Determination of Prey Hair in Faeces of Free-ranging Namibian Cheetahs with a Simple Method

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Namibia is thought to host the largest population of free-ranging cheetahs *Acinonyx jubatus* and the majority of this population inhabits commercial farmland (Morsbach 1987). Some farmers consider that cheetahs prey on both livestock and wild herbivores that are valuable for trophy hunting, and this perceived offtake has generated conflict leading to the indiscriminate elimination of cheetahs from some farms (Marker *et al.* 1996). To help assess the economic cost of cheetahs on commercial farmland, information on the proportion of different prey species in their diet is required.

As it is difficult to directly assess the diet of farmland cheetahs due to their extremely shy behaviour and the small chance of finding fresh prey carcasses (Fig. 1.), we assessed the diet of cheetahs on Namibian farmland by applying a simple method originally devised for police forensic science. The method is based on the unique imprint of hair from different prey species in cheetah faeces (e.g. Keogh 1983). The study was conducted in central Namibia at two study sites of the Cheetah Research Project run by the Leibniz-Institute for Zoo and Wildlife Research, Berlin. For a report of this study see the thesis work of Jauernig (2005) in the Digital Cat Library.

Methods

Faecal samples (n = 67) were collected mainly from trees that cheetahs use to scent mark. Samples were stored in glass jars at -20°C until processing, then diluted in warm water for at least 1 hour, and hairs extracted. Intact hairs were air-dried, purified with 96% ethanol to remove blood remains, rinsed with distilled water and dried again. Hairs were then macroscopically divided into different types according to length, colour, thickness and shape. Imprints were made for 3 hairs of each type of hair.

To obtain an imprint of a hair (Fig. 2), the base or tip of the hair was held on a 0.1 x 1 x 2 cm celluloid plate with the fingertip and the free end brushed over with a small brush soaked with acetone. The hair thereby sinks into the celluloid plate. After 3 to 5 seconds hairs were removed with a pair of tweezers. Celluloid plates with imprints were fixed with Entellan on a slide and examined under the microscope at 200x magnification. Hairs were identified to species using a reference catalogue with hairs of belly and back of potential prey animals and carnivores. In contrast to conventional imprinting methods this method is simple and quick. Furthermore, imprints can be preserved for many years without loss of quality.

When calculating the proportion of different prey species in the diet of cheetahs on the basis of faecal samples, it has to be considered that the digestive efficiency, and hence the number of faeces produced, for different prey animals varies, as it depends on the prey's body size and its ratio of fur to meat. To correct for these factors we used a regression equation describing the relationship between consumed prey mass per produced faeces and average mass of presented prey species derived by Marker *et al.* (2003) from feeding experiments and calculated correction factors for each prey species. Correction factors were valid for prey species weighing between 1.9 kg and 109.5 kg (for details of analysis see Marker *et al*. 2003 and Jauernig 2005). Since age and weight of prey cannot be derived from hair structure, we used age and weight classes of prey animals that are known to be hunted by cheetahs (Mills 1984, Caro 1994, Mills *et al*. 2004) for our calculations. Estimated weights of different age classes of prey species were taken from Bothma (1999) and Marker *et al*. (2003).

Results and discussion

22 faecal samples contained hairs from both prey and carnivore species, 44 faeces contained hairs of prey species only, and in one sample the type of hair could not be identified. 18 of the 22 faeces with carnivore hairs contained cheetah hair that was likely to be ingested during grooming. The remaining four faeces contained leopard hair and were excluded from the analyses, since it was assumed that they originated from leopards.

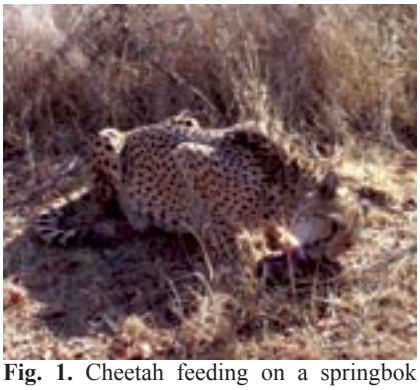

Fig. 1. Cheetah feeding on a springbok (Photo: S. A. Beaulier).

In the 18 cheetah faecal samples hairs of 8 different prey species were identified. Without correction factor, hartebeest *Alcelaphus buselaphus* and springbok *Antidorcas marsupialis* were the prey species represented most (Fig. 3a). In contrast, when correction factors were applied, spring hares *Pedetes capensis* comprised the highest proportion (0.43), followed by duikers *Sylvicapra grimmina* (0.17). Livestock (goats) and the three most valuable trophy species identified in faecal samples (kudu, hartebeest, warthog) comprised small proportions (Fig. 3b).

In the 44 faecal samples that consisted of only hair from prey species,

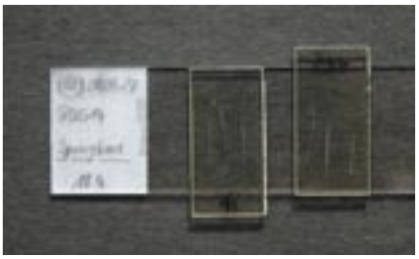

Fig. 2. Imprint of hairs of a spring hare with tips on left and bases on right celluloid plate (Photo: B. Wachter).

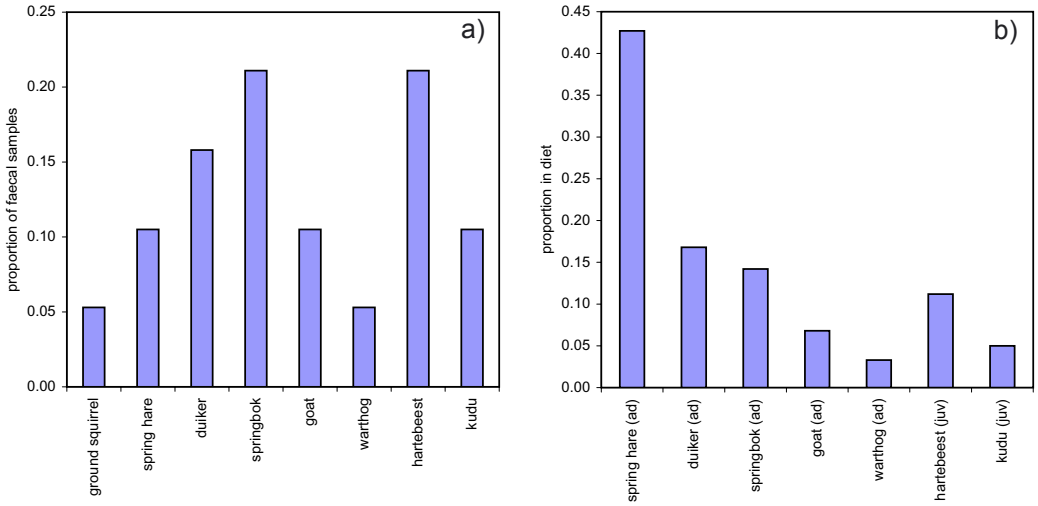

Fig. 3. Cheetah diet in this study. **a)** Proportion of faecal samples (n = 18) with hairs of different prey species. **b**) Proportion of prey species in the diet of cheetahs after application of the correction factor (excluding ground squirrels due to their small size, see method). Prey species are ordered according to their weight with the lightest species on the far left. Adult (ad) and juvenile (juv) refer to age classes that were used for the calculation of correction factors.

two additional prey species, oryx *Oryx gazella* and grey climbing mouse *Dendromus melanotis* were identified. Although a few of these 44 faeces might have originated from leopards, they were added to the 18 cheetah faecal samples for the following analysis. The corrected analysis on this sample of faeces also revealed that spring hares were the most important prey (0.43), followed by duikers (0.22), while goats comprised only a small proportion (0.04).

Our results were similar to those of a study that determined cheetah diet based on faecal samples north of our study area (Marker *et al*. 2003). In their study the main prey of cheetahs was also a small mammalian species (the scrub hare *Lepus saxatilis*), with a proportion of 0.41), while livestock comprised only a small proportion (0.04) of their diet.

In most ecosystems cheetahs preferably hunt during early morning hours and in the afternoon (Bothma 1999). Cheetahs on central Namibian farmland are likely also to regularly forage during twilight hours or at night, as illustrated by the presence of the nocturnal spring hares (Campbell 2003) in their faeces. This shift in activity pattern towards a more nocturnal foraging mode may have been facilitated by the low competition from large nocturnal carnivores such as lions, spotted hyaenas and leopards that have either been eradicated or only exist in small numbers on central Namibian farmland, and/or as a tactic to avoid persecution by humans during daylight.

Of the 101 examined types of hair, 10 could not be identified, and it is likely that most non-identified hair types were from small mammals. The hair reference catalogue will be extended to include hairs of more small mammal species, particularly of rodents. Furthermore, additional feeding experiments will be carried out to determine correction factors for mammals weighing less than 1.9 kg, and to test assumptions underlying the determination of the proportion of prey in the diet. For example, Marker *et al*. (2003) used the total weight of a prey species for their analyses including bones and hooves. How much and what parts of a given prey carcass is actually consumed by cheetahs was not considered.

This study shows that faeces collected from cheetah marking trees do not by default originate from cheetahs but sometimes also from leopards. Thus, faeces containing no predator hairs cannot be allocated to cheetahs with certainty and results from such faeces should be interpreted with caution.

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References

Bothma J. du P. 1999. Larger Carnivores of the African Savannas. J. L. van Schaik Publishers, Pretoria.

Campbell N. A. 2003. Biologie. Spektrum Akademie Verlag. Nürnberg.

Caro T. M. 1994. Cheetahs of the Serengeti Plains: group living in an asocial species. University of Chicago Press, Chicago.

Jauernig O. 2005. Beutespektrum von Geparden (*Acinonyx jubatus*) auf kommerziellem Farmland in Namibia. Studienjahresarbeit, Humboldt University Berlin, Berlin.

Keogh H. J. 1983. A photographic reference system of the microstructure of the hair of southern African bovids. Mammal Research Institute, Pretoria.

Marker L. L., Muntifering J. R., Dickmann A. J., Mills M. G. L. and Macdonald D. W. 2003. Quantifying prey preference of free-ranging Namibian cheetahs. S. Afr. J. Wildl. Res. 33, 43-53.

Marker-Kraus L., Kraus D., Barnett D. and Hurlbut S. 1996. Cheetah survival on Namibian farmlands. Cheetah Conservation Fund, Windhoek.

Mills M. G. L. 1984. Prey selection and feeding habits of large carnivores of the southern Kalahari. Koedoe suppl. 27, 281-294.

Mills M. G. L., Broomhall L. S. and du Toit J. T. 2004. Cheetah *Acinonyx jubatus* feeding ecology in the Kruger National Park and a comparison across African savanna habitats: is the cheetah only a successful hunter on open grassland plains? Wildlife Biology 10, 177-186.

Morsbach D. 1987. Cheetah in Namibia. Cat News 6, 25-26.

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