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Cheetahs Race for Survival: Ecology and Conservation

Laurie Marker

Abstract

Cheetahs reach speeds of up to 113 km/h accelerating from zero to 96 km/h in 3s. Revered for 5000 years throughout Asia, Europe and Africa has contributed to the species decline. Today's wild cheetah population is estimated at 7100 adult and adolescents, a 90% reduction from a century ago, and a range reduction of 9%. Over 80% live outside protected areas where human-wildlife conflict occurs. Female cheetahs live solitarily with their cubs; male cubs form lifelong coalitions. Living in low densities cheetahs' home ranges cover over 1500 km², requiring large landscapes with prey. Although cheetahs' lack genetic diversity from a historic population bottleneck, their greatest conservation problems are humans. Habitat loss and declining preybase leads to conflict with livestock farmers. Additionally, illegal wildlife trafficking of cubs is affecting small populations in the Horn of Africa. Solving the cheetah conservation crisis is critical and involves addressing a complex web of social, environmental and economic issues, and depends on a holistic approach balancing the needs of humans and cheetahs sharing land. Research into conserving and restoring habitat for cheetahs includes training, the use of Livestock Guarding Dogs, and other conflict mitigation strategies, addressing habitat loss, dismantling the illegal pet trade, and encouraging coexistence.

Keywords: cheetah, predators, protected areas, livelihood development, conservancies, illegal wildlife trade

1. Introduction

The cheetah, *Acinonyx jubatus*, is one of the oldest big cat species, with ancestors that can be traced back more than five million years to the Middle Pliocene era [1–3]. The cheetah is also the world's fastest land mammal, an icon of nature, and the most unique of the 41 species of cats [4]. The hunting style of the cheetah—to swiftly pursue prey over a moderate distance—necessitates some morphological and physiological specializations for both prey-killing and locomotion [5].

As an animal built for speed, all parts of its body have evolved for precision and agility. Because of its small, aerodynamic head, lean body, long legs, flexible backbone and tail that works like a boat's rudder, the cheetah can change direction in a split second and reach speeds of up to 113 km/h while turning 180° [6–8]. With each stride, the cheetah covers 6 m with just one foot touching the ground at a time; at two points in the stride, all four feet are in the air. The cheetah's flexible spine acts like a spring as it doubles up with feet under its body to clench the earth with powerful, semi-non-retractable claws, thrusting it forward with great speed

and maximum distance. The cheetah is not only the fastest running land mammal; it is also known for its rapid acceleration, as it can go from zero to 96 km/h in just 3 s [6].

With less than 7100 adults and adolescents remaining [9], the cheetah is one of the most endangered big cat species. Cheetah numbers have declined primarily due to increased human-wildlife conflict, loss of habitat and loss of prey, and the illegal wildlife trade. In addition to these threats, cheetahs lack genetic variation due to a historic population bottleneck, approximately 12,000 years ago, which makes the cheetah more vulnerable to ecological and environmental changes [10–12].

Today, nearly 80% of the remaining world's cheetahs are found outside of protected areas living near rural livestock farming communities [9]. Protected areas, such as wildlife reserves or national parks typically have higher densities of larger or more aggressive predator species that can outcompete cheetahs, making it difficult for cheetahs to survive. Despite being one of the best hunter species on the savanna, cheetahs often lose their kills to larger predators. In protected areas, cheetahs have been found to lose 10–15% of their kills to lions (*Panthera leo*), leopards (*Panthera pardus*), jackals (*Canis aureus*), and hyenas (*Hyaenidae*) [13, 14]. In addition to hunting pressures, cheetahs face direct threats by larger carnivores that may try to kill an adult cheetah or its young, to reduce competition for prey and territory [13–17].

Living outside protected areas prevents threats by other predators but puts the cheetah in direct conflict with commercial and subsistence livestock farmers [18, 19]. These farmers often perceive cheetahs to be a threat to their livestock, which leads into economic and emotional issues. The Rangewide Cheetah and Wild Dog program, an IUCN Cat Specialist endorsed program, brings together conservation organizations across the cheetah's range to work on a more sustainable future for cheetahs and farmers. Cheetah Conservation Fund (CCF), Cheetah Conservation Botswana (CCB), and the Ruaha Carnivore Project work with other stakeholders, such as community members, local and national governments, conservancies and scientists to develop and implement action plans for cheetah conservation throughout its range [9, 20–23].

As human populations grow, so do the chances of conflict with cheetahs. Simultaneously, available rangeland will shrink, along with the wild prey base, hastening the decline of the cheetah [24, 25]. If the observed trends of decline among cheetah population continues, the world's fastest land mammal could become extinct within the next 15–20 years [26].

2. Cheetah distribution

The cheetah was once one of the most widely distributed of all land animals. Through the course of time the cheetah was found from North America to China, throughout Asia, India, Europe, and Africa. About 20,000 years ago, it settled into its current range [3, 27].

A century ago, approximately 100,000 cheetahs were found in at least 44 countries throughout Africa and Asia. Today, the current free-ranging populations of cheetahs are restricted to 10% of their former range, found only in small, fragmented areas spread across 23 countries in Africa (in North Africa, the Sahel, East Africa and southern Africa), however, two thirds of these countries' cheetah populations number less than 200 individuals [9, 28]. It is estimated that fewer 50 wild cheetahs remaining in Iran, the last of the Asiatic population [9, 29].

Today, viable populations may be found in less than half the countries where cheetahs still exist. Cheetahs are particularly difficult to census due to their large home ranges, which average more than 1500 km² [14, 30–32], and their shy nature, an instinct that has been reinforced because of persecution on farmlands, where

they are shot, trapped and chased [19, 22, 33, 34]. As a result of persecution and due to their naturally large home ranges, wherever they live they occur in low densities [34].

All populations of cheetahs are listed on the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) Appendix 1 and are classified as Vulnerable or Endangered by the International Union for Conservation of Nature (IUCN) [35]. All cheetah populations are threatened due to habitat reduction and declines in prey populations, which bring them into increased contact (and ultimately conflict) with farmers and livestock [14, 20–23, 33].

Due to its declining numbers and genetic lack of diversity, it is important to protect remaining wild cheetah populations to ensure the species chances for survival. An evaluation of conservation priorities in each country where the cheetah is found has been conducted to better understand the issues involved in achieving this goal [20–23, 33, 36]. The remaining strongholds for cheetahs are Namibia and Botswana, in southern Africa; and Kenya and Tanzania in East Africa (see **Figure 1**). With approximately 20% of the world’s remaining wild cheetahs and successful efforts to conserve its wild population, Namibia is popularly known as “The Cheetah Capital of the World.”

As a result of habitat fragmentation over time, there are currently four genetically confirmed subspecies of cheetah, three African and one Asiatic subspecies [4, 12, 37]. These subspecies are physically distinct from one another, and research is still ongoing to determine the genetic uniqueness of each. One previously-accepted subspecies, the Northeastern African Cheetah, *Acinonyx jubatus raineyii*, which was found in Kenya, Tanzania, and Uganda, was determined in 2017 to be a conspecific of *A.j. jubatus* in 2017 and reclassified as such [4]. The currently classified subspecies of cheetah are as follows:

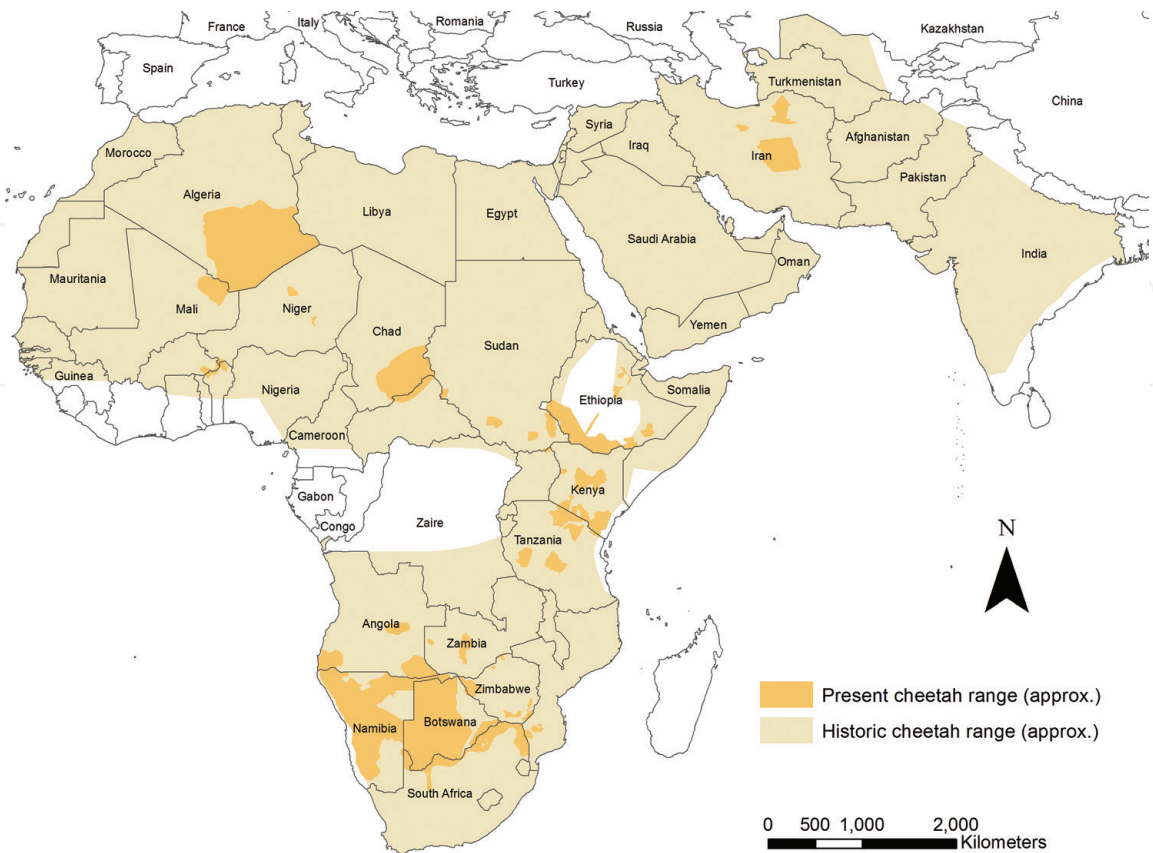


Figure 1.
Historic and current: cheetah range map [28].

2.1 Asiatic cheetah

Acinonyx jubatus venaticus originally found throughout Asia in Afghanistan, India, Iran, Iraq, Israel, Jordan, Oman, Pakistan, Saudi Arabia, Syria and Russia [38], but now there are approximately 50 remaining in a small, fragmented populations in Iran [29]. These cheetahs have denser fur and what appears to be a mane, which is actually extra tufts of hair on their neck and shoulder blades. This thicker coat keeps them warm in the cooler nighttime temperatures of their environment.

2.2 Northwestern African or Saharan cheetah

Acinonyx jubatus hecki, historically found in Northwest Africa in Egypt, Algeria, Tunisia, Morocco, Niger, Mauritania, Mali and in some western African countries, including Benin, Burkina Faso, Senegal and Ghana [38]. Today, small populations remain in Algeria, Niger, Benin, and Burkina Faso [28]. Most are in the central western region of the Saharan desert and the Sahel. Unique in appearance, this subspecies is critically endangered with only approximately 250 individuals remaining. Saharan cheetahs are extremely pale, almost white in color. Their coloring provides them with a natural defense against detection in the desert environment. Sometimes there are no spots on its face and its tear marks appear to be missing. In general, they are smaller than the other subspecies. This may be a product of their desert environment, where there is less prey for them to hunt.

2.3 Eastern African or Sudan cheetah

Acinonyx jubatus soemmeringii, was historically found in Sudan, Djibouti, Cameroon, Niger, Nigeria, Chad, Ethiopia and Somalia [38]. Today, small populations are in Chad, Ethiopia, Somali, Somaliland, and South Sudan [28]. This subspecies is the richly colored.

2.4 Southern African cheetah

Acinonyx jubatus jubatus, originally found throughout Namibia, Botswana, South Africa, Zambia, Angola, Mozambique, Malawi, and Democratic Republic of Congo and Zimbabwe [38]. Today, over 50% of the remaining cheetahs are found in Namibia and Botswana, with small populations in Angola, South Africa, Mozambique, Zambia and Zimbabwe [28], and the new classification of those from Kenya, Tanzania and Uganda [4]. They have large home ranges that can encompass hundreds of square kilometers.

3. Cheetah behavior

Cheetahs have evolved for speed and are not built to fight other predators. Because of this, they are shy in nature and will often abandon their kills in the presence of more robust predators, such as lions, leopards and hyenas [14, 39]. To combat this, cheetahs are typically diurnal hunters, as opposed to other large predator species, such as lions, hyena, and leopards, which are nocturnal [39, 40]. Their lack of defense against these predators has led to 80% of the current cheetah range being on farmland habitat [28, 41].

Female cheetahs live solitary lives and do not form coalitions. After a 93 to 95-day gestation, solitary female cheetahs give birth to two to six cubs, with 3.5 being the average litter [13, 28, 42]. Cubs stay in the den for the first 6 weeks, with females moving their cubs to different nest sites for protection [39, 43].

At 6 weeks of age, the cubs leave the den and follow their mother. At first, cubs will stay hidden while their mother begins to stalk prey. While the cubs are on their own, they may chase after inappropriate prey animals, such as jackals or birds [13]. To teach them how to catch appropriate prey, their mother will capture and release prey for the cubs to play with to practice their hunting skills [13]. The cubs will begin to chase the prey and trip it before the mother eventually comes and kills it for them [43]. Cubs start initiating their own hunts at about 1 year of age but are not proficient until they are independent [13]. Cubs stay with their mother for about 18–22 months. Even after they become independent, it can take cubs up to 3.5 years to master hunting [13]. Female cubs establish their home ranges within their mother's larger home range, so there is familiarity among female cheetahs that are related [44].

Once the young males disperse they will not maintain a territory until they are 4–5 years of age [13, 18]. Male cheetahs remain with their other male siblings from birth, forming a coalition for life. This behavior increases hunting success and is a defense against predators. By sticking together, they can hold and defend a better territory, where wildlife prey is abundant [39]. This also increases the chances of a greater number of desirable females coming into the territory for breeding.

Members of a coalition are very bonded to one another. If separated, they do a lot of vocalizations. Cheetahs have a variety of unusual vocalizations including a dog-like bark and a bird-like chirp for calling between each other [13, 39]. Other sounds they make include a bubble or “uhun” sound, a hiss, and a growl. They are also very affectionate to each other. They purr and lick each other's faces. Male coalitions work together when hunting and are able to hunt larger prey together. Cheetah coalitions are very stable, and the bond of brotherhood is permanent.

4. Cheetah ecology

Cheetahs require vast expanses of land with prey and other resources [9, 45]. Research in Namibia shows that cheetahs have an average home range of 1500 km² with individuals covering 20–40 km in a week, but live in low densities throughout their range [14, 39, 45, 46]. Most cheetahs live in open grasslands and savanna, which are arid environments [35]. Throughout the cheetahs range, cheetahs are known to use tall trees for greater visualization as well as territorial markings. In Namibia, these trees have been called “playtrees,” as cubs are often seen climbing into them, or “newspaper tree,” as male cheetahs use these trees for leaving their territorial scent marks, urine and feces [14, 47]. However, in many ecosystems throughout the cheetah ranges, bush encroachment, a form of desertification caused by overgrazing arid landscapes as well as the decline of many of the large mega-herbivores, has caused a problem for cheetah hunting ability as well as altering the mix of wildlife [47]. Bush encroachment results in the prolific growth of a native plant species, *Senegalia* sp., commonly known as thornbush [47]. On traditionally open savanna lands where cheetahs hunt using their natural advantage, speed, bush encroachment changes the landscape. Increased bush limits the cheetahs' vision and speed, which lowers their hunting success, ultimately altering the mix of wildlife [47, 48]. Decreased vision does not just hinder their hunts, as cheetahs are also more likely to consider livestock as prey over wildlife, becoming a problem animal to farmers and increasing conflict [49]. Throughout Africa, cheetahs are known to frequent certain trees [14, 47].

Changes in the arid ecosystems in favor of human needs have also created problems, mainly from overgrazing of livestock leading to desertification, leaving limited grazing for wildlife. Further compounding this issue, forces of nature that

are unpredictable and difficult to manage such as climate change, negatively affect agriculture and wildlife as rangelands become drier and vegetation is altered [50]. This also affects distribution and abundance of prey [14, 45]. And, as the human population grows, air and water become more polluted, habitat is lost to development, and the climate crisis deepens. Ultimately, the cheetah's chances for survival depend greatly on the re-balancing of the ecosystem and the restoration of habitat so it will support sufficient natural prey [26].

Learning to hunt is the most critical survival skill that the cubs must develop [13]. At 1-year-old cubs are participating in hunts and the mother, while assuring enough kills for the family's survival, will allow the cubs to join in. Cheetahs hunt in the early morning and early evening and capture their prey by stalking to within 10–30 yards or as far as 80 yards before beginning the chase [13]. During a hunt, cheetahs usually catch their prey after an average 200-yard sprint [13]. Although fast, their ability to accelerate at a high speed is most critical, and their maneuverability enabling them to turn rapidly is more important than their speed. Most hunts take place at a slower speed, as prey are dodging in efforts to flee [39]. Successful hunters need not only speed but stealth as well. They move slowly and remain low in the grass, staying downwind, sometimes hiding behind small mounds to obscure their approach, taking advantage of their coloring to camouflage their appearance and blend into their surroundings [13].

Only 10% of cheetah chases are successful, and diet depends largely on where the cheetah lives [13]. Medium-sized and smaller prey, such as antelope and gazelles, hare and the young of larger antelope like wildebeest (*Connochaetes*), kudu (*Tragelaphus* sp.) or oryx (*Oryx* sp.) and small warthog (*Phacochoerus*) are the most common targets, and coalition males often take larger prey species like zebra (*Equus hippotigris*, *E. dolichohippus*), kudu or ostrich (*Struthionidae*) [14]. Asiatic cheetahs prey on goitered gazelle (*Gazella subgutturosa*), ibex (*Capra* sp.), wild sheep (*Ovis* sp.) and chinkara (*Gazella bennettii*) [14]. Factors that lead to a successful hunt include herd size, prey response, number of cheetahs hunting, and the distance the cheetah runs [13, 39]. The cheetah can go days without water because they get hydration they need from the blood of their prey and will gorge themselves on a big enough kill and then fast for 2–5 days; however, they will hunt daily if possible [13].

Threats from other predators is one of the main reasons why nearly 80% of wild cheetahs today are found outside of protected areas (like national parks or wildlife reserves) and living alongside human communities [9, 28, 39]. In protected areas, cheetahs often lose their kill to larger and more aggressive predators. Cheetahs tend to lose 10–15% of their kills to other predators [39]. Cheetahs are apex predators and the best hunters on the savanna, they feed many species with their kills' thus increasing biodiversity of the ecosystem in which they live [14]. Without this balance, other species within the ecosystem will also be adversely affected, ultimately resulting in negative consequences for the human population.

5. Threats to the cheetah

Conservation research shows that the greatest conservation problems are not biological but have more to do with humans. Climate change and human population growth compounds these threats to an already genetically compromised species [19, 25, 33, 35, 45, 50]. Human-wildlife conflict, habitat loss and illegal wildlife trade have become the biggest threats to long-term cheetah survival [9, 26, 51, 52].

The majority of people who live alongside cheetahs are rural subsistence farmers whose livelihoods depend on the health and wellbeing of their livestock. These farmers have traditionally viewed cheetah as worthless vermin, a nuisance and a

threat. Some governments have sanctioned herd protection programs that allow for cheetahs on farmlands to be trapped and removed or killed on sight [51]. Culling of cheetahs in Namibia during the 1980s resulted in losses of nearly 7000 cheetahs due to real and perceived conflict with livestock and game farmers [18, 53]. While these programs were popular during the 1970s and 1980s, this led to a rapid, widespread reduction in the numbers of wild cheetah, which fortunately has been stemmed by the intervention of conservationists and the introduction of non-lethal predator control techniques [19].

In Northern Africa, the rarity of the Saharan or desert cheetah is directly linked to the rarity of the prey species, as the IUCN Red List lists both predator and prey as critically endangered species [28]. The Saharan cheetah can still be found in small numbers in Algeria (Ahaggar and Tassili N'Ajjer), Niger (Termit and Aïr), and possibly also in Mali, Chad and Mauritania [9, 28]. Due to the decline of prey, mainly from poaching and overhunting, these cheetahs are living primarily on hare (*Lagomorpha*) but are known to attack and kill young camels (*Camelus dromedarius*) and goats (*Capra sp*), provoking retaliation [45].

Habitat destruction across Africa and Iran is one of the biggest problems threatening cheetah survival. As wild lands are being destroyed and fragmented by human expansion, landscapes across Africa that once supported thousands of cheetahs now support only a few. With habitat loss comes the decline in wild game species that provide prey for the cheetah [45]. As the human population continues to grow exponentially, there is an every-increasing demand for land rights. This affects the cheetah, as increased agricultural pressure and subdivision of land mean a decrease in available habitat for the cheetah and other wildlife species [25].

For many African wildlife species, living within a protected national park or private game reserve such as the Maasai Mara in Kenya, the Serengeti National Park in Tanzania, or Kruger National Park in South Africa is the difference between life and death. Animals that live on protected lands are guarded by rangers and photographed by tourists, which makes them less likely to be poached. But for some species, including the cheetah, living in protected areas results in greater competition with other larger and more aggressive predators that will steal their kills and kill their cubs. There is a high cub mortality (up to 90% in protected areas), mainly due to predation [15]. Consequently, nearly 80% of all cheetahs throughout their range are found living outside of protected parks and reserves [9, 28].

The lifespan of an adult cheetah is between 8 and 10 years [18, 42]. Adult mortality is one of the most significant limiting factors for cheetah population growth and survival [18, 54, 55].

Because of in-depth, *in situ* research studies of the wild cheetah that have taken place since the early 1980s, we probably know more about this species than most any other big cat species [24]. The unique genetic profile of the cheetah demands a thorough understanding of their biology and capacity for reproduction. A potentially critical factor for the long-term survival of the cheetah is its lack of genetic variation relative to other felids [12].

Genetic homogeneity can make a species more susceptible to ecological and environmental changes to which the world is subjected now and has been interpreted in the context of two potential risks: the expression of recessive deleterious alleles and increased vulnerability to viral and parasitic epizootics that can affect genetically uniform populations [11, 12]. Cheetahs are known to be very susceptible to several feline diseases and are possibly more vulnerable due to the lack of heterogeneity in the population [11, 56, 57]. As cheetahs transverse the farmlands where more villages occur, the potential for disease transmission increases. Given the species lack of genetic diversity, monitoring the overall health of cheetah populations is an important component of understanding and promoting its long-term viability.

Another major threat is the trafficking of live cheetahs for the illegal pet trade. Wildlife trafficking is one of the top five transnational crimes and it is impacting affecting the survival of many species (U.N. Office on Drugs and Crime). While cheetahs are not poached at the same high rates as elephants and rhinoceros in Africa, an estimated 300 cheetah cubs are being smuggled out of the continent each year to supply the illegal pet trade [52] (**Figure 2**). Illegal capture is occurring mostly in Ethiopia, Somalia and northern Kenya, with most cases being reported in Somaliland [52]. Although trade in wildlife species products is regulated by both international and national laws, the illegal wildlife trade is estimated to be worth between \$50–150 billion USD annually. Cheetahs, listed as an Appendix 1 species under CITES, are removed from the wild for the pet trade and for their body parts.

Because the cheetah is light and built for speed and has a flight versus fight instinct. For this reason, the cheetah is a sought-after pet in multiple regions of the world [52]. In the Gulf States, cheetahs are one of the most popular exotic pets and are a status symbol [52]. Photos posted on social media show cheetahs with gem-studded collars posing in luxury vehicles beside their owners, or riding in speed-boats, or in other outlandish depictions.

Keeping a wild cheetah as an exotic pet undermines the species, as its numbers are so low it cannot sustain regular losses and still hope to survive. The illegal pet trade is decimating cheetah populations that are already small and nearly unsustainable [9, 52]. Five out of six cubs poached die before being sold into the pet trade. Cheetah cubs that survive long enough to be sold most likely will not make it beyond 2 years of age. All will become sick, disabled and die prematurely. Improper diet, environment and lack of veterinary care result in a myriad of debilitating health problems [52].

Another human issue impacting the cheetah is tourism. Everyone who visits Africa on safari wants to see a cheetah. While tourism helps bring international attention to the cheetah and instills economic value in species survival, crowds of multiple vehicles surrounding cheetahs can have a negative impact [20, 58, 59]. Cheetahs hunt in the early morning and late afternoon when most game drives take place. Vehicles sometimes move between the cheetah and its prey so tourists can



Figure 2.

A caged cheetah cub confiscated from illegal wildlife trafficking. Cheetahs are often illegally sold as pets to the Middle East and for everyone that makes it live into the trade, 5 die in transport.

get a better view. This interferes with the cheetah's ability to catch its prey and can separate mothers from cubs [20, 58, 59].

Predators are exceptionally aware of tourists and their vehicles and sometimes use them to their advantage. If a cheetah has made a kill it will most certainly lose it if vehicles are present, since other predators, particularly the hyena, lion or jackal are alerted by the tourists. If the cheetah has cubs, this is a very dangerous situation for them, as they are made more vulnerable by the interference of the vehicles. Research conducted in the Maasai Mara recorded that nearly 30% of cheetah sightings had more than 20 vehicles surrounding it, and of these, more than 50% were less than 30 yards from the animal [58]. Nearly 60% were reported as being noisy (hooting and engine revving) with tourists and drivers shouting or talking very loudly [20]. The busiest time for the tourist vehicles was found to be between 4:40 and 6:30 pm coinciding with the high times for hunting by cheetahs [20].

In the Maasai Mara, a high incidence in sarcoptic mange in cheetahs has been linked to stress caused by tourism vehicles. Chronic stress induces immunosuppression, which in cheetahs has been found to contribute to a high occurrence of uncommon diseases, like mange, gastritis and amyloidosis [56–58, 61].

6. Conservation initiatives

Solving cheetah conservation crisis involves addressing a complex web of social, environmental and economic issues. Although people are the root of most of the problems facing the cheetah in today's world, they are also the solution as well. Over the past several years, conservation professionals have come together to look closely at the crisis for the cheetah and devise strategies for cheetah survival [9, 24].

Though the situation for the wild cheetah is dire with less than 7100 wild adult and adolescents remaining, there is hope for species' long-term survival. Efforts to educate communities living alongside cheetah through awareness building media campaigns and to obtain government buy-in have been successful [60]. Range-wide strategies for the cheetah have been developed and implementation is underway through eastern, southern, north, west and central Africa [9, 14, 36]. Capacity building for range country conservation scientist and agriculture extension officers is an ongoing process, using the "train the trainer" approach [26, 60]. Committed conservationists are focusing on the bigger picture, encouraging community participation in finding solutions that alleviate conflict. The bigger picture allows for a global perspective and a multi-species, integrated approach to cheetah conservation.

At the 2003 World Park's Conference, conservation practitioners agreed there was need for community ownership and responsibility over assessing and addressing human wildlife conflict (HWC). To be successful, improved communication on a local level between stakeholders and on a global level between experts, practitioners, local communities and international conservation organizations would be required. Guidance manuals, processes and systems needed to be developed, and HWC mitigation needed to be supported by international political and legal institutions.

In 2007 and again in 2012, government representatives, non-government organizations (NGOs) and the International Union for Conservation of Nature (IUCN) Species Survival Commission's (SSC) Cat Specialist Group met to develop regional strategies for the survival of cheetahs [20–22]. Since then, strategies for the three regions of Africa have been developed: central, west, and southern, eastern and north. The Range Wide Conservation Plan is a joint initiative of the Wildlife Conservation Society and the Zoological Society of London, in partnership with the

Cat and Canid Specialist Groups of the IUCN/SSC. These strategies have created a structure under which government programs could be developed, thus enabling conservation action on a national level. Subsequently, National Action Plans have been developed in 13 cheetah range countries [14, 20–23].

Today, cheetah research and conservation programs are found in Botswana, Iran, Kenya, Namibia, Tanzania, South Africa, and Zimbabwe [14]. Furthermore, cheetah research and training has been conducted in countries such as Algeria, Angola, Benin, Ethiopia, Mozambique, Niger, Zambia and Somaliland [26].

Community-based, natural resource management NGOs are also working with many communities throughout Africa to develop integrated programs incorporating tourism development and economic incentives to diversify livelihoods for its citizens [62]. Through outreach programs focusing on agricultural education, farmers are being taught about livestock health and management along with grasslands, wildlife and basic principles of ecology [19, 60]. Conservancies—collaborative partnerships of neighboring farms united by common operating principles—are being formed to implement standardized land management techniques that benefit people, livestock and wildlife [33, 49, 63, 64]. Examples of successful conservancies are being used to provide the basis for developing large-scale trans-boundary land management plans for the future [64].

Conservation biologists increasingly underscore that national parks and reserves alone are not large enough to sustain the wildlife they were created to protect. This is particularly true for the cheetah [25, 65]. Therefore, the focus on conservation of private land is crucial. Conservancies are one of the most important solutions for cheetah survival as they promote sustainable management of natural resources and development of responsible eco-tourism [64]. Conservancies give communities a vested interest in the welfare of local wildlife by giving them control over the economic benefits from wildlife populations. As a result, fewer problems with poaching are experienced and human-wildlife conflict is reduced [49].

With populations dwindling through most cheetah-range countries, cheetah survival depends on people using an informed, integrated approach to conservation. Education is the foundation and must include communication, information sharing and capacity building [60, 66]. In 2005, CCF began conducting month-long courses to bring together conservation managers, scientists, and community representatives from African cheetah-range countries and Iran [66]. The courses build capacity, with a goal of stabilizing cheetah populations. More than 300 participants are now managing cheetah and wildlife conservation programs in their own countries.

At the same time, research into ways to conserve and restore habitat for cheetahs and farmers is also important by working with local livestock farming communities, to help improve their livelihoods. Assigning economic value to cheetahs and having a thriving population on the landscape is key. Training programs have been developed by the Cheetah Conservation Fund that address human-wildlife conflict called Future Farmers of Africa (FFA) [66]. FFA teaches best agricultural practices to rural farmers to help them manage integrated wildlife and livestock farmlands. FFA also teaches how non-lethal predator control methods can reduce predation losses. The use of livestock guarding dogs is included in this course. CCF has helped develop similar programs throughout the cheetah's range. Many of these methods of reducing predator conflict are also applicable or adaptable to other animals such as mountain lions, jaguars and wolves, and have been used as models elsewhere in the world.

FFA covers topics like livestock health, veterinary care, husbandry, and valuation as well as wildlife and rangeland management, methods of non-lethal predator

control, predator identification and best practices to reduce livestock losses including the use of kraals, birthing camps as well as seasonal, coordinated breeding. The use of a livestock guarding dog has been shown to be a very effective tool and is included in training [67] (see **Figure 3**). The Anatolian shepherd or Kangal dogs have been used for thousands of years in the Turkish region of Anatolia as livestock guarding dogs, where they were formidable guardians of livestock against bears and wolves [69–71].

Since 1994, the Cheetah Conservation Fund (CCF) in Namibia, has bred and placed these dogs with livestock farmers to reduce conflict with livestock and reduce the killing of cheetahs and other predators. Farmers who use CCF LGDs report a decrease in predation rates ranging over 80% [70, 72]. Simultaneously, LGDs reduce the killing and capture of cheetahs and other predators [72, 73]. The dogs have been so successful, similar programs in South Africa, Botswana and in Tanzania [68].

Increasingly, today's consumers rely on product labels to guide their purchases, and at the same time, are willing to pay a premium price to ensure a product's providence. In 2000, CCF conceptualized the Cheetah Country—Eco-Labeling Program to encourage predator-friendly farming techniques in producing beef, goat cheese, crafts, honey and wine [49, 62]. Under the brand *Cheetah Country*, CCF hopes to transform the perception of cheetahs from vermin that threaten farmers' livelihoods into that of a precious natural resource fostering tourism and economic development. The eco-label certifies a product meets or exceeds a set of consistent standards for environmental protection or social justice. Cheetah Country Beef, the eco-label for cattle farmers who ascribe to predator-friendly farming practices, has not yet been launched, however, under the voluntary certification, farmers would sign an agreement stating they will not indiscriminately kill cheetahs on their farmland and in return, they would receive a price premium for their meat [49, 62, 74]. The extra money will help farmers cover the cost of implementing non-lethal predator control measures, like the cost of calving kraals or keeping a livestock guarding dog [49]. The most successful example of an eco-label in food production is dolphin-friendly tuna, a concept that has gained traction around the world. Wildlife Friendly Enterprise Network (WFEN), an international organization that promotes conservation through facilitation and certification of responsibly-produced agricultural products is putting these concepts to use for cheetahs as well, if WFEN's standards for certification are met [62].



Figure 3.
A goat herd protected by a livestock guardian dog in Namibia. Turkish Anatolian shepherd and Kangal dogs are bred and placed with livestock through the Cheetah Conservation Fund in Namibia.

7. Conclusion

The outlook for the cheetah is today in human's hands. Cheetah populations can rebound. But humans also have the capacity to save them. In many parts of Africa, cheetahs and other large predators are viewed as threats to human livelihoods, rather than species vital to maintaining healthy, balanced ecosystems. Good livestock management can protect herds while allowing prey and room for cheetahs and other predators. Having thriving cheetah populations also brings economic value to land as they and other predator species help drive tourism.

Implementation of more programs now is critical, so future generations will benefit from having cheetahs on earth. Continuing to expand our scientific research will be important (**Figure 4**), while collaborating with international institutions in fields such as cheetah health, genetics, reproduction, ecology to establish population numbers, as well as expanding training and capacity building programs will be key in cheetah conservation, while expanding efforts to stop the illegal cheetah trafficking. If we wait much longer, we will lose this amazing feline icon of speed and grace. A holistic approach that considers all stakeholders is critical to balance the needs of people, wildlife and the land and try to make their efforts sustainable. This way, the communities are more likely to be good stewards of wildlife. The end goal to save the cheetah is to achieve coexistence. This is the only way to ensure a permanent place for cheetahs on Earth.

Education and outreach are key in building awareness for the cheetah's plight and for developing sustainable practices that alleviate pressure on the species. Looking to the future, teaching conservation and instilling a high regard for the environment among young learners will help cheetahs secure a permanent place on Earth.

Creative approaches are also necessary. The future of the cheetah will require enhancing the livelihoods of the human communities that live alongside them. These include developing alternative income sources, such as eco-tourism, economic incentives for predator-friendly products. The concept is that farmers in cheetah range areas can be monitored and certified as practicing predator-friendly livestock management. In return for being good stewards to the cheetahs on their land, these farmers can be certified with the Cheetah Country eco-label and receive premium prices for their products [49, 62]. A program in development, its model



Figure 4. Satellite collars allow monitoring of cheetahs movements. Through understand the cheetah's use of their large home ranges (ave. 1500 km²) allows for management plans can be used with rural communities to plan for the cheetahs' survival in the future.

could serve to protect all of the world's predators, each of whom are threatened by conflict with humans and yet are vital to maintaining the health and biodiversity of their ecosystem.

Despite all of the problems facing the cheetah, including genetic uniformity, competition with other large predators, destruction of habitat and conflict with humans, this iconic animal has survived for thousands of years. Cheetahs continue to fulfill their ecological role as the fastest mammalian apex predator on land. With integrated conservation programs across large landscapes, survival of cheetahs for future generations can be attained [26].

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