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Animal diversity and procurement strategies at Schroda, Limpopo Valley, South Africa

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This article presents a broad overview of excavated animal taxa and methods of procurement at the Middle Iron Age site of Schroda (AD 900–1100), located in the Mapungubwe National Park. Here, a diverse animal resource base was exploited through various strategies – some of which drew on individual participation, while others relied on group effort and resource pooling. Cattle, sheep and goat herds provided a reliable supply of meat, milk and skins throughout the year, while a range of wild mammals, birds, reptiles and fish were also hunted, trapped and collected. Although procurement strategies and animals targeted generally remained unchanged for about 200 years, there is a small shift in the proportion of livestock relative to other animals and a related increase in the exploitation of wild animals. Reliance on a broad spectrum of subsistence strategies is often done as a risk management strategy in areas with unpredictable environmental conditions. Erratic rainfall patterns, evident at the end of the first millennium in the middle Limpopo Valley, would have necessitated such an approach. In addition, the updated taxonomic list for Schroda provides a deep-time record of animal presence and expands the former distribution ranges for some taxa in the Mapungubwe National Park area.

Keywords: Middle Iron Age; Mapungubwe National Park; African zooarchaeology; subsistence economy; animal resources; zoogeography; past distribution; animal geography.

Introduction

The confluence of the Shashe-Limpopo Rivers is home to southern Africa's earliest complex society, the significance of which is encapsulated in the Mapungubwe Cultural Landscape (Figure 1). The area, part of which is today the Mapungubwe National Park (MNP), was inscribed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a World Heritage Site in 2003. This inscription acknowledges the cultural significance of the landscape. The importance of this landscape stems from the fact that the archaeological remains within its parameters chronicle the development and collapse of the Mapungubwe polity over a 400-year period (c. AD 900–1300, also known as the Middle Iron Age). Over the last several decades, archaeological research in MNP has focussed on the capitals of Mapungubwe (c. 1270–1320 AD) and its predecessor 'K2' (c. AD 1000–1200). Other important sites within the boundaries of the protected area include Schroda (c. AD 900–1100) and Leokwe Hill (12th century AD), whose histories and material culture have been studied to a much lesser degree compared to Mapungubwe and 'K2' (Abatino 2021; Calabrese 2007; ed. Fouché 1937; Gardner 1963; Huffman 2007, 2009; Meyer 1998; Wood 2011).

Schroda provides some of the earliest evidence for expanding Indian Ocean trade networks with the interior, and the middle Limpopo Valley in particular (Freeman-Grenville 1962; Hanisch 2002; Wood 2011). During the late 9th and early 10th centuries, settlements associated with Zhizo style ceramics started to appear south of the Limpopo River (see Antonites 2018; Huffman 2007 for details on ceramics and regional chronology). Settlement in the Valley may have been due to several factors. However, opportunities presented by participation in the coastal trade were probably a major consideration, especially the abundance of elephant herds and therefore ivory (Huffman 2009; see Forssman, Page & Selier 2014). During this Zhizo period (c. AD 900–1000), it is thought that much of the outgoing (e.g., ivory, skins, leather and other raw materials) and incoming trade goods (e.g. glass beads, marine shells) were channelled through Schroda, whose community rose to economic and political prominence in the region, as a result (Hanisch 2002; Huffman 2009).

Around the turn of the 11th century, the area started to attract more people, probably because of the trade connections, but also because of improved environmental conditions suited to floodplain

Note: Special Collection: Celebrating Cultural Heritage within National Parks.

ZA, South Africa; MZ, Mozambique; ZW, Zimbabwe; BW, Botswana; NM, Namibia.

FIGURE 1: Regional map of the Shashe-Limpopo confluence area, the middle Limpopo Valley, and location of Schroda and other sites in the immediate area mentioned in the text.

agriculture (Smith, Lee-Thorp & Hall 2007). These newcomers are identified by their distinct ceramic style, known as Leopard's Kopje or K2. They established a capital at the site of 'K2', took over the trade networks and gained political control of the region for c. 200–250 years (Huffman 2007, 2009). Although many of the Zhizo people moved west to Botswana after AD 1000, some remained in the middle Limpopo Valley and at Schroda. Shortly after political submission, the Zhizo people who remained in the Limpopo Valley started to incorporate K2 stylistic elements in their ceramics (now called Leokwe). Zhizo/Leokwe people continued to maintain a distinct identity among a predominantly K2 society for two centuries (Calabrese 2007), after which they seem to have been integrated into K2/Mapungubwe society.

Edwin Hanisch excavated Schroda in the late 1970s and early 1980s (Hanisch 1980, 2002). He uncovered a substantial Zhizo deposit underlying, what he thought at the time, a smaller Leopard's Leopard's Kopje or K2 horizon. This latter horizon was later reinterpreted as Leokwe, based on changes in ceramic stylistic features (Calabrese 2007), and the extent of the Leokwe horizon subsequently determined to be more extensive than previously thought (Antonites 2018). The site spans around 300 m × 500 m and consists of different living and activity areas. These areas include household spaces, cattle enclosures, a deep stratified refuse midden and activity area as well as a spatially extensive area linked to ritual and crafting activities (Antonites 2018; eds. Van Schalkwyk & Hanisch 2002).

More than 140 000 animal bone, tooth, ivory and shell fragments were excavated and initially analysed in the 1970s and 1980s by Elizabeth Voigt, Ina Plug and Andrea Brown (Plug & Voigt 1985; Voigt & Plug 1981). Less than 15% of the sample could be identified to taxon due to high fragmentation rates and the specific identification methodology used (see Brain 1974; Voigt 1983). As their study was done prior to the completion of Hanisch's excavations, not all the excavated remains were analysed. Although the original faunal study made a substantial contribution to the understanding of Middle Iron Age livestock and herding practices, these earlier researchers had treated Schroda as a single-phase settlement with little room for change over time. For the 1981 report, all faunal remains were interpreted as being from a single horizon (Zhizo). The existence of a Leokwe horizon at the site prompted a re-analysis of the faunal assemblage as part of a larger study on Middle Iron Age Limpopo Valley foodways (Raath 2014). From an archaeozoological perspective, the availability of an expanded comparative skeletal collection at the Ditsong National Museum of Natural History and refined morphological identification criteria also presented the opportunity to revisit previous identifications and interpretations.

This article presents the results of an archaeozoological study with the aim of updating and expanding the known range of animal resources present at Schroda. The different habitats animals were acquired from as well as the types of procurement strategies used to obtain these resources are discussed, with an emphasis on changes and continuities in animal procurement strategies over time. The discussion draws on modern-day studies of animal ecology and behaviour, as well as 20th century ethnographic and earlier historic examples. Ethnographic and historical sources

are used as interpretive starting points and not to imply cultural continuity between archaeological and more recent communities. In addition to expanding our understanding of past animal resource use in the Limpopo Valley, the study also contributes to historical distribution data for MNP and the surrounding area. Historic distribution baseline data provide valuable information that can inform ecological and conservation policies, procedures and planning (Boshoff & Kerley 2015; Goodman & Tomkinson 1987). However, drawing on written sources limits the use of such data to the last few centuries. Information drawn from archaeozoological studies can serve as complementary datasets for understanding past species and habitat distribution, environmental conditions and animal geography (see Bernard & Parker 2006).

Local environment

Schroda is located in the middle Limpopo Valley (Figure 1), about 7 km downstream from the confluence of the Limpopo River with its largest tributary, the Shashe. The ~15 ha site lies on a rocky plateau 1 km south of the Limpopo River. The area falls within the larger Savannah Biome, and Schroda specifically within the Limpopo Ridge Bushveld vegetation unit. Vegetation is characterised by moderately open savannah and a poorly developed ground layer. Within close walking distance, the site is flanked by Musina Mopane Bushveld to the south and subtropical alluvial vegetation to the north and north-east (eds. Mucina & Rutherford 2006). Grasses in this sweetveld zone are generally nutritious and edible for most of the year. It thus supports large game populations and is especially suited for cattle (*Bos taurus*) grazing, although it is sensitive to overgrazing (Van Oudtshoorn 1992).

A diverse range of wild animals inhabits the MNP and neighbouring areas in southern Zimbabwe and eastern Botswana on a permanent or seasonal basis. Common herbivores include blue wildebeest (*Connochaetes taurinus*), eland (*Tragelaphus oryx*), impala (*Aepyceros melampus*) and plains zebra (*Equus quagga*); gemsbok (*Oryx gazella*) were recently introduced and did not occur here historically (Du Plessis 1969). Megaherbivores include elephant (*Loxodonta africana*), hippopotamus (*Hippopotamus amphibius*) and giraffe (*Giraffa camelopardalis*), while white rhinoceros (*Ceratotherium simum*) has been reintroduced (Ferreira et al. 2017); historically, the distribution range of black rhinoceros (*Diceros bicornis*) included this area, although it is not present in the MNP (Du Plessis 1969). Leopards (*Panthera pardus*) are common, with carnivores such as lion (*P. leo*), cheetah (*Acinonyx jubatus*), African wild dog (*Lycaon pictus*) and caracal (*Caracal caracal*) less frequently sighted. Other mammals include vervet monkey (*Chlorocebus pygerythrus*), baboon (*Papio ursinus*), warthog (*Phacochoerus africanus*), Cape porcupine (*Hystrix africaeaustralis*) and honey badger (*Mellivora capensis*) (South African National Parks 2023). Birdlife is especially diverse with more than 400 species recorded (SANParks 2023). Several reptile species, notably crocodile (*Crocodylus niloticus*), southern African rock python (*Python natalensis*) and black mamba (*Dendroaspis polylepis*), as well as amphibians and freshwater fish species are also present in the broader Limpopo Valley area (Alexander & Marais 2007; Du Preez & Carruthers 2009; Gaigher 1998).

Today the Limpopo River is highly seasonal; however, it probably flowed more frequently throughout the year in the past. Water is also available below the sandy surface of the ephemeral Shashe River, while smaller tributaries and streams provide water on a seasonal basis (Hanisch 1980). Smith and colleagues (2007) found that rainfall was erratic and low during the 10th century Zhizo period, with episodes of slightly higher and lower rainfall (from $\leq$ 300 mm to $\geq$ 500 mm). These conditions prevailed during the early K2/Leokwe period, but by AD 1030 rainfall increased to $\geq$ 500 mm with less fluctuation. Because of irregular rainfall, even in years of increased precipitation, living conditions in this semi-arid region were challenging. Yet, despite the environmental challenges, people have lived in this dryland area for centuries through innovative adaptive strategies (Chirikure, Fredriksen & Manyanga 2018; Manyanga 2006; Nyamushosho et al. 2018; Smith et al. 2007).

Research methods and design

A subsample of diagnostic specimens from previously analysed material was re-examined to confirm and refine Plug and Voigt's (1985) previous taxonomic identifications. An additional subsample of specimens from material that had not been analysed before was also included (see Raath 2014:165 for sampling details).

Taxa were identified following the methodology by Voigt (1983; Brain 1974) and using the comparative skeletal collection at the Ditsong National Museum of Natural History in Pretoria. Additional morphological criteria set for distinguishing between specific taxa were also consulted for ambiguous identifications in conjunction with using actual specimens (MacDonald 1992; Peters 1988; Zeder & Lapham 2010; Zeder & Pilaar 2010). Because of southern African bovid diversity, archaeozoologists categorise fragmented skeletal remains that have no diagnostic features, yet clearly represent an animal from that family into four-size classes: small (Bovid I), medium (Bovid II), large (Bovid III) and very large (Bovid IV) (Brain 1974). These categories are based on live animal weight, not bone size, and there is some overlap between size classes. Specimens identified only to class or order level were similarly subdivided along relative size categories; for example, 'medium carnivore' includes jackal-sized (*Lupulella* sp.) animals and 'medium bird' refers to guineafowl-sized (Numidinae) birds. Number of identified specimens (NISP) was used to quantify relative abundance (see Lyman 2008; Raath 2014 for details).

Results

A total of 14 956 diagnostic specimens, weighing ~65 kg, have been incorporated into the current study. Of the total diagnostic sample, 2200 NISPs are new additions to the taxonomic list.

A wide variety of animal taxa were identified, including mammals, birds, reptiles, fish and molluscs (Table 1 and Table 2). Hanisch (1980) did not note the screen size used during the excavations, but the presence of skeletal elements from small taxa, such as fish, rodents and hares, strongly suggests that recovery methods obtained a representative faunal sample.

An expanded comparative skeletal collection and improved identification criteria enabled more species- or genus-specific identifications of wild animals that were previously limited to family or order level only, as evident in the earlier faunal studies from Schroda. New additions to and confirmations of probable identifications ('cf.') of Voigt and Plug's (1981; Plug & Voigt 1985) original taxonomic list include vervet monkey, black-backed jackal (*Lupulella mesomelas*), brown hyena (*Parahyaena brunnea*), spotted hyena (*Crocuta crocuta*), lion (confirmed), caracal, serval (*Leptailurus serval*), black and/or white rhinoceros (Rhinocerotidae), kudu (*Tragelaphus strepsiceros*), eland (confirmed), blue wildebeest, red hartebeest (*Alcelaphus buselaphus*), probable mountain reedbuck (*Redunca* cf. *fulvorufula*), probable waterbuck (cf. *Kobus ellipsiprymnus*), steenbok (*Raphicerus campestris*, confirmed), scrub hare (*Lepus saxatilis*), guineafowl (Numididae) and bullfrog (*Pyxicephalus adspersus*).

Several taxa considered as potential food sources were grouped into broader categories to explore more general trends between pre- and post-AD 1000 (Table 3). The most obvious trend is the change in livestock proportions relative to wild animals (all except carnivores and very large mammals) between Zhizo and Leokwe settlement horizons (Figure 2). A chi-square test of independence was performed to examine Zhizo and Leokwe grouped animal taxa. The relation between these variables was significant, X^2 (8, N = 5568) = 183.08, $p \leq 0.0001$, which shows that there are significant changes in animal taxa between Zhizo and Leokwe samples. The increase in wild animal proportions in relation to livestock can be interpreted in two ways. On the one hand, the lower livestock proportions could be the result of an actual decrease in access to livestock at the site. On the other hand, livestock remains could be equally abundant as before, but a significant increase in wild animal exploitation changed the proportions.

Discussion

Domesticates

Domestic animals – cattle, sheep (*Ovis aries*) and goats (*Capra hircus*) – dominate the Zhizo and Leokwe assemblages at Schroda (Table 1). Although their proportions vary between horizons and across different areas of the site, their role as the primary meat source is evident. Livestock also held symbolic significance, as evidenced by, for example, a Zhizo period offering of sheep and/or goat meat portions (Hanisch 1980:188) as well as their abundant representation among the cache of ceramic and clay figurines (eds. Van Schalkwyk & Hanisch 2002). The social and ceremonial significance of livestock – especially cattle – among present-day communities

TABLE 1: Mammalian taxa from Zhizo and Leokwe deposits at Schroda.

Taxon (common name)	Z	L
Soricidae (shrew)	1	0
Papio ursinus (chacma baboon)	1	2
Chlorocebus pygerythrus (vervet monkey)	1	0
Canis familiaris (dog)	7	5
Canis cf. *familiaris*	1	2
Lupulella mesomelas (black-backed jackal)	0	2
Lupulella/Canis (jackal/dog)	1	0
Otocyon megalotis (bat-eared fox)	2	0
Canidae (foxes, wild dogs and jackals)	7	2
Parahyaena brunnea (brown hyaena)	1	0
Crocuta crocuta (spotted hyaena)	1	1
cf. *Crocuta crocuta*	0	1
Hyaeninae (hyaena)	1	0
cf. *Ichneumia albicauda* (white-tailed mongoose)	1	0
cf. *Mungos mungo* (banded mongoose)	1	0
Herpestinae (surricates and mongooses)	4	7
Panthera pardus (leopard)	1	0
Panthera leo (lion)	1	3
cf. *Panthera leo*	2	1
Caracal caracal (caracal)	0	1
Felis silvestris (African wild cat)	1	3
Leptailurus serval (serval)	1	0
cf. *Leptailurus serval*	0	1
Felidae (cats)	0	2
Carnivore, medium	38	9
Carnivore, large	7	3
Loxodonta africana (elephant; ivory, rib fragment)	32	33
Ceratotherium/Diceros (rhinoceros)	1	0
Equus quagga (plains zebra)	86	30
cf. *Equus quagga*	0	5
Procavia capensis (rock hyrax)	23	11
cf. *Procavia capensis*	0	1
Heterohyrax brucei (yellow-spotted rock hyrax)	1	2
Potamochoerus larvatus (bushpig)	2	0
cf. *Potamochoerus larvatus*	0	1
Phacochoerus africanus (common warthog)	1	2
Suidae (pigs)	4	1
cf. Suidae	1	0
Hippopotamus amphibius (hippopotamus)	8	0
cf. *Hippopotamus amphibius*	1	0
Giraffa camelopardalis (giraffe)	7	2
cf. *Giraffa camelopardalis*	4	0
Bos taurus (cattle)	623	224
cf. *Bos Taurus*	33	43
Ovis aries (sheep)	378	175
cf. *Ovis aries*	68	27
Capra hircus (goat)	90	66
cf. *Capra hircus*	17	12
Ovis/Capra (sheep/goat)	815	210
cf. *Ovis/Capra*	9	0
Syncerus caffer (African buffalo)	9	3
cf. *Syncerus caffer*	4	0
Tragelaphus strepsiceros (greater kudu)	0	2
Tragelaphus oryx (eland)	1	2
Connochaetes taurinus (blue wildebeest)	1	2
cf. *Connochaetes taurinus*	2	0
Alcelaphus buselaphus (red hartebeest)	0	1
Alcelaphus sp. (hartebeest)	7	0
cf. Alcelaphinae	0	1
Sylvicapra grimmia (common duiker)	4	10
cf. *Sylvicapra grimmia*	3	2

Table 1 continues on the next page →

TABLE 1 (Continues...): Mammalian taxa from Zhizo and Leokwe deposits at Schroda.

Taxon (common name)	Z	L
Redunca cf. *fulvorufula* (reedbuck cf. mountain reedbuck)	1	0
cf. *Kobus ellipsiprymnus* (waterbuck)	1	0
Raphicerus campestris (steenbok)	3	1
cf. *Raphicerus campestris*	0	2
Aepyceros melampus (impala)	41	28
cf. *Aepyceros melampus*	1	9
Oreotragus oreotragus (klipspringer)	3	10
cf. *Oreotragus oreotragus*	0	3
Bovid, small (Bov. I)	129	112
Bovid small/medium (Bov. I/II)	4	4
Bovid, medium (Bov. II)	1829	1144
Bovid, medium (Bov. II, wild)	29	30
Bovid, medium/large (Bov. II/III)	4	8
Bovid, large (Bov. III)	1123	806
Bovid, large (Bov. III, wild)	9	9
Bovid, very large (Bov. IV)	12	1
Thryonomys swinderianus (greater canerat)	1	5
Pedetes capensis (springhare)	31	19
cf. *Pedetes capensis*	3	3
Rodent, small	17	5
Rodent, medium	13	19
Rodent, large	4	0
Rodent, indeterminate	2	7
Lepus saxatilis (scrub hare)	2	11
Lepus sp. (hare)	2	6
Leporidae (hares, rabbits and rock rabbits)	94	70

Z, Zhizo; L, Leokwe; cf., probable identification.

TABLE 2: Avian, reptilian, amphibian, fish and molluscan taxa from Zhizo and Leokwe deposits at Schroda.

Taxon (common name)	Z	L
Struthio camelus (ostrich; eggshell fragments only)	182	163
Numididae (guineafowl)	2	3
Bird, francolin size	2	1
Bird, pigeon size	2	2
Bird, partridge size	3	0
Bird, small	3	3
Bird, medium	28	41
Stigmochelys pardalis (leopard tortoise)	22	28
Tortoise/terrapin	460	304
Snake	9	8
Varanus sp. (monitor lizard)	62	55
cf. *Varanus* sp.	3	4
Lizard	1	0
Crocodylus niloticus (Nile crocodile)	6	8
Reptile, small	2	2
Reptile, large	0	1
Reptile, indeterminate	3	5
Pyxicephalus adspersus (African bullfrog)	0	2
Frog and/or Toad	11	6
Clarias sp. (catfish)	121	48
Synodontis sp. (catfish)	51	9
Clarias/*Synodontis*	12	64
Fish, indeterminate	119	76
Achatinidae (large terrestrial snail)	925	1516
Terrestrial snail, small	12	8
Corbicula africana (freshwater clam)	2	0
Unionidae (freshwater mussel)	86	100
Monetaria annulus (ring cowrie)	3	14

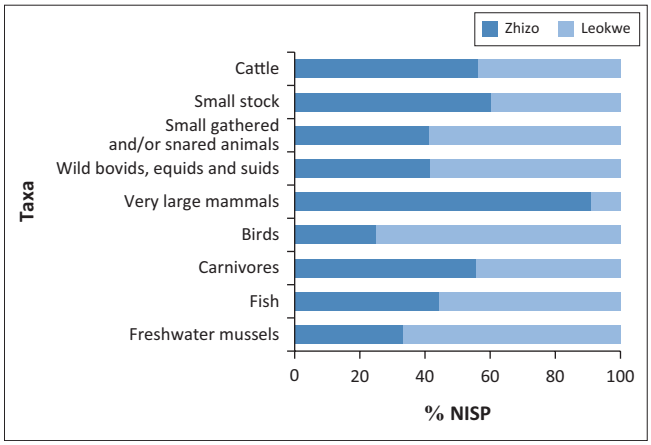
Z, Zhizo; L, Leokwe; cf., probable identification.

TABLE 3: Number of identified specimens (NISP) and %NISP of grouped animal taxa from Zhizo and Leokwe deposits at Schroda.

Taxa	Zhizo		Leokwe	
	NISP	%NISP	NISP	%NISP
Small stock	1380	38.0	490	25.0
Cattle	656	18.0	267	14.0
Small gathered and/or snared animals	707	19.0	520	27.0
Wild bovids, equids and suids	354	10.0	267	14.0
Very large mammals	22	1.0	2	0.1
Birds	40	1.0	50	3.0
Carnivores	81	2.5	46	2.0
Fish	303	8.0	197	10.0
Freshwater mussels	86	2.5	100	5.0
TOTAL	**3629**	**100.0**	**1939**	**100.0**

NISP, number of identified specimens.

Note: Small stock = sheep and goats. Wild bovids, equids and suids = bovids of all sizes identified to species or genus level, as well as Bovid I and wild specimens of Bovid II and Bovid III, zebra, warthog and bushpig. Small gathered and/or snared animals = hyrax, porcupine, cane rat, springhare, hare, tortoise and lizard. Very large mammals = giraffe, rhinoceros, hippopotamus and elephant (excluding ivory).



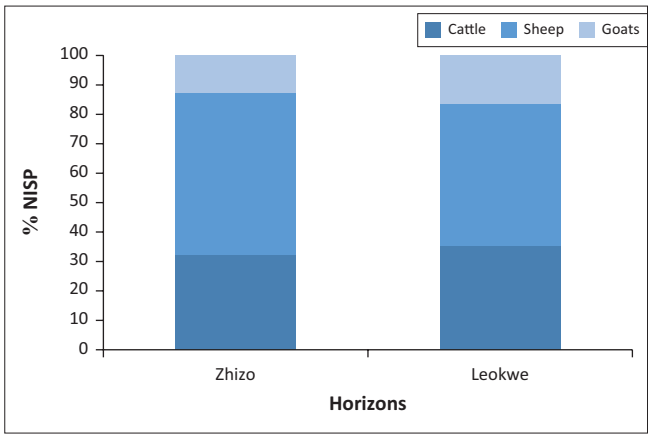
NISP, number of identified specimens.

FIGURE 2: Proportions of grouped animal taxa from combined Zhizo and Leokwe deposits at Schroda (%NISP).

in southern and East Africa is well-documented (Dahl & Hjort 1976; Kuper 1982). The social significance of cattle stretches back into the southern African Iron Age and its time depth and origins have been the subject of some scholarly debate (see Badenhorst 2017 for overview).

Sheep and goat remains remains from archaeological sites routinely cause analytical difficulties (see, e.g., Zeder & Lapham 2010). The challenge in distinguishing fragmented sheep and goat bones and teeth often results in their broad combined grouping as 'sheep and/or goat', 'caprines' or 'ovicaprids', as was the case with the Schroda assemblage. Although both are considered 'small stock' and are often treated in the literature as a homogeneous entity, their management and roles as food sources may have been different (Dahl & Hjort 1976). It is therefore important to consider these species separately.

The ratio of sheep to goat specimens is fairly consistent throughout space and time, with the former representing roughly 80% and the latter 20% of the sample (based on NISP; see Raath 2014 for details). Following Badenhorst's (2018)



NISP, number of identified specimens.

FIGURE 3: Livestock proportions from Zhizo and Leokwe deposits at Schroda (%NISP). Number of identified specimens (NISP) for Zhizo cattle (n = 656), sheep (n = 1124) and goats (n = 256). Number of identified specimens for Leokwe cattle (n = 267), sheep (n = 366) and goats (n = 124). Sheep and goat NISP have been adjusted by adding proportional sheep/goat NISP to increase sample size (see Raath 2014 for details).

caprine index, which measures sheep and goat proportions, values closer to 1 for Zhizo (0.80) and Leokwe (0.72) periods also confirm the predominance of sheep. Future analysis will probably assign many of the specimens currently still identified as sheep and/or goat to either species, which may change the sheep:goat ratio. However, if correct, these figures indicate a heavier reliance on sheep at Schroda – a pattern widespread across Early and Middle Iron Age sites elsewhere in the region (Abatino 2021; Badenhorst 2018; Hutten 2005; Manyanga 2006; Plug & Voigt 1985).

When comparing the relationship between livestock only (Figure 3), their proportions remain consistent over time. The increase in goat and cattle proportions is almost negligible (3% each), while the decrease in the proportion of sheep is more noticeable (6%) but continuing to be quite low. Similar proportions over time means that there were no major changes in herding or utilisation patterns between livestock species after the arrival of K2 groups in the Limpopo Valley. K2/Leokwe period cattle, sheep and goats continue to hold the same positions – in relation to each other – as they had during the earlier Zhizo period.

However, this still does not address the overall change in livestock compared to wild animal proportions at the site. Here, the NISP figures are important. Although wild animal %NISP increases over time, the actual NISP decreases (Table 3). For livestock, both NISP and %NISP drop. Thus, although the total Leokwe sample is smaller, the decrease in livestock remains is more drastic than those of wild animals – effectively resulting in an increased %NISP for wild animals. This means that the number of slaughtered livestock at Schroda declines over time.

In addition to livestock, other domesticates present include dogs (*Canis familiaris*), from both Zhizo and Leokwe horizons. Their presence at Limpopo Valley settlements and beyond is well established (Clutton-Brock 1994; Plug 2000). The earliest evidence of domesticated dogs in southern Africa comes from the 6th to 8th century AD levels at Diamant, west of the Waterberg in the Limpopo Province and the 7th century AD deposits at Mamba I, in KwaZulu-Natal's Thugela Valley (Plug 2000; Voigt & Peters 1994). The earliest remains in the Limpopo Valley are from the Zhizo horizons at Schroda and the nearby site of Pont Drift.

Primates

Primates are very rare at Schroda and include a vervet monkey metatarsal from the Zhizo horizon and adult baboon teeth from Zhizo and Leokwe deposits. Vervet monkeys thrive in or near riparian vegetation and would have been a common sight along the waterways close to Schroda. Baboons are gregarious animals and have a wide distribution across the southern African subregion (Skinner & Chimimba 2005). These primates often come into close contact with people through opportunistic human food scavenging and crop raiding (Naughton-Treves & Treves 2005); their aggressive behaviour towards humans when confronted may well have contributed to occasional killing (Badenhorst, Ashley & Barkhuizen 2016).

Carnivores

Voigt and Plug (1981; see also Plug & Voigt 1985) initially noted a large number of carnivore remains from Schroda – a phenomenon which they attributed to a trade in carnivore skins. Although possible, more research on the nature and taphonomy of these remains needs to be done to support this argument. In addition, although ethnographies have been used to argue for the avoidance of carnivore meat (Schapera & Goodwin 1937:133; Stayt 1968 [1931]:47), examples that do note their consumption have not been fully engaged with either (Grivetti 1979:237; Quin 1959:124). It is clear though from the range of carnivores and their distribution throughout the deposits that they are not incidental inclusions, and their role as potential meat sources, perhaps in addition to other uses, remains open to investigation.

Most of the carnivores represented at Schroda are nocturnal with limited diurnal activities, for example, brown hyaena, spotted hyaena, leopard, lion, caracal and serval. The high safety risk involved in hunting dangerous prey at night probably directed such activities towards the daylight hours. These animals may have been more difficult to find during the day; however, their inactive and vulnerable state probably made them an easier target. Alternatively, they could have been trapped at any time of day. Mongooses (Herpestidae) and bat-eared foxes (*Otocyon megalotis*) dig burrows or use existing holes dug by other animals (Skinner & Chimimba 2005), providing an easy means to catch them.

The diversity of carnivores identified points to the wide range of environments utilised. Whether deliberate or per chance, animals were hunted and/or snared from damp,

riverine environments (e.g. banded mongoose [*Mungos mungo*], serval) to drier, open terrain (e.g. bat-eared fox, black-backed jackal) (Skinner & Chimimba 2005).

The white-tailed mongoose (*Ichneumia albicauda*) is absent from the area today but their current distribution falls close to the Limpopo Valley sites, and it is possible that their former range included this area. They prefer savannah woodland in well-watered areas (Skinner & Chimimba 2005), which is interesting because their remains have only been identified from drier Zhizo levels. Perhaps these animals were restricted to the riparian environment along the Limpopo River during this time.

Wild bovids, equids and suids

Bushpig (*Photamochoerus larvatus*) and common warthog remains sporadically occurred in Zhizo and Leokwe levels. The two suid species are similar in their preference for wet environments (bushpigs: forest, thickets, riparian undercover and reed beds; warthogs: floodplains, *vleis*, open areas around waterholes and pans). However, they differ in the amount of cover required – bushpigs favour dense cover while warthogs are more commonly associated with open woodland and shorter grassland (Skinner & Chimimba 2005). As with baboons and some carnivores, bushpigs present a threat to both agricultural produce and small livestock, which they have been known to kill (Naughton-Treves & Treves 2005). This, coupled with their aggressive nature, may well have provided enough reason to kill them.

Wild bovids of all sizes as well as plains zebra occur across all excavated areas and occupation phases. Impala and zebra are most abundant. Both species are gregarious, which enables hunting strategies that target single or multiple animals. They are also water-dependent (Skinner & Chimimba 2005) and would be an easy and predictable target when congregating at water sources. In addition, hunting gregarious animals such as impala and zebra facilitates communal participation (Holliday 1998).

Besides impala and zebra, wild ungulates are mostly represented by a single or small number of bones and teeth. More specimens of these animals may also be present amongst the large number of indeterminate bovid remains. All the identified bovids occur in the Limpopo Valley region today (Skinner & Chimimba 2005), except mountain reedbuck, whose past distribution range included this area (Du Plessis 1969:133; see also Croll et al. 2023).

Many of the wild bovids identified are water-dependent, which means regular visits to water sources. Regular movements would have created predictable behavioural patterns, which Schroda hunters probably exploited. The riverine environment of the Limpopo River and other water sources in the area further provided ample opportunities to hunt, trap or snare, for example, bushbuck, red hartebeest and waterbuck (Skinner & Chimimba 2005). Species such as blue wildebeest, impala, steenbok, klipspringer (*Oreotragus oreotragus*) and mountain reedbuck show that hunters also took advantage of the surrounding woodland as well as rocky habitats.

As with zebra and impala, the gregarious nature of buffalo and eland would have provided hunters with a choice of procurement strategies. However, judging by the low number of skeletal elements of these species, it seems more likely that hunters targeted individual animals. The presence of juvenile buffalo further indicates that maximum meat yield was not necessarily the main objective. Protection of crops may have provided another procurement strategy, as some bovids, including buffalo and eland, occasionally raid gardens and crops (Naughton-Treves & Treves 2005). These animals could have been killed either through direct encounters or by snares and traps set near the fields (see Badenhorst et al. 2016; Holliday 1998).

Very large mammals

Very large mammals or megaherbivores include elephant, rhinoceros, hippopotamus and giraffe. Although their remains occur in both Zhizo and Leokwe contexts, they tend to be more prevalent in the earlier Zhizo deposits. Elephants are mainly represented by ivory – usually as complete or portions of bangles, or as production debris. The tip of a poorly preserved unworked elephant tusk came from a Leokwe context. Huffman (2007:368) argues that Zhizo period farmers settled in the Limpopo Valley to hunt elephants for their ivory. The ivory was presumably exchanged, with other raw materials, along the Indian Ocean trade networks for glass beads (Wood 2011). Some of the tusks were turned into decorative objects like bangles or armbands and remained in the Limpopo Valley. Evidence of their production in the Valley comes from Schroda and K2 (Plug & Voigt 1985; Voigt 1983). Complete and fragmented bangles have been recorded at other farming community settlements, but these tend to be isolated finds and rarely in the same volume as at the production sites mentioned (Plug & Voigt 1985). In these cases, ivory production debris does not accompany any of the isolated bangle finds, which lead Voigt and Plug (1981) to argue that complete objects were traded onto the settlements from elsewhere.

At Schroda, elephant ivory occurs in both Zhizo and Leokwe deposits (Table 1). The majority of bangle and unworked fragments are from the deep stratified midden deposit with only two possible fragments from the top-most layers. As with the carnivore remains, the main period of ivory exploitation seems to have been during the Zhizo and early Leokwe phases. People may have obtained tusks through scavenging; however, such a supply could soon be exhausted (Plug 2000; but see Forssman, Page & Selier 2014). Alternatively, hunters may have dug and covered deep pits to trap and then spear unsuspecting animals or killed the animals while asleep (Theal 1901:321).

Ethnographic and historic accounts do mention the hunting and consumption of elephants (Junod 1962 [1927]:74). In one 16th century account from the southeast African interior, an entire village walked to the spot where an elephant had died; slaughtered, boiled and roasted the meat and stayed there until the entire animal had been consumed (Theal 1901:321). Bones would probably not have made it back to the settlement unless they had some other use. Hunters and other members of the Schroda community could also have cut large chunks of meat from the bone to carry a lighter load back home. A single elephant rib fragment from a Zhizo context is the only evidence of carcass portions being brought to the site.

Hippopotamus and rhinoceros remains only occur in the Zhizo deposit at Schroda. The former consists of both bones and ivory and the latter of a single sesamoid bone. Today, only white rhinoceros can be found in the MNP, and their presence here is mainly due to conservation efforts; overhunting has negatively impacted both white and black populations in the region (Du Plessis 1969; Ferreira et al. 2017). Recent and historic rhinoceros meat consumption is not well-documented. One of the few written accounts comes from the eastern Kalahari (Botswana), where John Campbell, an early 19th century missionary, observed the preparation of a rhinoceros leg 'left to age and ripen inside a termite mound' (Grivetti 1979:237; see also Junod 1962 [1927]:75; Quin 1959:126). The single sesamoid recovered does not necessarily imply a similar practice during the Zhizo period, although rhinoceros consumption cannot be ruled out either.

Portions of a hippopotamus mandible and tusk are associated with a Zhizo hut feature from the deep stratified midden and activity area (Hanisch 1980:107). Various other hippopotamus bones were also identified including a phalanx, carpal and fragments of a radius and pelvis. The fact that several front and hind limb bones occur in the deposits suggests that these portions were removed intact and brought back to the settlement (see Voigt & Von den Driesch 1984; see also Junod 1962 [1927]:67; Quin 1959:126 for recent examples). Hippopotamuses are also known agricultural pests (Van Houdt & Traill 2022) and some of them may have been killed through direct confrontation or trapping to protect crops.

Like most of the other megaherbivore remains, giraffe bones mostly occur in Zhizo deposits with only two bones thus far identified from Leokwe ones. Giraffes could have been hunted or scavenged, with their docile nature and high juvenile mortality rate (Skinner & Chimimba 2005) making them an easy target. Perhaps the juvenile giraffe remains at Schroda attest to this. The presence of several large and dangerous animals, such as lion, leopard, buffalo, rhinoceros and elephant, potentially indicates an advanced level of hunting ability as well (Plug 2000). Recovered artefacts that may have been used in hunting these animals include bone and iron arrow points, which may have been covered with poisons to increase effectiveness (see, e.g., Bird et al. 2023).

Very large mammals are often artistically depicted in the Limpopo Valley. The golden rhinoceros found in a burial on Mapungubwe Hill is one of the most iconic animal symbols in the region. Although the species represented and meaning of the figurine remain unclear (see Boeyens & Van der Ryst 2014), its material and location in a high-status burial suggest an important link between the rulers of Mapungubwe and rhinoceroses. Elephant, hippopotamus, rhinoceros and giraffe representations are present in the rock art of Mapungubwe (N. Ndlovu [SANParks] pers. comm., July 2023); elephant, hippopotamus and giraffe clay figures from Schroda were probably part of initiation ceremonies (eds. Van Schalkwyk & Hanisch 2002), while a possible hippopotamus figurine came from K2 and a giraffe figurine from Mapungubwe (Voigt 1983:128; see also ed. Fouché 1937:18, Plate XV, nr. 5; Gardner 1963:100). In addition, rhinoceros, hippopotamus and giraffe remains are also associated with K2/Leokwe period rain control activities at Ratho Kroonkop (Croll et al. 2023). The large mammals at Schroda likely had some symbolic meaning beyond their ability to feed many people.

Small mammals

Rodent remains occurred in all deposits and a variety of taxa were identified (Table 1). A large proportion of the rodent remains were only identified to size class. Hanisch (1980, 2002) recorded extensive rodent burrowing activities at Schroda, and the presence of recent intrusions is not unexpected; however, their exploitation as a food source is also plausible (Voigt & Plug 1981; see also Abatino 2021; Croll et al. 2023; Plug 2000).

Springhares are almost exclusively nocturnal, which means that they were either caught in snares during the night or manually removed from their burrows during the day. Both their meat and skins would have been sought after. Porcupines and greater cane rats are potential agricultural pests (Happold 2013a; Naughton-Treves & Treves 2005) and, as with other such animals, could have been killed to prevent crop raiding. Snaring or trapping of these animals seems most likely considering their predominantly nocturnal nature; today, dogs are also often used to hunt cane rats, and a similar practice likely existed in the past (Krige & Krige 1980 [1943]:28; Skinner & Chimimba 2005). The presence of cane rats – thriving in damp areas and reed beds (Happold 2013b) – further points to the active exploitation of the riverine environment around Schroda.

Leporidae (hares and rock rabbits) also occur throughout both phases, with most of the remains probably from Cape and scrub hare (Table 1). Scrub hares' wide regional distribution and preference for savannah woodland and cultivated areas (Skinner & Chimimba 2005) suggest that the majority of *Lepus* sp. identified may well be from this species.

Rock hyrax (*Procavia capensis*) and yellow-spotted rock hyrax (*Heterohyrax bruchei*) sporadically occur throughout most of the excavated deposits, which suggests an occasional

inclusion in the diet – perhaps because of opportunistic snaring, trapping or hunting. These syntopic species prefer rocky outcrops and there is little difference in terms of habitat and diet between them (Barry & Mundy 1998).

Birds

As with rodents and hares, bird remains are present in all Zhizo and Leokwe deposits. The bones mainly represent small- and medium-sized birds, including ground feeding Phasianidae and Numididae. Several Phasianidae species occur in the Limpopo Valley today (eds. Hockey, Dean & Ryan 2005) and include Natal spurfowl (*Pternistis natalensis*) and common quail (*Coturnix coturnix*). Based on its current distribution (eds. Hockey et al. 2005:82), the helmeted guinea fowl (*Numida meleagris*) is the most likely member of the Numididae family represented at Schroda (cf. Abatino 2021).

Ostrich (*Struthio camelus*) eggshell is abundant throughout most deposits. Thousands of ostrich eggshell beads were recovered at Schroda (Hanisch 1980), but the numbers reported here reflect only unmodified shell fragments (Table 2). They are present in varying quantities, in both Zhizo and Leokwe contexts across the site. Whether these fragments originated from hatched eggs collected as raw material for shell bead production or from complete eggs collected for consumption and then discarded or saved for bead production is difficult to determine. What is clear, however, is that ostrich eggshell was an important source of raw material for disc bead production (together with land snail shell), as is evidenced by a hidden cache of incomplete beads and eggshell fragments from a Leokwe context (Raath 2014).

Reptiles and amphibians

Reptile remains are a common occurrence throughout most of the deposits, most of which are tortoise shell fragments. Tortoises are slow-moving animals and would have been easy to pick up and carry while walking. Alternatively, natural (or deliberate) bush fires may also have resulted in large numbers of dead tortoises on the landscape (Avery et al. 2004), which could be collected and carried back to the settlement. Leopard tortoises reach average lengths of 300 mm – 450 mm and weights of 8 kg – 12 kg (Alexander & Marais 2007:386). Animals of this size would provide a fair amount of meat while the shell would be a useful container (see Livingstone 1858:119). The large number of carapace and plastron fragments recovered could also represent taxa such as marsh terrapin (*Pelomedusa subrufa*), hinged terrapins (*Pelusios* sp.) and hinged tortoises (*Kinixys* sp.), all of which occur in the area today (Alexander & Marais 2007).

Snakes that occur in the Limpopo Valley range from dangerous species such as the southern African python, venomous species such as the black mamba, and harmless species such as the brown house snake (*Boaedon capensis*) (Alexander & Marais 2007). The snake remains from Schroda ended up in the deposits for several reasons, which could include being killed in defence of human or animal life, and/or to acquire skins or meat for food, medicinal and belief-based purposes (see Junod 1962 [1927]:82; Quin 1959:127). Some of these remains may also be later intrusions.

Most of the lizard bones are from the larger rock monitor (*Varanus albigularis*) or water monitor (*V. niloticus*). Their large size – both can reach body lengths just short of a metre (Alexander & Marais 2007:210) – must have made them an appealing food source, just as they have been in the recent past (Junod 1962 [1927]:82). However, most of the remains recovered were from small- and medium-sized animals – perhaps snatched from nests or generally easier caught than fully grown adults.

Crocodile remains were identified from both the Zhizo and Leokwe horizons (Table 2). They are often treated in archaeological literature as non-food, taboo or 'ritual' animals (Hanisch 2002; Huffman 2014). In some southern African communities, crocodiles serve as metaphors for leadership and leaders (see Huffman 2014 for discussion). The distribution of crocodile remains may thus directly reflect activities associated with leaders, which tend to be of a ritual nature. Diviners also use crocodile remains for a variety of purposes, which further links these animals to ritual, secretive or secluded activities (Junod 1962 [1927]:519). However, their presence in contexts seemingly associated with secular activities, such as communal refuse middens, and across multiple contexts at Schroda, requires more study.

Frog and/or toad remains are uncommon throughout the deposits at Schroda. The only species positively identified is the giant bullfrog, of which two bones came from Leokwe deposits. Giant bullfrog is the largest frog in southern Africa and can weigh up to 1.4 kg. They remain underground for most of the year, but emerge during the summer rainy season, where they are most commonly found in shallow grassy pans, low marshy areas and rain-filled depressions (Du Preez & Carruthers 2009). The drier climate experienced during the Zhizo period may thus explain their absence from these contexts. The consumption of amphibians in the region is not unknown (Livingstone 1858:37; Quin 1959:124).

Fish

Fish remains are found in low numbers throughout all Zhizo and Leokwe deposits and at least two genera were identified (*Clarias* sp. and *Synodontis* sp.). Based on current distribution maps, the most likely species are sharptooth catfish (*C. gariepinus*), brown squeaker (*S. zambezensis*) and to a lesser extent snake catfish (*C. theodorae*) (Skelton 1993:227). The identification of only two genera is, however, not representative of fish diversity in the Limpopo River catchment system (see Gaigher 1998).

It is difficult to determine whether the low fish numbers reflect infrequent consumption or recovery bias, although it is probably not recovery bias that can explain the relative

absence of fish in the archaeological deposits. Fish remains are present at many settlement sites in the Limpopo Valley, but usually in low frequencies (Abatino 2021; Hutten 2005; Plug 2000). They are uncommon at other farming community settlements outside the Limpopo Valley as well (Plug & Voigt 1985). Some scholars (Plug 2000) have taken this to imply some sort of dietary preference or restriction related to fish and perhaps other riverine resources; this interpretation in based on 20th century ethnographic accounts where fish are often considered inedible and a low status food (Junod 1962 [1927]:83; Quin 1959:128; Schapera & Goodwin 1937:133; Stayt 1968 [1931]:47). Whitelaw (2009), on the other hand, documents more active fish exploitation from farming communities at coastal and riverside settlements in KwaZulu-Natal. As many of his examples show, absent or low fish consumption among archaeological farming communities should be demonstrated rather than assumed. The occurrence of fish remains in all the Zhizo and Leokwe deposits does point to fish as a definite, but minor or perhaps seasonal, food source. Their low numbers could be attributed to informal rather than institutional fishing strategies (see Whitelaw 2009).

Molluscs

Land snail (Achatinidae) shell fragments are common in all deposits, although slightly more abundant in Leokwe deposits. Voigt (1983:10) noted that all such remains from the K2 and Mapungubwe sites probably belong to *Achatina immaculata*, a species that prefers dry environments. This may also be the case for the land snails from Schroda (Voigt & Plug 1981:38). In general, the number of shell fragments could be inflated because of their high identification rate (even when fragmented). These animals have an ambiguous presence in farming community archaeological deposits as they may represent post-depositional intrusions, raw material (for shell bead production) and a possible food source.

Achatinidae are known to burrow into loose soil during the dry season. In some cases, the animal may die while underground, and their shells incorporated into the archaeological deposit (see Plug 1990). Archaeozoologists often attribute the presence of complete shells to such intrusions, although the impact of aboveground activities may also crush them. The majority of land snail specimens from Schroda are fragments. Their increased presence in later Leokwe deposits may thus, on the one hand, reflect the accumulated remains of burrowing activities over time.

A shift in human exploitation strategies may, on the other hand, also explain this increase. The use of land snails as a food source is difficult to prove archaeologically (but see Wojcieszak et al. 2023). Their use as a food item is further complicated by the fact that people may have collected empty shells, which are a common sight in the bush even today, for shell disc bead production. Finished land snail shell disc beads are abundant in both Zhizo and Leokwe contexts at Schroda. At present, it is unclear whether the increase in shell fragments in Leokwe deposits corresponds to an increase in shell bead production activities. A possible belief-based value should also be considered as evidenced by their inclusion in burials at K2 (Gardner 1963; Voigt 1983) and other ritual deposits, such as at Pont Drift (Hanisch 1980).

Freshwater mussels (*Unionidae*) are also found in all Zhizo and Leokwe deposits, albeit in limited quantities. As with land snail shell fragments, freshwater mussel numbers may be influenced by their high identification rate. However, their sporadic presence throughout all deposits, together with the presence of freshwater clams (*Corbicula africana*), fish and other riverine animals show occasional, and probably seasonal, exploitation of riverine resources as a food source. Voigt and Plug (1981:55) suggest that the small freshwater clam shells were collected and used as ornaments, based on a perforated example from a K2/Leokwe period context at Pont Drift.

Finally, a total of 17 ring cowrie shells (*Monetaria annulus*) were recorded and occurred in Zhizo and Leokwe contexts. The dorsal surfaces were cut, and the edges smoothed, perhaps to enable fastening to clothing or utensils. They are rare finds at interior sites and their presence here typically attributed to long distance trade networks with Indian Ocean trade ports (see Moffett et al. 2022). They are more numerous in the Leokwe deposits, which is in line with expanding trade activities during this time.

Continuities and changes in animal procurement

The expanded and revised taxonomic list shows that the Schroda community drew on a diverse animal resource base that involved the use of different procurement strategies. Some of these strategies required individual participation, while others relied on group effort and the pooling of resources. Procurement involved both planned and opportune strategies across woodland, open grassland and riparian environments and shows a flexible approach to obtaining food and other resources. Animals caught in human-wildlife conflict situations – such as crop raiding, food scavenging and posing a safety threat – were likely opportunistically procured around cultivated fields (Badenhorst et al. 2016) and within the village. Mixed herds provided a reliable supply of meat, milk and skins throughout the year. There was a particular emphasis on the herding of small stock – particularly sheep – and, to a lesser extent, cattle. Although a very large assemblage from the Leokwe horizon must still be analysed, initial results suggest that procurement strategies and animals targeted generally remained unchanged for almost 200 years. The only noticeable change seen during the Leokwe horizon is a shift in the proportion of livestock relative to other animals and the related increase in the exploitation of wild animals.

Reliance on a broad spectrum of food procurement strategies is often done as a risk management or coping strategy in

areas with unpredictable environmental conditions (Manyanga 2006; Nyamushosho et al. 2018). Erratic rainfall patterns, as suggested for the Zhizo period in the Limpopo Valley (Smith et al. 2007), would have necessitated such an approach. However, the continued flexibility in animal resource procurement during the early K2/Leokwe period, when seemingly improved rainfall and climatic conditions allowed more intensive agricultural output and more reliable herd growth, suggests alternative reasons for continued diversification of subsistence strategies. This continued diversification may perhaps be linked to expansion of habitats that attracted wild taxa to the area, demand for animal resources linked to regional trade or new tribute demands from K2. Investigating these and other motivations forms part of ongoing research at the site.

Conclusion

A large sample of faunal specimens from the Schroda archaeological collection was analysed to identify the range of animal resources present in the archaeological deposit and to describe the types of procurement strategies used to obtain these resources. The Schroda community drew on a broad animal resource base and combined livestock herding with game hunting, capturing smaller mammals, reptiles and birds, and fishing. Over time, there is a shift towards an increase in wild animal procurement, which may have been due to environmental, economic and/or political reasons.

Fifteen new taxa (13 mammal, 1 bird and 1 reptile) were added to the list of taxa represented at the site. The presence of three mammal species for which previous identifications were uncertain has also been confirmed. Two species identified – mountain reedbuck and white-tailed mongoose – do not occur in the MPN area today, but they did so in the past. Although archaeological faunal assemblages are mostly of an anthropogenic nature, and therefore not an accurate representation of an area's biodiversity or taxonomic abundances, these datasets do provide additional lines of evidence towards understanding past distribution ranges. In addition, these remains also inform on the nature of human-animal relationships in the past, which may contextualise the modern-day interactions between humans, animals and their shared environments.

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Competing interests

The author declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

Author's contributions

A.R.A. declares that they are the sole author of this research article.

Ethical considerations

The study of archaeological animal remains from museum collections does not require ethical clearance. Noninvasive analysis does not require a permit from heritage authorities. The study was conducted with permission from the Ditsong National Museum of Cultural History, the official repository of the Schroda archaeological collection.

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Data availability

The data that support the findings of this study are available on request from the corresponding author, A.R.A.

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