- Appendix A -

An evaluation of the techniques used for the capture, immobilization, marking and habituation of the honey badger *Mellivora capensis*

9.1 Abstract

Techniques used for capturing, marking and habituating honey badgers in the semi-arid Kalahari and more mesic Zambezi Valley are described and evaluated. Honey badgers can be successfully and safely captured in cage nets and on foot in hand nets. Radio collars provide increased signal strength, which is beneficial given the extensive home ranges of adult honey badgers, but radio implants are preferable as they are not damaged by inter- and intraspecific interactions and are more suited to an animal which catches its prey through digging. While freezebranding was a successful technique for recognizing selected individuals that were recaptured, the freezebrands were often difficult to see through the vegetation. Habituation of selected individuals provided a unique opportunity to investigate scent marking and social behaviour through direct observations.

9.2. Introduction

The honey badger, or ratel, *Mellivora capensis* is a medium-sized mustelid that is found across the greater part of Africa, south of the Sahara, extending through Arabia, Iran and western Asia to Turkmenistan and the Indian peninsula (Neal, 1990; F. Cuzin, *in litt.* 2001). Despite its extensive distribution the honey badger has not been well studied, yet it has a formidable reputation as a tenacious and aggressive carnivore (Chapter 1). During the course of a comprehensive study of the feeding ecology and social organisation of the honey badger it was necessary to locate and identify individual animals at frequent intervals. In a preliminary study, Kruuk & Mills (1983) showed that individuals can move as far as 27 km in a day, and they suggested that honey badgers might be considered nomadic. Radio telemetry was therefore considered crucial for locating individuals and for collecting information on home range and movement patterns. Both radio collars and intraperitoneal radio implants have been used successfully on other mustelids (river otters *Lutra lutra:* Melquist & Hornocker, 1979; mink *Mustela vison:* Eagle *et al.*, 1984).

Individual field recognition was also important and since honey badgers do not have external pinnae, ear tagging was not possible. Freeze branding, or cryo-branding, was considered as a suitable alternative as it is considered cost effective and long lasting (Rood & Nellis, 1980) and has been successfully achieved on mongoose species and other small mammals (Rood & Nellis, 1980). Finally, habituation of selected individuals was considered essential to gain an understanding of foraging and social behaviour through direct observations.

This paper provides detailed information on the methods of capture, immobilization, marking and habituation applied while studying the feeding ecology and social organization of the honey badger in the southern Kalahari. Additional previously unpublished information on the capture and marking of honey badgers during a preliminary study in Mana Pools National Park, Zimbabwe is also included (K. Begg, pers. comm.).

9.3. Study area

9.3.1 Kgalagadi Transfrontier Park

The main study was initiated in July 1996 and continued until December 1999 (42 months) in the Kgalagadi Transfrontier Park (KTP), which encompasses an area of 36 200 km^2 with the Kalahari Gemsbok National Park, South Africa and neighbouring Gemsbok National Park, Botswana. It is a semi desert region and is described by Acocks (1988) as the western form of Kalahari Thornveld with a very open savanna of *Acacia haemotoxylon*, *Acacia erioloba* and desert grasses. This study was primarily conducted in the central dune area, which is characterized by medium to high dunes on reddish sands where *A. haemotoxylon* appears in a shrub like form with occasional *Boscia albitrunca* and *A. erioloba* trees (Van Rooyen *et al.*, 1984.).

9.3.2 Mana Pools National Park, Zimbabwe

A preliminary study of honey badgers took place from October 1994 to February 1995 in Mana Pools National Park (MNP), Zimbabwe (Begg, 1995), an area of 2196 km^2 in the middle Zambezi Valley in northeastern Zimbabwe. The area is characterized by mature riparian (*Acacia albida* dominated) woodland growing on alluvium, with riverine thickets occurring along the tributaries. Further south, extensive areas of Mopane *Colophospermum mopane* woodland occur as well as tracts of "Jesse bush" (dense *Commiphora sp.* and *Combretum sp*. dominated thickets) growing on acidic, sandstone-derived soils (Dunham, 1992). Visibility is poor particularly during the single highly variable rainy season extending from November to April with an average rainfall of 760 mm.

9.4 Methods

9.4.1 Capture techniques

9.4.1.1 Nets

A permit for the capture of live honey badgers was obtained from South African National Parks Board. In the KTP, tourists and staff do not commonly see the honey badger and there were no known areas (i.e. refuse bins, water points) that were regularly visited by honey badgers. The lack of a central attraction point and the extensive open habitat precluded the use of cage traps. Sandy tracks and firebreaks running through the central study area were routinely driven at 10 -25 km /h at regular intervals during the study period and fresh (< 24 hrs) tracks of a honey badger that had crossed the road transects were identified by a Khomani-san tracker (K. Kruiper). The tracks were followed on foot by the tracker and one researcher until the honey badger(s) were in sight. Honey badgers were then approached downwind to within 10-50 m, chased and caught in hand nets.

Capture nets were made from polyethylene cargo mesh (area 2 m x 2 m; mesh sizes = 50 mm^2 x 3 mm; 100 mm^2 x 8 mm) sewn with 3 mm nylon braid onto a hoop (diameter = 500 mm) constructed from 10 mm steel round bar, and attached to a 1,8 m aluminium handle (diameter = 30 mm).

Captured individuals were wound up inside the net to minimize their movement and immediately hand injected in the rump with an immobilizing drug (section 9.4.2). When a radio collar needed to be replaced or removed (e.g. for an abdominal implant) the honey badger was located by radio tracking and caught in the same manner.

9.4.1.2. Drop door traps

In MNP honey badgers regularly raided refuse bins within the campsite. Two baited drop door cage traps (50 cm x 50 cm x 120 m) made from expanded metal were set in close vicinity to concrete refuse bins. Three smaller baited drop door cage traps (50 cm x 90 cm x 50cm) were made from weld mesh and designed to fit inside these refuse bins. The cage traps were custom made with a single sliding door and baited with a variety of food i.e. lightly fried beef fat, smoked fish, chicken, maize meal and honey). The traps were set from October - November 1994 and August - September 1995) and were repeatedly checked throughout the night. Captured individuals were hand injected through the side of the cage for immobilization. Following study and radio marking the honey badger was allowed to recover in the cage until it was sufficiently awake to be safely released at the capture site.

9.4.1.3 Darting

On one occasion a Co^2 rifle (Dan-inject JM Standard model) was used to inject a habituated honey badger in the KTP by means of a standard (10,5 mm; 1,5ml capacity) dart syringe. Co^2 pressure can be individually adjusted for each shot with a manometer for short range and low impact hits.

9.4.2 Immobilization

All captured honey badgers were immobilized in the field so that they could be easily handled. Two kinds of dissociative anesthetics (Cyclohexylamines) were used during capture. Zoletil R (Tiletamine hydrochloride with the Benzodiazephine derivative Zolazepam in 1:1 combination) or Ketalar R (Ketamine hydrochloride). Both have a wide safety margin, and the former is considered to be three to four times more potent than Ketamine (McKenzie, 1993). The sedative neuromuscular blocking agents Rompun R (Xylazine hydrochloride) and Domitor R (Medetomidine) were always used in conjunction with Ketamine to counter the associated increase in muscle tone commonly associated with use of this type of anesthetic. The alpha-2-agonists RX821002A and Antisedan R (Atipamezole) were used to reverse the effects of the Rompun and Domitor respectively.

9.4.3. Marking

9.4.3.1 Radio collars

In the MNP captured honey badgers were fitted with AVM transmitters (AVM Instrument Company, California), custom built by the Mammal Research Institute (M. Haupt; Department of Zoology and Entomology, University of Pretoria). In the KTP, individuals were fitted with Telonics MOD 400 (180 grams) or MOD 335 (105 grams) radio collars (Telonics telemetry-electronics consultants, Arizona). All transmitters were attached to a Telonics CLM collar (width = 4 cm; adjustable range = 27 cm – 35 cm) with a CAT-1 protective casting and a 20 cm external flexible whip antenna (Telonics; TA-5 HFT). In four collars the full length of the external antenna was entirely sewn within a butyl tab to increase strength and prevent the antenna from breaking off at the point of exit from the collar. To increase battery life (from 19 months to 22 months) the pulse rate was reduced from 70 pulses / min to 60 pulses / min. A beta-light was fastened onto the upper surface of one collar to test the feasibility of using beta-lights to follow honey badgers at night, as had been achieved in studies of the brown hyaena *Hyaena brunnea* (Mills, 1990) and European badgers *Meles meles* (Kruuk, 1989).

9.4.3.2 Intraperitoneal implants.

In both the MNP and KTP studies, selected individuals were surgically implanted with intraperitoneal radio implants IMP/400/L (Telonics; 31 mm x 94 mm) and IMP-2 (Merlin Systems; 19 mm x 105 mm) in the field, by wildlife veterinarians. The Telonics IMP/400/L has been used effectively in coyote, otter, beaver, African wild dog, and aardwolf (M. Ben-David pers. comm.; P. Richardson pers. comm.). Each implant was inserted through a 45mm incision into the peritoneal cavity and was "free floating", allowing the implant to stabilize on its own. All implants were soaked in a disinfectant (15 % Hibitane solution) for 24 h prior to surgery and rinsed in sterile water directly before implantation. Two layers of single interrupted sutures closed the wound. Animals were injected with penicillin (approximately 2 cc) before release, placed in a hole to recover and were monitored from afar with binoculars.

9.4.3.3 Freeze branding

Honey badgers captured but not radio-marked were individually marked with a freeze brand for possible later identification in the field. In addition, three radio-marked individuals were freeze branded to assess the success of the technique. Following immobilization, an area of black fur (approx. 40 mm x 40 mm) was clipped on either the shoulder or rump, shaved and cleaned with ethanol. A small (20 mm diameter) cardboard hexagon was pressed against the skin as a template. "Histofreezer" (Koninklijke Utermohlen, The Netherlands) is a cryosurgical aid used primarily by dermatologists for removal of verrucae and consists of a liquefied cryogenic gas composed of dimethyl ether and propane in a small gas canister (125 ml) with applicators. The "Histofreezer" nozzle was held gently against the skin, with the freezing agent sprayed liberally onto the skin for varying amounts of time (15 sec – 30 sec) within the template.

9.4.4 Age determination and classification

No information on ageing in honey badgers is available. For this reason the age classes used in the KTP study are presented in detail. While counting cementum annuli in teeth is known to be an accurate method of age determination in other carnivores (Kruuk, 1995), the absence of material from known age individuals for comparison and the problems with using cementum annuli in an animal living in a non-seasonal environment (Harris *et al.*, 1992) precluded using this method in this study. Since tooth wear alone is known to show large differences both between individuals and in different habitats (Harris *et al.*, 1992), information on behaviour, size and condition were also assessed. To minimize error, honey badgers were simply divided into four broad categories, den cub (0-3 months), foraging cub (3 months to independence), young adult (age 1-3 yrs), and adult (older than three years; Table 9.1).

Cubs younger than 3 months were never captured as they remained in the den and these cubs were categorized primarily by their behaviour and estimated length in relation to the adult female e.g. length of the female's head. In adults tooth wear was most noticeable on the third incisor on the upper jaw, which in young adults is noticeable different to other incisors and resembles a canine (Plate 9.1b & c), but is quickly worn down to resemble the other incisors in older badgers. It is likely that teeth of Kalahari honey badgers wear down more rapidly than teeth in other areas due to the abrasive action of the sand, as has been suggested for the brown hyaena *Hyaena brunnea* (Mills, 1990) in the same habitat.

Table 9.1: Descriptions of the age categories used in this study to assess captured honey badgers.

Age category	Overall description	Tooth wear
Den cub 0-3 months	Not foraging with mother, remained in den, < 30cm long. Obtain black& white colouration at 1 month.	"Milk" or deciduous teeth erupting
Foraging cub 3-16 months	Weaned but still dependent on mother for food, initially smaller than mother but reached adult dimensions at about 8 months (Figure 8.2). May be larger than adult female if cub is male. Bright white mantle.	Ranged from teeth still erupting (Plate 9.1a) to permanent teeth (Plate 9.1b) with no wear.
Yearling Est. 1- 3 yrs	Independent, few scars on body and in males no back scar and small testes (Plate 6.2a)	Slightly worn teeth, most noticeable on 3rd incisor and canines (Plate 9.1c)
Adult Est. 3- 8yrs	Presence of scars, In males large testes, and in older males a prominent back scar. White mantle appears to darken with age.	Moderate (Plate 9.1d) to extensive (Plate 9.1e & f) tooth wear, on all teeth. 3rd incisor no longer pointed. In older individuals teeth were frequently missing or rotten.

[1] Adult study animals followed for more than 2 years were seen to age considerably in this time i.e. teeth wear, loss of condition.

A) Foraging cub
Milk teeth -, approx. 6mths old

B) Foraging cub
Permanent teeth - 16mths old

C) Young adult

D) Adult

E) Old adult

F) Old adult

Plate 9.1: The teeth (primarily canines and incisors) of the honey badger from three age classes based on tooth eruption and wear from the KTP. Note the wear on the third incisor on the upper jaw. The worn incisors and canines of two individuals (Plate 9.1E & 9.1F) that were considered old are also shown.

9.4.5 Habituation

The openness of the KTP vegetation lends itself to visual observation (Mills, 1990). Habituation was attempted on seven radio-marked females and five radio-marked males with a goal to follow individuals in a vehicle without any obvious influence on their behaviour. On no occasion were individuals fed as it was considered likely that this would create a positive (not a neutral) association with the vehicle. The vehicle was parked on a dune crest within sight and smell of a selected honey badger in a hole (± 100 m) and remained in this position until the honey badger (s) left the hole. Each time the honey badger left the hole the engine was started, but no approach was made. After a number of attempts, the individual left the hole and moved on without running back into the hole. Initially the distance of 100 m or further was maintained whilst following the honey badger (often ahead out of sight) and the engine was kept running at all times. The objective being to allow the individual to become accustomed to the engine noise and not to threaten the animal by advancing towards it. Initially the honey badger was encouraged to dig and eat without the vehicle approaching, and then gradually the distance was reduced until individuals could be followed from 10-15 m away without any obvious effects on the behaviour of the honey badger. In the final step, inidviduals were habituated to the engine being turned on and off whilst they were foraging. On no occasion were they followed on foot and while researchers did sit on the vehicle roof or on the bonnet, they always remained within the vehicle silhouette

9.5 Results & Discussion

9.5.1 Capture success

9.5.1.1 Nets

Hand nets were used to catch honey badgers 69 occasions. This technique was considered highly efficient, with a minimal amount of stress and little potential for harm compared to the other methods e.g. dart, cage trap. On 22 captures individuals were located through spoor tracking, while radio tracking was used to relocate individuals for capture on 43 occasions, including three captures at night. Twenty non radio-marked individuals (cubs and accompanying adults) were caught when they were observed with radiomarked individuals and four honey badgers were caught after an opportunistic sighting.

The honey badger can not outrun a reasonably healthy person over a short distance (< 80 m) and will frequently turn to face the aggressor, affording an ideal opportunity for capture. On one occasion a female and large male offspring were caught in the same net. The larger net design was considered inappropriate (mesh size = 100 mm^2 x 8 mm) as a female and her offspring could escape through this mesh size and it was considered unnecessarily heavy. Although honey badgers can bite through the finer 3 mm polyethylene net, they were never observed to escape from the net as immobilization was almost immediate. For habituation purposes, no vehicles were allowed near (< 500 m) the scene of capture until the honey badger was completely immobilized. On one occasion a female honey badger was caught with the vehicle close by and this female could not be habituated.

9.5.1.2 Cages

In the MNP honey badgers were regularly seen scavenging in four concrete refuse bins in the Nyamepi tourist camp and within the staff accommodation quarters (particularly when fish was being smoked). Trap success was 29.6 % (n = 8; 27 trap nights). During the nine nights when traps were set, honey badgers were sighted on 16 occasions in the immediate vicinity (>500 m) of the traps. The main draw back of this technique was that it was non selective as three individuals were recaptured and one African civet *Civetticitis civetta* and one small spotted genet *Genetta genetta* were trapped. Captured honey badgers appeared considerably calmer inside a drop door cage compared to other canids, felids and viverrids (pers. obs.).

9.5.1.3 Darts

On one occasion a habituated honey badger (Am 4) was darted from a vehicle at close range (± 6 m). The first dart missed due to the typically unpredictable movements of the honey badger. The second dart was placed in the upper thigh area; the honey badger ran off after a defensive rattle and was relocated 12 minutes later immobilized above ground. This technique is generally not considered advisable due to the risk of the honey badger going underground before being immobilized. There was also a significant risk of missing the small target area (shoulder or thigh) and potentially harming the honey badger. The honey badger did not appear to associate the vehicle with the dart and remained habituated after capture.

9.5.2 Immobilization

Honey badgers were chemically immobilized on 73 occasions (MPP= 5; KTP = 68). Only one fatality was recorded after immobilization as a result of heat stress (ambient temperature 36^{0}C) during the recovery period. To immobilize the honey badger using Ketamine, McKenzie (1993) suggested 5-6 mg / kg, plus Xylazine at 0,5 mg / kg but in MNP higher doses (8.5 – 18 mg / kg; average 17 mg / kg) were required for successful immobilization of five adult male honey badgers. This is comparable to the dosages required (17 – 25 mg/kg) to immobilize the wolverine *Gulo gulo* (Hash & Hornocker, 1980). Recumbency occurred within three to four minutes and honey badgers were immobile for 60 - 95 min. In conjunction with Ketamine, a dose of between 1 – 12 mg / kg of Xylazine or 0,1 mg / kg of Medetomidine was also administered.

When using Zoletil, the suggested dosage was 2 - 3 mg / kg for the honey badger (Schobert, 1987; McKenzie, 1993). In the KTP, Zoletil was used successfully used on 67 occasions in the KTP with dosages ranging from 2.7 mg / kg to 9 mg / kg ($\bar{x}$ = 5.2 mg / kg). It should be noted that some of the higher doses were due to Zoletil being used months after reconstitution. Honey badgers typically recovered after 50 -180 min ($\bar{x}$ = 71 min; n = 18). The eyes were covered with a dark cloth to prevent eye damage from sunlight and to prevent stimulation from movement. During recovery, a hole (± 50 cm deep) was dug in the shade of a bush and the sedated individuals were placed in this hole with a few branches covering the entrance to provide shade.

9.5.3. Marking

9.5.3.1 Radio-marking

Radiomarking was considered essential as the honey badger does not return to a fixed den site and can move up to 40 km in 4.3 h (Chapter 5). Honey badgers were radio collared on 32 occasions (MNP = 2; KTP = 30). The transmitters from both radio collars fitted in the MNP were broken by the honey badgers within 10 days and individuals could no longer be located. Eight of the Telonics radio collars received serious aerial damage within four to seven months, with the external aerial cable broken off at the point of exit from the collar. For this reason collars were removed or replaced with implants within six months, although in one case a collar remained in tact for 15 months. To prevent aerial damage a butyl tab was sewn (± 25 cm) along the external portion of the aerial. This delayed breakage but after a few months the stitching wore out on these tabs. All collars were removed from honey badgers before the end of the battery life or at the end of the study period.

A total of 17 honey badgers were implanted (MPNP =3; KTP = 14). Both Merlin implants failed immediately despite intensive above ground tests and these individuals were never relocated. In contrast, only one of the 15 individuals implanted with Telonics implants was never relocated after implantation. Eight females (5.8 kg – 7,1 kg) were implanted and three were known to conceive and give birth after implantation. Implants lasted the full duration (20 – 22 months) and it was decided that they should not be removed since this would increased the chances of post-surgical infection and implants were frequently encapsulated within the abdomen wall (D. Grobler pers. comm.). On one occasion an implant was recovered from individual that was killed by a leopard and it showed no sign of wear. Since the honey badger appears to be short lived (3 - 8 years) in the wild, implants are considered to be of minimal threat to the individual.

Overall implants are considered preferable to collars in the honey badgers due to their active digging lifestyle and regular intra- and inter-specific interactions. However, radio implants provided a significantly weaker signal and individuals were more difficult to locate from the ground. This is an important consideration given that females have a mean home range size of 138 km^2 and males, 548 km^2 (Chapter 5). Radio collars are particularly useful for the initial few months after capture as they immediately provided information on the area use of an individual but should be replaced with implants within 3-4 months.

9.5.3.2 Freeze branding

In freeze branding the pigment producing melanocytes in the hair follicles are killed, and hair that regrows at the frozen site is white (Rood & Nellis, 1980). Freezebranding provides an effective, permanent, and in the black and white honey badger, a relatively unobtrusive method of marking individuals. In the KTP a total of 15 honey badgers were freeze branded on the shoulder or thigh. Eight individuals were never adequately re-sighted or recaptured to determine the success of this technique. One honey badger was freeze branded for 15 sec, which resulted in no visible change while a freeze brand of 20 sec resulted in a pale discoloration of the skin, but no white regrowth of the hair. Three individuals branded for 25 sec showed variable amounts of white hair regrowth. The freeze brands of two individuals branded for 30 sec were very successful, resulting in a clearly noticeable white patch of fur within two months of marking. This technique proved useful for recognizing individuals less than 50 m meters away, but freezebrands were difficult to see in dense vegetation.

9.5.4. Habituation

Direct observations allowed events such as scent marking and prey capture to be described in the behavioural contexts in which they occurred. More than 2000 h of effort were required to successfully habituate nine radiomarked honey badgers (five females with five cubs, four males). On average habituation took 14 days with large individual differences. In general males appeared easy to habituate than females and females with young cubs were the most difficult. The key to successful habituation was to separate the factors associated with capture from habituation (i.e. capture on foot vs. habituation to a vehicle) and to maintain a continuous presence for at least the first ten days. Two females could not be habituated within a reasonable time frame. The one individual was initially captured with the vehicle and would bolt into a hole at the vehicle's approach and the other had a small cub (< 3 months old). In all individuals it was necessary to visit habituated individuals at least every 6 weeks to maintain a workable level of habituation. Habituated individuals were visually observed for 5811 h, and continuous observations of selected individuals provided detailed information on sexual and seasonal differences in diet, foraging behaviour, movement patterns, scent marking and inter- and intra-specific interactions.

9.6 References

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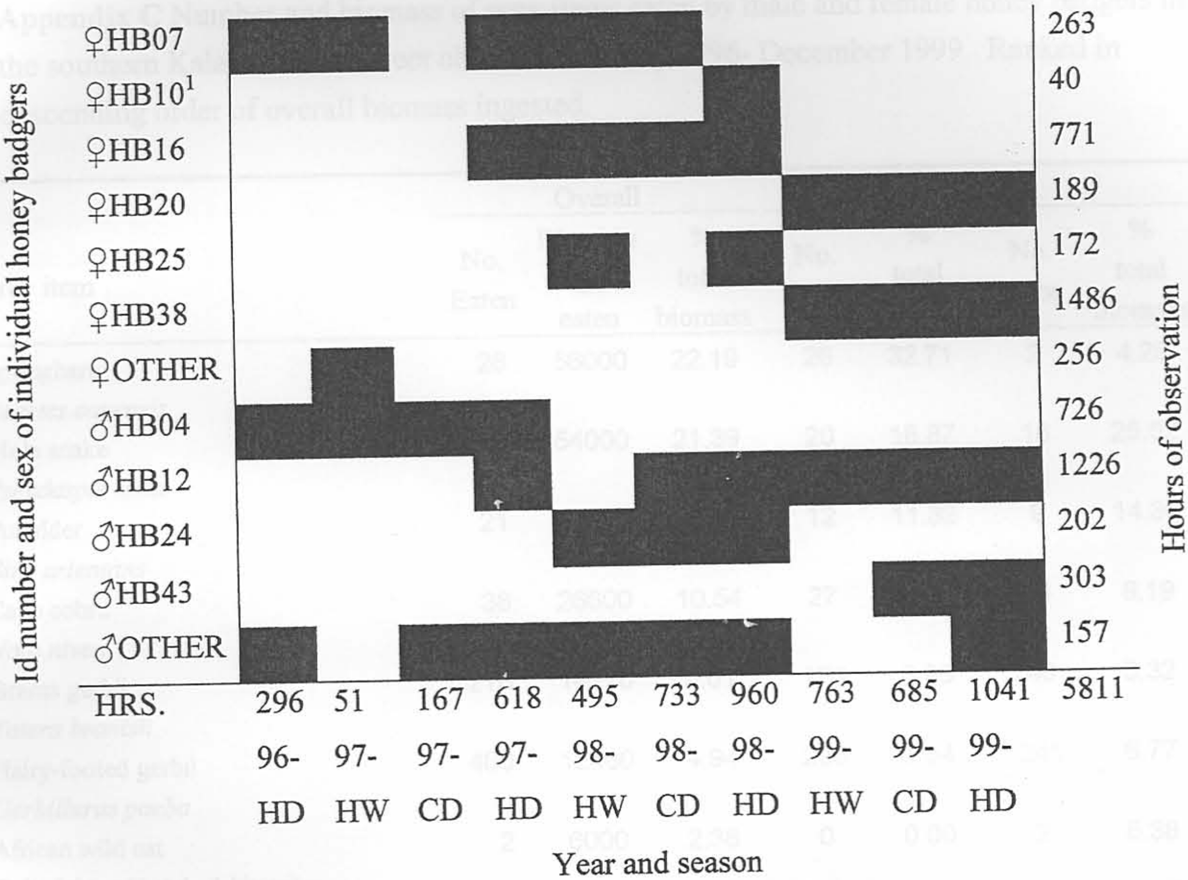
- Appendix B -



Appendix B: Year, season, and number of hours individual habituated honey badgers were directly observed in the KTP from 1996 - 1999. Where HB10 was the habituated cub of HB16 that was followed for a brief period after independence before she moved out of the study area

- Appendix C -

Appendix C Number and biomass of prey items eaten by male and female honey badgers in the southern Kalahari from direct observations: July 1996- December 1999. Ranked in descending order of overall biomass ingested.

Prey item	Overall			♀		♂	
	No. Eaten	Biomass (g) eaten	% total biomass	No. eaten	% total biomass	No. eaten	% total biomass
Springhare *Pedetes capensis*	28	56000	22.19	26	32.71	2	4.25
Mole snake *Pseudaspis cana*	36	54000	21.39	20	18.87	16	25.52
Pufadder *Bitis arientans*	21	31500	12.48	12	11.32	9	14.36
Cape cobra *Naja nivea*	38	26600	10.54	27	11.89	11	8.19
Brants gerbil *Tatera brantsii*	218	14170	5.61	170	6.95	48	3.32
Hairy-footed gerbil *Gerbillurus paeba*	480	12480	4.94	235	3.84	245	6.77
African wild cat *Felis lybica* (1 Ad., 1 kitten)	2	6000	2.38	0	0.00	2	6.38
Horned adder *Bitis caudalis*	22	4400	1.74	11	1.38	11	2.34
Common barking gecko *Ptenopus garrulous*	845	4225	1.67	631	1.98	214	1.14
Cape fox *Vulpes chama (cubs)*	5	4000	1.58	1	0.50	4	3.40
Scrub hare *Lepus saxatilis*	2	4000	1.58	0	0.00	2	4.25
Yellow mongoose *Cynictis penicillata*	6	3480	1.38	4	1.82	2	1.23
Solitary bee larvae *Parafidelia friesei* [1]	84	2983[3]	1.18	3	0.1	81	3.17
Striped mouse *Rhabdomys pumilio*	88	2816	1.12	26	0.52	62	2.11
Sand snakes *Psammophis sp.*	14	2800	1.11	11	1.38	3	0.64
Giant ground gecko *Chondrodactylus angulifer*	111	2553	1.01	78	1.13	33	0.81
Pale chanting goshawk *Melierax canorus* (chicks)	5	2500	0.99	0	0.00	5	2.66

Appendix C cont.

Prey item	Overall: No. Eaten	Overall: Biomass (g) eaten	Overall: % total biomass	♀: No. eaten	♀: % total biomass	♂: No. eaten	♂: % total biomass
Kalahari tree skink *Mabuya occidentalis*	198	1980	0.83	8	0.88	190	0.74
Striped polecat *Ictonyx striatus*	3	2100	0.78	2	0.05	1	2.02
Black korhaan *Eupodotis afra*	3	1800	0.71	2	0.75	1	0.64
Bat-eared fox *Otocyon megalotis (1SA,1cub)*	2	1600	0.63	1	0.50	1	0.85
Suricate *Suricata suricatta*	2	1400	0.55	1	0.44	1	0.74
Honey badger (cub) *Mellivora capensis*	2	1000	0.40	0	0.00	2	1.06
Yellow scorpion *Opistophthalmus wahlbergii*	190	950	0.38	177	0.56	13	0.07
Bibrons stilleto *Atractaspis bibronii*	6	900	0.36	4	0.38	2	0.32
Adder sp.	4	800	0.32	1	0.13	3	0.64
Brants' whistling rat *Parotomys brantsii*	9	720	0.29	8	0.40	1	0.09
Bicoloured quill-snouted snake *Xenocalamus bicolor bicolor*	3	600	0.24	3	0.38	0	0.00
Namaqua sandgrouse *Pterocles namaqua*	2	600	0.24	1	0.19	1	0.32
Spotted eagle owl *Bubo africanus* (chick)	2	600	0.24	1	0.19	1	0.32
Ant eating chat *Myrmecocichla formicivora*	12	480	0.19	9	0.23	3	0.13
Cape gecko *Pachydactylus bibronii*	27	351	0.14	19	0.16	8	0.11
Barn owl *Tyto alba*	1	300	0.12	0	0.00	1	0.32
Bushveld elephant shrew *Elephantulus intufi*	5	210	0.08	4	0.11	1	0.04
Short-tailed gerbil *Desmodillus auricularis*	4	184	0.07	0	0.00	4	0.20
Spotted eagle owl eggs	3	135	0.06	0	0.00	3	0.16
African rock python (juv) *Python sebae natalensis*	1	150	0.06	0	0.00	1	0.16
Damara molerat *Cryptomys hottentotus damarensis*	3	90	0.04	1	0.04	2	0.06

Appendix C. cont.

Prey item	Overall No. Eaten	Overall Biomass (g) eaten	Overall % total biomass	♀ No. eaten	♀ % total biomass	♂ No. eaten	♂ % total biomass
Common quail *Coturnix coturnix*	1	95	0.04	1	0.06	0	0.00
Termites (alates) *Hodotermes mossambicus* (34 individuals)[1]	1	68	0.03	1	0.02	0	0.00
Beetle: Scarabaeidae; subfamily:Melolonthinae (31 individuals) [1]	4	62	0.02	1	0.00	3	0.06
Pygmy mouse *Mus minutoides*	12	60	0.02	5	0.02	7	0.04
Yellow scorpion *Parabuthus raudus*	9	45	0.02	4	0.01	5	0.03
Striped sandveld lizard *Nucras t. tessellata*	4	60	0.02	3	0.03	1	0.02
Ground agama *Agama aculeate*	2	50	0.02	2	0.03	0	0.00
Lark sp.	1	60	0.02	0	0.00	1	0.06
Pouched mouse *Saccostomus campestris*	1	47	0.02	0	0.00	1	0.05
Woosnams desert rat *Zelotomys woosnami*	1	62	0.02	1	0.04	0	0.00
Maggots Order: Diptera-(8 individuals)[1]	1	16	0.01	1	0.01	0	0.00
Black scorpion *Opistophthalmus carinatus*	5	25	0.01	4	0.00	1	0.00
Black/brown scorpion *Parabuthus granulatus or kalaharicus* [2]	3	15	0.01	0	0.00	3	0.02
Black & yellow sand lizard *Heliobolus lugubris*	2	20	0.01	2	0.01	0	0.00
Scaly feathered finch *Sporopines squamifrons*	1	30	0.01	1	0.02	0	0.00
Beetle *Order: Coleoptera*	2	4	0.00	2	0.00	0	0.00
Locust *Order: Orthoptera*	2	4	0.00	0	0.00	2	0.00
Sociable weaver chicks *Philetairus socius* [1]	3	-	-	0	-	3	-
Owl pellet [4]	2	-		0		2	
Snake skin [4]	2	-		0		2	
TOTAL	**2550**	**249405**		**1526**		**1024**	

1 = Number eaten represents feeding events not individuals.

2 = Identification of scorpion remains in scats (L. Prendini; Appendix C) showed that honey badgers were eating two species of black scorpion with small pincers, the more common *Parabuthus granulatus* and the endemic *P. kalaharicus*.

3 = Biomass estimated from time spent feeding at 0.88 larvae/minute

4 = Prey items assumed to have little biomass value

- Appendix D -

Appendix D Number of hours of observation of habituated male and female honey badgers for each hour of the day in each season in the KTP.

	Hours-♀				Hours-♂			
Time of day	HW	CD	HD	Total	HW	CD	HD	Total
00h00-01h00	46.8	25	67.7	139.5	7	39.7	59.8	106.5
01h00-02h00	45.8	25	64.5	135.3	7	36.3	56.9	100.2
02h00-03h00	44.2	25	64	133.2	7	36.7	54.1	97.8
03h00-04h00	42	25	63.1	131	7	37	50	94
04h00-05h00	41	25	62.5	129	7	37	50	94
05h00-06h00	40.3	25	64	129.3	7	37.7	52.3	97
06h00-07h00	42.3	26	64.5	132.8	7	37.6	59.3	103.9
07h00-08h00	44	27.1	61.8	132.9	7	37.2	59.1	103.3
08h00-09h00	41.6	25.5	57.3	124.4	10.1	40.3	53.4	103.8
09h00-10h00	43.3	25.9	57.4	126.6	10.5	41.4	53.8	105.7
10h00-11h00	44.8	24	58.1	126.9	11.7	45.9	54.8	112.4
11h00-12h00	44.2	20.2	59.4	123.8	11.4	41.2	56.1	108.7
12h00-13h00	40.8	20.5	60	121.3	11	43.7	57.7	112.4
13h00-14h00	39	20.2	60	119.2	11	44.3	58	113.3
14h00-15h00	39	20.3	60	119.3	11.5	44.6	58	114.1
15h00-16h00	39.8	23.5	59.6	122.9	12	45.6	58	115.6
16h00-17h00	40.9	23.3	58.3	122.5	11.2	45.9	59	116.1
17h00-18h00	42.7	23.1	63.6	129.4	10.6	46.3	61.7	118.6
18h00-19h00	43.4	23.0	64.4	130.8	10.3	47.9	61.2	119.4
19h00-20h00	70.2	21.5	64.6	156.3	10.2	44.8	65.6	120.6
20h00-21h00	51.3	24.1	66.4	141.8	10.9	42	65.7	118.6
21h00-22h00	53.7	24.4	71.2	149.3	8.9	42.4	64.2	115.5
22h00-23h00	53.1	24	72.7	149.9	7.6	41.8	65.9	115.3
23h00-00h00	53	36.6	72	161.6	7.7	43.3	65	116
Total	1087	583	1517	3188	223	1001	1400	2623