Notes and records

Leopard (*Panthera pardus* Linneaus) cave caching related to anti-theft behaviour in the John Nash Nature Reserve, South Africa

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Introduction

Discussions of leopard *Panthera pardus* (Linnaeus) anti-theft behaviour usually revolve around the leopard's well documented propensity for storing carcasses in trees (Skinner & Smithers, 1990; Estes, 1991). In and around the John Nash Nature Reserve, South Africa, tree stashing behaviour was noted to be a rare event. Instead, dolomitic caves serve as more frequent caches. It is hypothesized that, when available, leopards in this region will preferentially utilize the deep recesses of caves to protect kills from theft, rather than dragging them up into trees and that this may be a general rule applied to leopard behaviour.

Materials and methods

During the course of this investigation six leopard-utilized caves were examined to characterize the nature of leopard-derived bone accumulations within the dolomitic caves. These caves were chosen specifically because leopards had been contacted in them, clearly identifying leopards as the accumulating agents. Four caves are located on the John Nash Nature Reserve, an approximately 9500 ha, privately owned game reserve 30 km north of Johannesburg, Gauteng, South Africa. Two other caves on nearby game parks (Krugersdorp Game Reserve and Motsetse Game Park) provided additional data concerning the activity of leopards in caves.

A five-year survey of leopard kills within the John Nash Nature Reserve, as well as interviews with game managers on several nearby game farms, was conducted between 1991 and 1995 to compare leopard carcass storage in trees versus caves. Over two dozen carcasses were observed directly by one of us (L.R.B.), while the remaining carcasses were recorded by game wardens. Most of the carcasses were identified as leopard kills based on spoor, while a handful of kills were observed directly.

The most common game in the John Nash Nature Reserve are blesbok (*Damaliscus dorcas* (Harper)) and impala (*Aepyceros melampus* (Lichtenstein)), although a variety of other species are also found (Table 1). Brown hyaenas (*Hyaena brunnea* (Thunberg)), black-backed jackals (*Canis mesomelas* (Schreber)) and large populations of Cape Vultures (*Gyps coprotheres* (Forster)) are also present, adding significant scavenging pressure to resident leopards. Any carcass exposed for more than a few hours is invariably discovered and eaten.

Results and discussion

The most commonly reported method by which leopards protect their kills from theft is by dragging the carcasses into the branches of nearby trees, out of the reach of competitors (Brain, 1981; Mills, 1990; Skinner & Smithers, 1990; Estes, 1991). One long-term study found that leopards took as many as 76% of their kills into trees (Le Roux & Skinner, 1989). Brain (1981) noted that leopards will also use caves as feeding retreats, and leopard-derived bone accumulations have been reported in caves in Kenya (Simons, 1966), Tanzania (Sutcliffe, 1973) and Namibia (Brain, 1981). The John Nash Nature Reserve has a number of caves within its boundaries, several of which have been mapped and reported on previously (Martini & Keyser, 1989). Most caves in the Highveldt of South Africa have trees growing in their entrances, and all of the caves in which leopard

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Table 1 Large mammals (>1 kg) commonly found in the John Nash Nature Reserve

Connochaetes taurinus (Burchell) black wildebeest
Alcelaphus buselaphus (Pallas) red hartebeest
Damaliscus dorcas (Pallas) blesbok
Antidorcas marsupialis (Zimmerman) springbok
Oreotragus oreotragus (Zimmerman) klipspringer
Raphicerus campestris (Thunberg) steenbok
Aepyceros melampus (Lichtenstein) impala
Oryx gazella (Linnaeus) gemsbok
Tragelaphus strepsiceros (Pallas) kudu
Taurotragus oryx (Pallas) eland
Redunca fulvorufula (Afzelius) mountain reedbok
Kobus ellipsiprymnus (Ogilby) waterbok
Equus burchelli (Gray) burchell's zebra
Giraffa camelopardalis (Linnaeus) giraffe
Papio cynocephalus (Linnaeus) baboon
Cercopithecus aethiops (Linnaeus) vervet monkey
Galago moholi (A. Smith) bushbaby
Panthera pardus (Linnaeus) leopard
Hyaena brunnea (Thunberg) brown hyaena
Canis mesomelas (Schreber) black-backed jackal
Civettictis civetta (Schreber) civet cat
Felis caracal (Schreber) caracal
Hystrix africaeaustralis (Peters) porcupine
Procavia capensis (Pallas) rock dassie

accumulations have been located in the John Nash Nature Reserve possessed several trees. Nonetheless, the leopards dragged carcasses into the dark recesses of the caves, avoiding the trees in cave entrances entirely.

A total of 75 leopard kills was recorded, and information pertaining to the storage of the carcasses was analysed. In 45 (60%) of the recorded cases, prey was left by the leopards in the open veldt after consumption. Of the remaining 30 carcasses, 25 (33% of the total 75) were cached in dolomitic caves or rock shelters, while 5 (7%) were dragged into trees. None of the carcasses stored in trees occurred in the vicinity (closer than 500 m) of a cave or rock shelter. In terms of anti-theft behaviour, 83% of the 30 total cached carcasses were deposited in caves and 17% were placed in trees.

One of the John Nash Nature Reserve leopard lairs, designated WU/BA-001 (de Ruiter & Berger, 2000), contained the remains of no less than eight medium and large antelope, as well as a caracal (*Felis caracal* (Screber)) and two porcupines (*Hystrix africaeaustralis* (Peters)) (Table 2). Most remarkably, the remains of an adult female eland (*Taurotragus oryx* (Pallas)) were found intact, except

Table 2 Species represented in WU/BA-001 leopard lair, John Nash Nature Reserve

Species	No. of carcasses recorded	Average live-weight (kg)
Damaliscus dorcas (Pallas) blesbok	4	61
Raphicerus campestris (Thunberg) steenbok	1	11
Taurotragus oryx (Pallas) Eland (female)	1	350–450
Redunca fulvorufula (Afzelius) mountain reedbok	2	30
Felis caracal (Screber) caracal	1	12–14
Hystrix africaeaustralis (Peters) porcupine	2	11

for the probable removal of the viscera prior to transport into the cave. Bite marks on the neck of the animal clearly indicate that the eland was killed through bite suffocation. This animal would have weighed between 350 and 450 kg alive (Skinner & Smithers, 1990; Estes, 1991). Records of kills by leopards of antelope this large are rare, although Wilson (1981) indicated that other reports of adult eland kills by leopards were known. Another leopard lair on the John Nash Nature Reserve (WU/BA-002) housed the remains of an adult zebra (*Equus burchelli* (Gray)), an animal weighing on average 300 kg (Skinner & Smithers, 1990). Yet another leopard lair on the nearby Krugersdorp Nature Reserve contained the remains of a subadult eland, estimated to be between 250 and 300 kg in weight.

Leopards are reported to be catholic in their prey preferences, and are capable of subsisting on virtually any form of animal protein (Estes, 1991). However, their diet tends to consist mainly of small to medium-sized mammals, usually less than 70 kg in mass (Skinner & Smithers, 1990). Although most of the prey in the cave WU/BA-001 fell below the normal 70 kg weight limit of leopard prey, an adult female eland was notable in that an animal this size was killed and then dragged into the deepest recesses of this cave. Whereas most kills by leopards of such large animals are juveniles, this eland was fully adult as estimated by dental eruption and epiphyseal fusion.

Prevailing local conditions and scavenging pressures force leopards to drag kills into trees to protect them from competitors, particularly if they do not have caves to

retreat into. Caves, however, probably afford leopards the opportunity to transport and store larger carcasses than do trees, as gravity will aid, not hamper, the movement of kills within caves. The recesses of caves are often inaccessible to hyenas due to the extreme angles of the slopes of the cave floors. The presence of accumulations of bones in several leopard lairs both on and around the John Nash Nature Reserve indicates that carcass storage in caves is a consistent behavioural pattern, at least in this area. The occurrence of such large animals as eland and zebra in caves also indicates that the leopards in this area are capable of transporting and caching very large prey. This preferential cave storage pattern may be applicable in other karstic areas.

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