in Namibia in 1990 and has since developed innovative One Health and community-centred programmes, including integrated livestock-guarding dog, habitat restoration, and veterinary initiatives. Under her leadership, CCF has become a global model for carnivore conservation, research, and education. Her work has been widely acknowledged through numerous international awards, and she continues to champion collaborative solutions that benefit wildlife, domestic animals, and rural communities. Dr. Marker has been instrumental in guiding CCF's rabies prevention and One Health activities, supporting the development and expansion of community-based vaccination campaigns across the Greater Waterberg Landscape.



Dr Anne Schmidt-Küntzel (DMV, PhD) is the Director of Animal Health and Research at the Cheetah Conservation Fund (CCF). She has guided and overseen CCF's veterinary-related research and outreach work since 2009, including the expansion of the Rabies Outreach campaigns and supervising its current evaluation by a former MSc student. In 2008, she established CCF's state-of-the-art Conservation Genetics Laboratory in Namibia, which she has directed since its inception, conducting research on cheetah populations, illegal wildlife trade, and related conservation topics. Dr Schmidt-Küntzel also oversees CCF's Scat Detection Dog programme, which, together with the genetics laboratory, plays a key role in non-invasive wildlife monitoring and research. She applies her combined veterinary and genetic expertise to investigate disease processes and morphological variation. In 2022, she oversaw CCF's veterinary work for the reintroduction of cheetahs to India. In 2018, she and Dr Marker co-authored and co-edited the comprehensive textbook, CHEETAHS: Biology and Conservation, published by Elsevier.

