Namibian Journal of Environment

Environmental Information Service, Namibia for the Ministry of Environment and Tourism, the Namibian Chamber of Environment and the Namibia University of Science and Technology.

The *Namibian Journal of Environment* (NJE) covers broad environmental areas of ecology, agriculture, forestry, agro-forestry, social science, economics, water and energy, climate change, planning, land use, pollution, strategic and environmental assessments and related fields. The journal addresses the sustainable development agenda of the country in its broadest context. It publishes two categories of articles. **SECTION A: Peer-reviewed papers** includes primary research findings, syntheses and reviews, testing of hypotheses, in basic, applied and theoretical research. **SECTION B: Open articles** will be editor-reviewed. These include research conference abstracts, field observations, preliminary results, new ideas and exchange of opinions, book reviews.

NJE aims to create a platform for scientists, planners, developers, managers and everyone involved in promoting Namibia's sustainable development. An Editorial Committee ensures that a high standard is maintained.

ISSN: 2026-8327 (online).

Editor: J IRISH

SECTION A: PEER-REVIEWED PAPERS

Recommended citation format:

Vebber L, Noack J, Heyns L, Rodenwoldt D & S Edwards (2020) Rehabilitated cheetahs exhibit similar prey selection behaviour to their wild counterparts: A case study of prey selection by rehabilitated cheetah released into an enclosed reserve in north-central Namibia. *Namibian Journal of Environment* 4 A: 13-19.

Cover image: LANDSAT 5 TM / Acquisition date: 09.05.2009 / False Natural Color Composite (RGB: 5,4,3) / Source: USGS Earth Explorer

Rehabilitated cheetahs exhibit similar prey selection behaviour to their wild counterparts: A case study of prey selection by rehabilitated cheetah released into an enclosed reserve in north-central Namibia

L Vebber[1], J Noack[2], L Heyns[2], D Rodenwoldt[2], S Edwards[2]

URL: http://www.nje.org.na/index.php/nje/article/view/volume4-vebber
Published online: 11th March 2020

[1] Miami University, Department of Biology, 13 Peabody Hall, Oxford, OH 45056, United States. vebberl@miamioh.edu
[2] AfriCat Foundation, PO Box 1889, Otjiwarongo, 9000, Namibia. research@africat.org

Date received: 28th October 2019; Date accepted: 4th March 2020.

ABSTRACT

A major challenge for cheetah (*Acinonyx jubatus*) conservation is locating suitable areas to release captive-raised cheetahs that meet their need for large home ranges, whilst protecting them from human-wildlife conflict. The AfriCat Foundation has been rehabilitating and releasing cheetahs onto Okonjima Nature Reserve (ONR) near Otjiwarongo, Namibia, from 2000-2018. We analysed kill data for rehabilitated cheetahs on ONR to determine if captive-raised cheetahs exhibit similar prey selection to their wild counterparts. Between August 2017 and November 2018, a total of 65 kills made by seven cheetahs, comprising two sibling coalitions and three solitary individuals were recorded and analysed. Results suggest captive-raised cheetahs can hunt successfully, although all cheetahs in ONR required supplemental feeding for variable periods immediately after release. Once they were successfully hunting, rehabilitated cheetahs demonstrated similar prey selection behaviours to wild cheetahs. The ONR cheetahs selected prey based on size and local species abundance, and showed little difference in prey diversity across cheetah groupings. This study builds on previous studies into cheetah prey-selection behaviour, and can provide insight into choosing release sites for cheetahs, creating cheetah coalitions in captivity before release, as well as managing released cheetahs living with humans and other predators in smaller, fenced reserves.

Keywords: *Acinonyx jubatus*; cheetah; Namibia; prey selection; rehabilitated.

INTRODUCTION

Cheetahs (*Acinonyx jubatus*) were historically found across most of the African continent. However, due to human population growth, habitat loss, illegal wildlife trade, and human-wildlife conflict, they have been reduced to 9% of their former range in the last 40 years (Marker *et al*. 2018b). Cheetahs are classified as 'Vulnerable' and 'Decreasing' by the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species (Version 2019-3), with an estimated population size of 7,100 in 2015 (Durant *et al*. 2015). However, a more recent and comprehensive estimate by Weise *et al*. (2017) indicates the number is likely closer to 6,800. These estimates, paired with population growth modelling, have prompted Durant *et al*. (2017) and Weise *et al*. (2017) to recommend cheetahs should be uplisted to 'Endangered' status. Namibia is home to approximately 1,500 cheetahs, the largest number of wild (free-ranging) cheetahs left in any country in the world (Marker *et al*. 2018b).

Two key reasons for the declining cheetah population are human-wildlife conflict outside of protected areas, and their position as subordinate predators to lion (*Panthera leo*), spotted hyaena (*Crocuta crocuta*), and leopard (*Panthera pardus*) when living inside protected areas. Cheetahs require larger home ranges compared to other predators; male home ranges in Namibia have been recorded as large as 1,595 km^2 (±1,151 km^2) (Melzheimer *et al*. 2018). Weise *et al*. (2015) found during long-term monitoring of translocated cheetahs that less than 5% of public or private protected areas in Namibia were large enough to keep cheetahs from leaving the protected boundaries. Because of this, more than 80% of cheetahs in Namibia live outside of protected areas on farmlands and communal conservancies where they can roam freely over vast areas with fewer people and fewer predators to compete with for resources (Durant *et al*. 2017, Marker *et al*. 2018a).

Free-roaming cheetahs can cause human-wildlife conflict among both game and livestock farmers. Domestic livestock and game farming support 70% of the Namibian population (Powell *et al*. 2017). Human-caused cheetah mortality from retaliatory and preventative killing due to real and perceived livestock and game losses is responsible for the most deaths (Lindsey *et al*. 2013). Although they are protected, the Namibian government allows cheetahs to be killed or captured if people or livestock are in immediate danger (Marker *et al*. 2018b). The responsibility of reporting carnivore killings is on the farmer, but many do not report fatalities. Therefore,

the true number of cheetah losses per year is unknown (Marker *et al*. 2018b).

Translocation and lethal removal of adult 'problem' cheetahs to mitigate human-cheetah conflict are common practices on farmland in Namibia (Weise *et al*. 2015). However, a recent study in Botswana estimated only 18% of translocated cheetahs survived one year after translocation (Boast *et al*. 2016). Furthermore, 63.6% of farmers who moved cheetahs off their land did not perceive a decrease in predation (Boast *et al*. 2016). In spite of poor long-term results, either translocation or bringing cheetahs into permanent captivity are often the only options to avoid lethal control (Revised National Policy on Human Wildlife Conflict Management 2018). However, the goal of cheetah conservation is to keep their populations viable in the wild, not captivity. Hauser *et al*. (2011) conducted extended post-release monitoring of captive-raised cheetahs in a fenced reserve in Botswana, and found cheetahs developed the skills to sustain themselves in the wild, but all of the cheetahs in the study were killed by humans within days of leaving the fenced reserve (Hauser *et al*. 2011). Less than 5% of the wild cheetah population lives in protected areas, further supporting the theory that the best chance for long-term cheetah survival is enabling them to range freely on farmlands (Durant *et al*. 2017).

Finding safe areas where conflict-translocated cheetahs can be released is increasingly difficult. Furthermore, when dependent juveniles accompany their captured mothers into box traps or stay within the vicinity of a trapped mother, they are often surrendered alive to non-government organisations (NGOs). These juvenile animals, unable to survive independently in the wild, are usually captive-raised, which poses the dilemma of where to place these animals once they become adults. The AfriCat Foundation, based on the Okonjima Nature Reserve (ONR), north-central Namibia, chose to release captive-raised cheetahs into the ONR where constant post-release monitoring could be conducted to monitor the success of such individuals. The ONR is equipped with a predator-proof electric fence perimeter, which prevents the cheetahs from moving into surrounding farmlands and potentially causing further human-wildlife conflict. Whilst adult captive-raised cheetahs demonstrated the ability to hunt independently, the high density of leopards within the ONR was found to be a major source of cheetah mortality, with interspecific encounters accounting for 71% of all known causes of death. In a 2015-2016 density survey, Noack *et al*. (2019) estimated 14.51 adult leopards per 100 km^2 in ONR, compared to 3.60 per 100 km^2 in the commercial farmlands bordering the Waterberg Plateau Park, which is approximately a 100 km straight line distance from the study site (Stein *et al*. 2011). In 2019, the decision was made to bring the cheetahs back into captivity and stop future releases into the ONR.

There is a substantial body of literature exploring several aspects of prey selection among wild cheetahs, including wild-caught and translocated cheetahs, but minimal research about different demographics of rehabilitated, captive-raised and released cheetahs (Hauser *et al*. 2011). The few released-cheetah studies looked at the species as a whole, and suggest they exhibit similar hunting, killing, and feeding behaviour to wild cheetahs (Hauser *et al*. 2011). However, studies have shown captive-raised cheetahs have a lower survival rate than wild-caught cheetahs once released into the wild (Jule *et al*. 2008). Released cheetahs are often housed with other cheetahs and form different coalitions in captivity than those found in the wild. Coalitions with both males and females, and unrelated individuals are common, compared to the wild where most coalitions are all male, and females are solitary unless they are raising cubs (Hilborn *et al*. 2018).

We analysed existing data from an aerial population density and census survey of ONR, as well as sightings of cheetah kills on ONR. We aimed to discern if the prey selection of released cheetah groups reflected the findings for free-ranging cheetahs, and the role cheetah groupings, sexual dimorphism, prey diversity, size, and abundance play in prey choices. Our findings could guide future research into increasing the success rate of released cheetahs on both farmlands and in fenced reserves.

METHODS

Study Site

This study was conducted in the Okonjima Nature Reserve (ONR), a 200 km^2, privately-owned, fully fenced reserve which lies approximately 50 km south of Otjiwarongo, north-central Namibia. The ONR perimeter fence traces a central plateau, at an average altitude of 1,600 metres, surrounded by the Omboroko Mountains. The electrified perimeter was erected in 2010 and is largely impenetrable to wildlife. Two tourism lodges, staff housing and offices are situated in the south-east section of the reserve, and the 20 km^2 surrounding these buildings is also enclosed with an electric wildlife proof fence, resulting in a total of 180 km^2 of the ONR in which a variety of wildlife, including leopards, spotted and brown hyaenas (*Parahyaena brunnea*), and cheetahs reside. The reserve receives an average annual rainfall of 450 mm, which falls during the hot, wet season from October to March. The vegetation is predominantly tree and scrub savannah, interspersed with silver Terminalia (*Terminalia sericea*) and several Acacia species. Perennial water is provided from 18 artificial waterholes across the reserve.

ONR is home of the AfriCat Foundation. Founded in 1991, the core mission of AfriCat is to conserve Namibia's large carnivores in their natural habitat (AfriCat 2018). It has been rehabilitating and releasing captive-raised cheetahs into its 200 km² private wildlife reserve for 18 years, and since 2000, a total of 53 cheetahs have been released into the ONR (AfriCat 2018). Released individuals were fitted with very high frequency (VHF) collars to enable post-release monitoring to be conducted, with individuals being located on a daily basis. When an individual was located and visually sighted, its location, behaviour and any kills were recorded.

Data collection

Cheetah kill data used for this study were collected from August 2017 to November 2018, and were recorded by the AfriCat research team and guides during early morning and late afternoon tourist game drives. There were less data recorded during the rainy season (October-March) due to the low season for tourism and fewer game drives. An aerial survey was conducted in August 2018 to estimate game counts and densities of larger herbivores. There are no population estimates for smaller potential prey species such as duiker (*Sylvicapra grimmia*), Damara dik dik (*Madoqua kirkii*), scrub hare (*Lepus saxatilis*), warthog (*Phacochoerus africanus*), bat-eared fox (*Otocyon megalotis*), and aardwolf (*Proteles cristata*), all of which require a ground survey for accurate counts.

Data were collected from seven released cheetahs, including two sibling coalitions and three solo cheetahs (Table 1). Coalition A was comprised of two brothers (1M and 2M). Coalition B consisted of two brothers (4M and 5M) and one sister (3.0F), who were brought to AfriCat when they were less than three months old. They had difficulty hunting after their first release in 2012, and were brought back into captivity to serve as ambassador cheetahs. Five years later, they were released again, and lived in the reserve until each of them died of old age. The female (3.0F), became solitary (3.1F) after the death of her brothers, and was a successful hunter until she died in September 2018. Two of the solo cheetahs are female (3.1F and 7F), and one is male (6M). All rehabilitated cheetah required supplemental feeding immediately after release until they began hunting. Supplemental feeding periods ranged between one week and seven months. Data considered here reflect the times when cheetah were successfully hunting on a regular basis.

Table 1: *A key of the cheetah social groupings observed in Okonjima during the study period, Aug 2017-Dec 2018.*

Name	Sex	Notes
Coalition A		Two male siblings
1M	M	
2M	M	
Coalition B		Two males & one female sibling
3.0F*	F	*In coalition Sept-Nov 2017
4M	M	
5M	M	
Solitary Cheetah		
3.1F**	F	** Alone May-Sept 2017; Nov 2017-Sept 2018
6M	M	
7F	F	

Due to the low sample size (65 total kills) and to enable comparisons of results with published literature, we grouped the prey species into small (<15 kg), medium (15-46 kg), and large (>47 kg) categories (Table 2). Juveniles and adults of the same species were treated separately because of the

Table 2: *Size classifications of observed prey species. Weight categories devised from Hayward et al. (2006b). Juvenile weight calculated as 70% of adult weight.*

Small (<14 kg)	**Medium (15-46 kg)**	**Large (>47 kg)**
Aardwolf *Proteles cristata*	Duiker *Sylvicapra grimmia*	Eland *(*J) *Taurotragus oryx*
Bat-eared fox *Otocyon megalotis*	Impala (J) *Aepyceros melampus*	Gemsbok (J) *Oryx gazella*
Dik dik *Madoqua kirkii*	Impala	Kudu (J) *Tragelaphus strepsiceros*
Scrub hare *Lepus saxatilis*	Springbok (J) *Antidorcas marsupialis*	Red hartebeest *Alcelaphus buselaphus caama*
Steenbok *Raphicerus campestris*	Warthog (J) *Phacochoerus africanus*	Mountain zebra* (J) *Equus zebra*
	Warthog	Plains zebra* (J) *Equus quagga*

J = juvenile

** Both zebra species are present in the study area and have been combined for analysis*

Table 3: *Observed kill data for Okonjima cheetah, Aug. 2017-Dec. 2018.*

		Coalitions		Solo Cheetah		
Observed Prey Species	**Total Kills**	**A (MM)**	**B (MMF)**	**3.1F**	**6M**	**7F**
Aardwolf	1		1			
Bat-eared fox	3		1		1	1
Duiker	8	1	2	3		2
Dik dik	4			3	1	
Eland (juvenile)	1	1				
Gemsbok (juvenile)	2		2			
Impala (juvenile)	4	2	1	1		
Impala	6	3				3
Kudu (juvenile)	6	2	2	1	1	
Red hartebeest	1	1				
Scrub hare	5			1		4
Springbok (juvenile)	3	2				1
Steenbok	9	2	1	3	1	2
Warthog (juvenile)	5	2	1		2	
Warthog	1				1	
Zebra (juvenile)	6				6	
Unidentified	5*	2*	1*	1*	1*	
Total Observed Kills	**70*/65**	**16**	**11**	**12**	**13**	**13**

**Unidentified kills were not included in analysis.*

significant weight differences between the developmental stages.

We compared the prey species taken by each cheetah grouping. However, due to the small samples, statistics were not used on the data.

RESULTS AND DISCUSSION

During the data collection period, a total of 70 kills comprised of 14 different species were recorded. The species could not be identified for five of the kills, and those were removed from data analysis. The raw data (Table 3) shows, when combining all cheetah kills, steenbok was preyed upon the most (14%), followed by duiker (12%), and impala, juvenile kudu, and juvenile zebra, all at 9%. The solitary male (6M) showed a selection for juvenile zebra, comprising 46% of his kills. Solitary female 7F selected scrub hare 31% of the time.

Medium-sized prey made up the largest percentage of all cheetah kills (42%), and 63% of the male coalition kills (Figure 1). The solitary male took the highest proportion of large prey (54%), and the solitary females took the highest percentage of small prey (56%).

ONR's solitary male cheetah's 54% proportion of large kills is a result of his selection for juvenile zebra. This data is unusual because previously, male coalitions have been documented killing the largest prey of all cheetah groupings (Clements *et al*. 2014, Tambling *et al*. 2014, Rostro-Garcia *et al*. 2015, Mills & Mills 2017). In their comprehensive study of cheetahs in the southern Kalahari Desert of Botswana, Mills and Mills (2017) suggest that solo males have a similar diet to solo females, favouring small and medium sized prey. They also hypothesise that individual cheetahs can have long-term prey species preferences that are not significantly correlated to other widely accepted factors such as size and abundance. The rank of cheetah groupings choosing large prey (Figure 1) is most likely skewed by the number of juvenile zebra taken by the solo male. Since we were only tracking one solo male, it is difficult to conclude if this male truly favours larger prey.

Solo female cheetahs (n=2) consumed 77% of the small prey recorded. Similar to the solo male who frequently hunted juvenile zebra, solitary female 3.1F most frequently hunted scrub hare. But considering small prey comprised 56% of the solo females' diet, the species selection does not contradict previous findings. Radloff and Du Toit (2004) noted that smaller prey is often underestimated because it is eaten quickly and there are no remains. Furthermore, Mills and Mills (2017) note that scrub hares are nocturnal, and are most often hunted at night, making remains and direct observations less likely. This could indicate the percentage of small prey eaten is not accurately represented across all cheetah groupings. Mills and Mills (2017) utilised scat in addition to observations to develop a more accurate record of cheetah diet, and determined solo male cheetahs relied on small prey for 50% of their nutritional needs. Without population estimates for scrub hares, it is not possible to know if the potential preference is due to abundance or size preference.

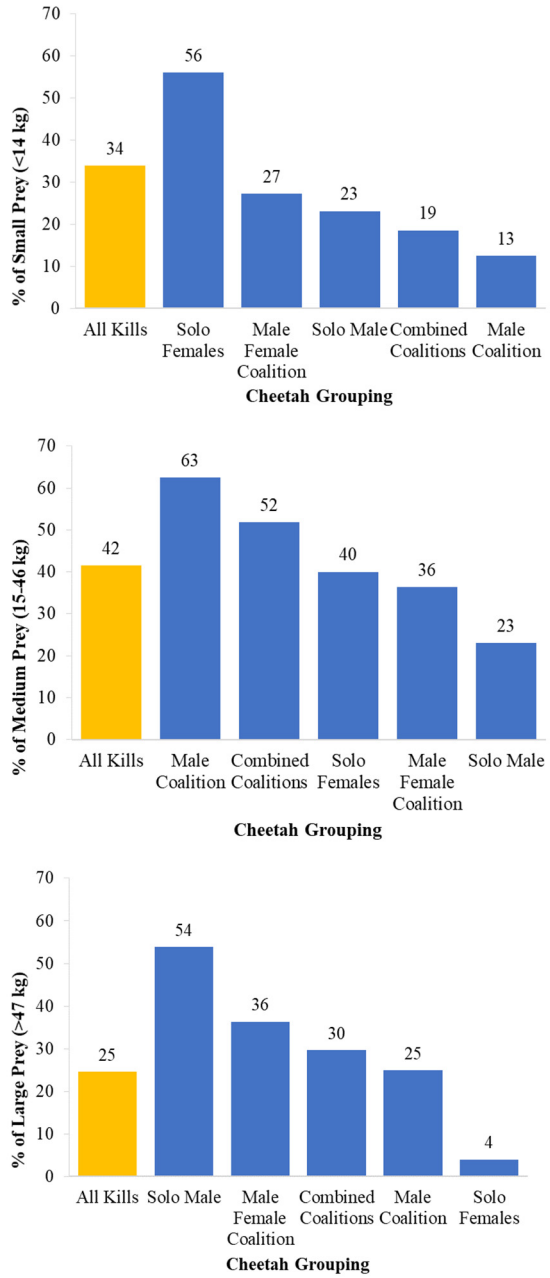

Figure 1: *Percentage of all observed cheetah kills in each prey size classification compared to each cheetah grouping*

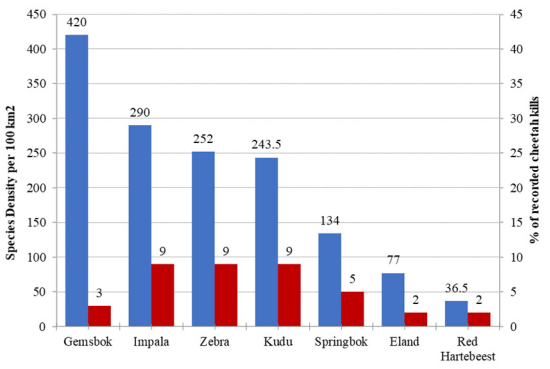

Figure 2: *Percentage of recorded cheetah kills per species (red) compared to species density on Okonjima Nature Reserve (blue).*

The lower energy expenditure and risk level of hunting small prey may also be a factor.

Bissett and Bernard (2006) studied the habitat and feeding ecology of different released cheetah groups in the Eastern Cape Province, South Africa, and their data showed the male coalition consumed larger prey (specifically kudu) 55% of the time, compared to medium-sized prey (7%). They hypothesise it was not only because kudu was the most abundant species, but because of cooperative hunting and the increased nutritional needs to sustain a male coalition. Rostro-Garcia *et al* (2015) recorded similar results in their reintroduced cheetah study in Phinda Reserve, South Africa. The male coalition in ONR clearly selected medium-sized prey (Figure 1), and did not support either Bissett and Bernard's (2006) or Rostro-Garcia *et al*'s (2015) results. However, data was based on one male coalition in each study, and requires further study with a larger sample size of cheetah social groups to draw firm conclusions.

Our data show prey abundance and size influenced prey choices of released cheetahs more than species, as has been recorded in free ranging cheetahs, which most often choose medium-sized prey weighing between 15-46 kilograms (Marker *et al*. 2003, Hayward *et al*. 2006b, Clements *et al*. 2014, Clements *et al*. 2016, Broekhuis *et al*. 2017). Medium-sized prey is easier to catch with lower risk of injury, and it can be eaten quickly, enabling cheetahs to maximise their nutritional intake before other predators can steal it (Radloff & Du Toit 2004).

We compared species proportions of all cheetah kills to the available species densities in ONR to determine if prey selection mirrored species abundance as is suggested by Hayward *et al*. (2006b). With the exception of gemsbok, which has the highest density of any species recorded in ONR, species density and observed cheetah kills exhibited a similar pattern (Figure 2). Mills and Mills (2017) hypothesise gemsbok pose too much of an injury risk for cheetahs to hunt frequently because the adults have large horns, and the juveniles are closely protected by the adults. They found that coalition males were the only group that hunted gemsbok, and only smaller juveniles.

Okonjima has a high density of kudu (243.5/100 km²), zebra (252/100 km²), and gemsbok (420/100 km²), which are often too large for solo cheetah prey, and could explain the 22% of juvenile kudu, juvenile zebra, and juvenile gemsbok kills reported in the ONR data (Figure 2). The literature indicates cheetahs most often hunt juveniles and subadults of large prey species rather than adults (Rostro-Garcia *et al*. 2015, Mills & Mills 2017). Mills and Mills (2017) disagree with Hayward *et al*.'s (2006b) assessment that abundance is the primary factor in

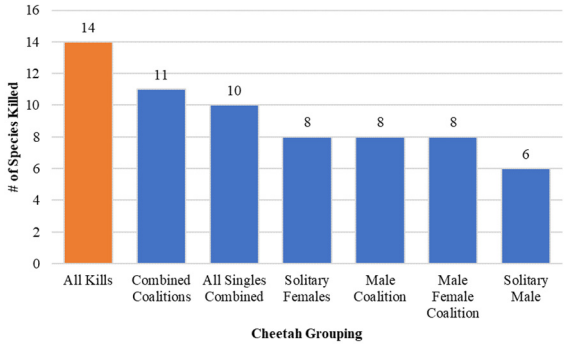

Figure 3: *Number of different species killed by each cheetah grouping compared to all species kills.*

cheetah prey selection. Their findings conclude that habitat selection, individual specialisation, opportunity, and demographic group are also important factors in prey choice.

Comparing the number of prey species used by each cheetah grouping, the results indicated virtually no difference in prey diversity between coalitions, solo cheetahs, or gender (Figure 3). The overall number of species for each grouping is very similar, and the higher diversity numbers occur when combining groupings. This validates the earlier indications that abundance and size are important factors in prey selection. However, the difference in which species were selected in each cheetah grouping suggests cheetahs could develop individual species preferences. For example, the solo male had the lowest diversity (n=6), but made the same number of overall kills as other groupings (n=13), because 46% of his kills were juvenile zebras. This corresponds with other studies that argue prey species diversity is based on the largest species a predator can kill (Clements *et al*. 2014, Radloff & Du Toit 2004). They theorise just because a predator can kill larger prey does not mean it stops hunting smaller prey as well. The coalitions have a species breadth advantage because they are able to kill a larger variety of species due to cooperative hunting (Clements *et al*. 2014). Leopards have a similar broad range, giving them the highest prey overlap with cheetahs (Hayward *et al*. 2006a). This potential competition for resources could be a contributing factor in the high number of cheetah mortalities caused by leopards in ONR.

Male cheetahs are generally 25% heavier than females, raising the question if weight difference between the sexes is a significant factor in prey selection, as is widely recorded (Marker *et al*. 2003, Radloff & Du Toit 2004, Bissett & Bernard 2006, Tambling *et al*. 2014, Clements *et al*. 2016). We compared the body weights of the males (n=5) to the body weights of the females (n=2) used in the study by performing an unpaired t-test to assess the significance of sexual dimorphism, and found no significance (t=2.09, df=5.43, p=0.08). It would be interesting to explore if this is a difference between captive-raised and wild cheetahs, but due to our small sample size, further testing is necessary.

Whilst we could not conclude that sexual dimorphism significantly impacted prey selection on ONR, demographic grouping and sex did play a role. Even though male coalitions have been well documented as the cheetah grouping taking the largest prey, it does not hold true for solo males (Clements *et al*. 2014, Tambling *et al*. 2014, Rostro-Garcia *et al*. 2015, Mills & Mills 2017). This suggests the larger body size of males does not provide a hunting advantage over females, and cooperative hunting is a bigger factor in large prey selection. Mills and Mills (2017) noted that male coalitions displayed a different diet profile than solo males, solo females, and sibling coalitions, which were all similar. In fact, the solo males in Mills and Mills (2017) consumed the highest percentage of small prey across cheetah groupings.

CONCLUSION

Whilst cheetahs continue to be trapped and shot on farmlands, the challenge of finding suitable locations to place the offspring of lethally removed individuals will persist. A key factor in determining suitable release sites will be identifying the prey base required by captive-raised individuals to survive. Here, we show captive-raised cheetahs are able to hunt successfully, and that their prey selection mirrors that of wild counterparts. Furthermore, the data suggested whilst there are species selection differences among the individual groupings, when combining all cheetah groupings, the overall prey diversity is very similar. This indicates cheetahs may be more flexible in their diet, allowing them to be successful across a range of habitats, regardless of grouping. Although the high leopard density on ONR ultimately caused the deaths of the majority of captive-raised cheetahs, our results show the ability of captive-raised cheetahs to adapt and hunt a diversity of prey species independently, suggesting such individuals may do well in areas with reduced competitor pressure.

ACKNOWLEDGEMENTS

We would like to thank the guides and guests at Okonjima Nature Reserve for recording cheetah sightings and kills. This work was completed as part of graduate work through Project Dragonfly at Miami University in Oxford, Ohio, in conjunction with the AfriCat Foundation and Okonjima Nature Reserve, Otjiwarongo, Namibia. Reviewers Dr. Matthew Hayward, anonymous at the time, and another remaining anonymous, are thanked for their valuable comments on the manuscript.

Lisa Vebber is a graduate of the Advanced Inquiry Program through Miami University (Oxford, Ohio, USA) in affiliation with San Diego Zoo Global (SDZG). The views

expressed in the article do not necessarily represent the views of SDZG.

REFERENCES

AfriCat (2018) About us. Retrieved from https://africat.org /about-us/

Bisset C and Bernard RTF (2006) Habitat selection and feeding ecology of the cheetah (*Acinonyx jubatus*) in thicket vegetation: is the cheetah a savanna specialist? *Journal of Zoology* 271: 310-317.

Boast L, Good K, Klein R (2016) Translocation of problem predators: is it an effective way to mitigate conflict between farmer and cheetahs (*Acinonyx jubatus*) in Botswana? *Oryx* 50: 537-544.

Broekhuis F, Thuo D, Hayward MW (2017) Feeding ecology of cheetahs in the Maasai Mara, Kenya and the potential for intra- and interspecific competition. *Journal of Zoology* 304: 65-72.

Clements HS, Tambling CJ, Hayward MW, Kerley GIH (2014) An objective approach to determining the weight ranges of prey preferred by and accessible to the five large African carnivores. *PLoS ONE* 9(7): e101054.

Clements HS, Tambling CJ, Kerley GIH (2016) Prey morphology and predator sociality drive predator prey preferences. Journal of Mammalogy, 97: 919–927.

Durant S, Mitchell N, Ipavec A, Groom R (2015) *Acinonyx jubatus*. *The IUCN Red List of Threatened Species* 2015: e.T219A50649567.

Durant S, Mitchell N, Groom R, Pettorelli N, Ipavec A, Jacobson *et al*. (2017) The global decline of cheetah *Acinonyx jubatus* and what it means for conservation. *PNAS*, 114: 528-533.

Hauser A, Gusset M, Bragg CJ, Boast LK, Somers MJ (2011) Pre-release hunting training and post-release monitoring are key components in the rehabilitation of orphaned large felids. *South African Journal of Wildlife Research* 41:11–20.

Hayward MW, Henschel P, O'Brien J, Hofmeyr M, Balme G, Kerley GIH (2006a) Prey preferences of the leopard (*Panthera pardus*). *Journal of Zoology* 270: 298-313.

Hayward MW, Hofmeyr M, O'Brien J, Kerley GIH (2006b) Prey preferences of the cheetah (*Acinonyx jubatus*) (Felidae: Carnivora): morphological limitations or the need to capture rapidly consumable prey before kleptoparasites arrive? *Journal of Zoology* 270: 615–627.

Hilborn A, Pettorelli N, Caro T, Kelly M, Laurenson M, Durant S (2018) Cheetahs modify their prey handling behavior depending on risks from top predators. *Behavior Ecology and Sociobiology* 2018: 72-74.

Jule K, Leaver L, Lea S (2008) The effects of captive experience on reintroduction survival in carnivores: a review and analysis. *Biological Conservation* 141: 355-363.

Lindsey P, Havemann C, Lines R, Palazy L, Price A, Retief T, Rhebergen T, Van der Wall C (2013) Determinants of persistence and tolerance of carnivores on Namibian ranches: implications for conservation on southern African private lands. *PLoS ONE*. 8(1) e52458.

Marker L, Cristescu B, Dickman A, Nghikembua MT, Boast LK, Morrison T *et al*. (2018a) Ecology of free-ranging cheetahs. In: Marker L, Boast L, Scmidt-Küntzel (eds) *Cheetahs: Biology and Conservation* 107-119. Elsevier, London, United Kingdom.

Marker L, Cristescu B, Morrison T, Flyman MV, Horgan J, Sogbohossou EA *et al* (2018b) Cheetah rangewide status and distribution. In: Marker L, Boast L, Scmidt-Küntzel (eds) *Cheetahs: Biology and Conservation* 33-54. Elsevier, London, United Kingdom.

Marker LL, Muntifering JR, Dickman AJ, Mills MGL, Macdonald DW (2003) Quantifying prey preferences of free-ranging Namibian cheetahs. *South African Journal of Wildlife Research* 33: 43-53.

Melzheimer J, Streif S, Wasiolka B, Fischer M, Thalwitzer S, Heinrich SK, Weigold A, Hofer H, Wachter B (2018) Queuing, takeovers, and becoming a fat cat: long-term data reveal two distinct male spatial tactics at different life-history stages in Namibian cheetahs. *Ecosphere* 9(6): e02308.

Mills MGL and Mills, MEJ (2017) Chapter 3: Diet. In *Kalahari Cheetahs* 31-41. Oxford University Press, New York, USA.

Noack, Heyns, Rodenwoldt, & Edwards (2019) Leopard Density Estimation within an Enclosed Reserve, Namibia Using Spatially Explicit Capture-Recapture Models. *Animals* 9(10): 724. https://doi.org/10.3390/ani9100724.

Powell L, Kazahe U, Kharuxab R (2017) Livestock farmers engage in ecotourism as a result of beliefs and attitudes toward wildlife on communal lands in Namibia. *Human Dimensions of Wildlife* 22(3): 217-230.

Radloff FGT, Du Toit JT (2004) Large predators and their prey in a southern African savanna: a predator's size determines its prey size range. *Journal of Animal Ecology* 73(3): 410–423.

Revised National Policy on Human Wildlife Conflict Management: 2018-2027. (April 2018) Ministry of Environment and Tourism. Windhoek, Republic of Namibia. http://www.met.gov.na/files/files/HWC revise Policy.pdf

Rostro-Garcia S, Kamler J, Hunter L (2015) To kill, stay or flee: the effects of lions and landscape factors on habitat and kill site selection of cheetahs in South Africa. *PLoS ONE* 10(2): e0117743

Stein A, Fuller T, DeStefano S, Marker L (2011) Leopard population and home range estimates in north-central Namibia. *African Journal of Ecology* 49: 383-387.

Tambling CJ, Wilson JW, Bradford P, Scantlebury M (2014) Fine-scale differences in predicted and observed cheetah diet: does sexual dimorphism matter? *South African Journal of Wildlife Research* 44(1) 90–94.

Weise F, Lemeris J, Munro S, Bowden A, Venter C, van Vuuren, M *et al* (2015) Cheetahs (*Acinonyx jubatus*) running the gauntlet: an evaluation of translocations into free-range environments in Namibia. *PeerJ* 3: e1346.

Weise F, Vijay V, Jacobson A, Schoonover R, Groom R, Horgan J *et al* (2017) The distribution and numbers of cheetah (*Acinonyx jubatus*) in southern Africa. *PeerJ* 5: e4096.