

## Predation on the tent tortoise *Psammobates tentorius*: a whodunit with the honey badger *Mellivora capensis* as prime suspect

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The collection of 63 shells of the tent tortoise *Psammobates tentorius* in the Bushmanland Nama Karoo revealed that 49% of them had been cleanly broken open and the body of the tortoise removed. The line of the single break of the plastron approximated the humeral-pectoral joint of the overlying shields. The lack of tooth or other damage to the shells suggests that the break was effected by forcibly pulling back the anterior, projecting section of the plastron. The observation of the spoor of the honey badger *Mellivora capensis* at one such freshly killed tortoise suggests that it is the principal predator responsible for killing tortoises using this method.

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The natural predators of southern African tortoise species have been poorly documented and many records are anecdotal (Steyn 1984; Fraser 1985; Branch 1992). The pale chanting goshawk *Melierax canorus* is known to feed on tent tortoise *Psammobates tentorius* and leopard tortoise *Geochelone pardalis* hatchlings (Malan & Branch 1992). The shells of larger tent and leopard tortoises and greater padlopers *Homopus femoralis* have been found under the nests of both black eagle *Aquila verreauxii* and martial eagle *Polemaetus bellicosus* (Boshoff, Palmer & Avery 1990; Davies 1994). Kelp gulls *Larus dominicanus* are significant predators of angulate tortoises *Chersina angulata* on Dassen Island (Branch & Els 1990) and crows (*Corvus* spp.) are reported as predators of Karoo padloper *H. boulengeri* and juvenile leopard tortoises (Branch 1992). Limited field observations suggest that eagles, gulls and crows fly up with the tortoises and then drop them onto rocks to crack the shells open (Steyn 1984; Fraser 1985; Branch & Els 1990; Branch 1992). The rock monitor *Varanus exanthematicus* frequently eats tortoise juveniles (Branch 1992). Although various carnivores are known to kill and eat tortoises, particularly hatchlings and juveniles (Branch 1992), tortoises have not been formally recorded in the diet of these predators (Skinner & Smithers 1990).

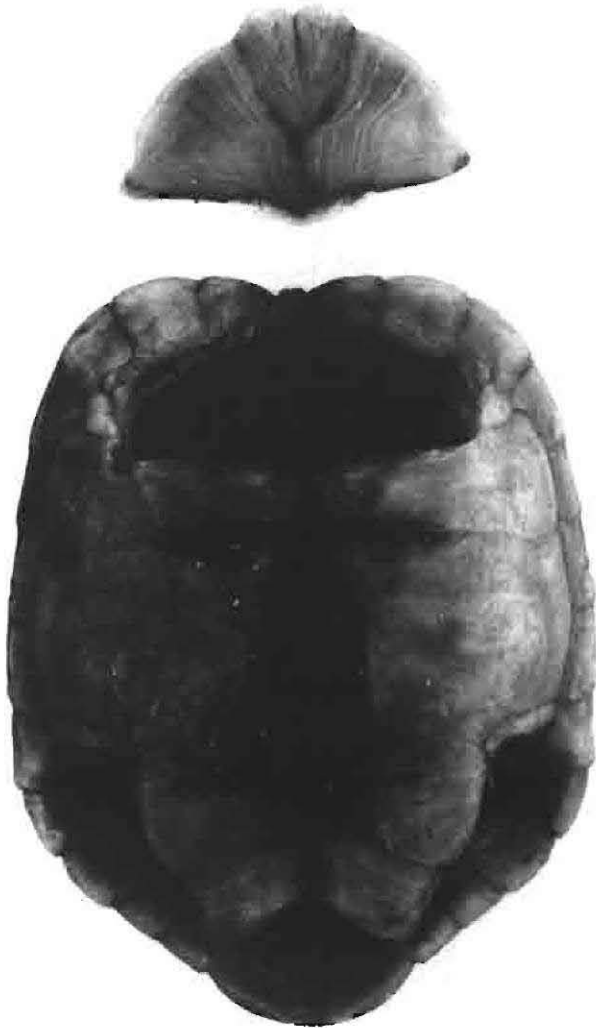
On the senior author's (PL) arrival on the farm Droëgrond (29°07'S 20°16'E) in the Kakamas district of the Northern Cape Province, the farmer (DAS) pointed out a number of tent tortoise shells in his collection, all of which were missing the anterior part of the plastron (ventral shell) that is overlain by the gular and humeral shields. Having once found the spoor of a honey badger *Mellivora capensis* at a freshly killed tortoise which had had this section of the shell broken off, DAS was of the opinion that the honey badger was the predator responsible for killing and eating tortoises in this manner. To investigate the incidence of this type of predation in greater detail, PL collected all tortoise shells he encountered during four seasons (three months each, 1993–1996) of field work on bird breeding ecology at Droëgrond. During this time, PL covered a total distance of 4 400 km on a mountain bicycle within the study area of 10 000 ha. Annual rainfall measured at a rain-gauge located centrally in the study site over the period 1958–1996 averaged 116.1 mm (range 20.5–494.2 mm; 71% coefficient of variation). The vegetation is Bushmanland Nama Karoo (Hoffmann 1996), and consists of mixed grassland (*Stipagrostis ciliata* and *S. obtusa*) and short shrubland (*Rhigozum trichotomum*, *Salsola tuberculata* and *Hermannia spinosa*) with a projected ground cover of 5–10%. Potential tortoise predators recorded at the study site

**Table 1** The condition of tent tortoise shells collected by PL and DAS on Droëgrond farm. Whole shells showed no damage to the shell and broken shells had the anterior part of the plastron missing.

		Sample: PL	Sample: DAS	Total
Whole shells	Lacking internal bones	14	–	–
	Dried body remains	5	–	–
	Total	19	13	32
Broken shells	Lacking internal bones	18	–	–
	Dried body remains	0	–	–
	Total	18	13	31

include the martial eagle, pale chanting goshawk, black-backed jackal *Canis mesomelas*, Cape fox *Vulpes chama*, caracal *Caracal caracal*, African wildcat *Felis lybica*, honey badger, yellow mongoose *Cynictis penicillata*, Cape grey mongoose *Galerella pulverulenta*, suricate *Suricata suricatta* and striped polecat *Ictonyx striatus* (pers. obs.). Densities of the blackbacked jackal and caracal have been severely depressed by rigorous predator control activities by farmers in this marginal sheep-farming region.

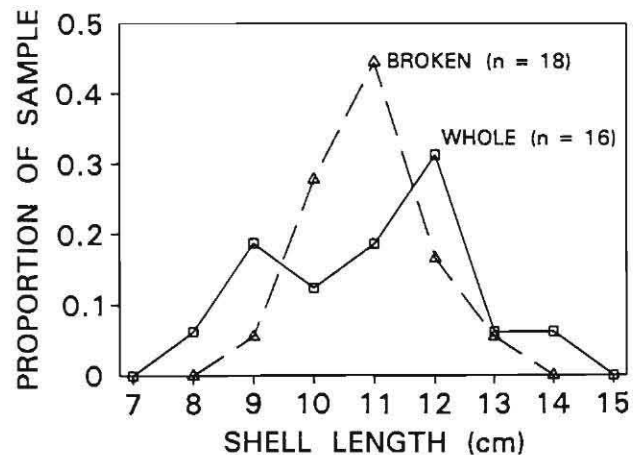
The sample of 37 shells PL collected was added to the existing 26 shell collection of DAS for analysis (Table 1). The criteria for the collection of the latter sample was the condition of the dorsal carapace, thus weathered and broken shells were ignored, whereas PL collected all shells encountered. Only the local subspecies of tent tortoise *P. tentorius verroxii* was encountered, and the shells were found scattered singly throughout the study area. Shells were classified as whole if they exhibited no damage to the shell shields. All shells classified as broken had the anterior section of the plastron (overlain by the gular and humeral shields) missing (Figure 1). The break generally approximated a straight line between the axillary shields. Interestingly, this break followed the joint



**Figure 1** A ventral view of a tent tortoise shell with the anterior section of the plastron overlain by the gular and humeral shields removed as a single, undamaged piece with a clean break through the plastron underlying the joint between the humeral and pectoral shields.

between the overlying humeral and pectoral shields, but did not coincide with any plastron suture as such. In only three shells did the break intrude posteriorly into the plastron overlain by the pectoral shields. On only two of the broken shells did a single chip to the edge of the dorsal carapace indicate possible tooth damage. Two broken shells were found with the missing fragment lying nearby. In both cases, the missing piece was whole and showed no signs of tooth or other damage. Fourteen of the 19 whole shells lacked bones internally, suggesting they may have had the body of the tortoise scraped out, although the possibility that all the bones had fallen out naturally after decomposition of the body cannot be ruled out. All broken shells lacked bones internally.

The nature of the break and the lack of damage to the rest of the shell rules out avian predation (by dropping) on the sample of broken shells collected. The lack of tooth damage to the shells suggests that the anterior plastron was forcibly pulled away from the rest of the shell by the hands of the predator to effect the break, rather than being bitten or gnawed off. Having increased the aperture of entry to the body of the tortoise, the predator removes the body contents without further damage to the shell. Consistently breaking open a tortoise shell in this manner is quite an accomplishment, and suggests a highly specialised behaviour. Because the break does not coincide with a transverse plastron suture, two bones (one on each side of the midline) are broken in half in a region designed to cope with mechanical stresses. The only carnivores present at the study site likely to possess the strength to handle a tortoise in this manner are the blackbacked jackal, caracal and honey badger. All three occur at artificially (the jackal and caracal) or naturally (the honey badger) low densities at the study site (the opinion of DAS, based on 50 years experience living here). Nonetheless, one or more of these species is responsible for at least 49% of all tent tortoise deaths on Droëgrond. These predator(s) are not limited by the size of tent tortoise they can handle – tortoises up to 13 cm in length were killed (Figure 2) and the maximum recorded length for a tent tortoise is 14.5 cm (Branch 1992). The renowned strength of the honey badger (Skinner & Smithers



**Figure 2** The size distribution of a measured sample of whole and broken tent tortoise shells collected on Droëgrond farm by PL. Length (to the nearest cm) measured as the straight carapace length along the midline (cf. Branch 1992).

1990) and the single observation of its spoor at a tortoise freshly killed in this manner, favours it as the single or principle carnivore involved in this behaviour. Although tortoises have never been recorded in the diet of the honey badger, it is a versatile and opportunistic predator (Skinner & Smithers 1990). The tortoises whose shells were not damaged but which lacked bones internally, may have been either killed or scavenged after natural death by the smaller, mongoose-sized carnivores whose hands are small enough to gain entry through the head and limb openings.

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