Late Pleistocene and Holocene fauna from Waterfall Bluff Rock Shelter, Mpondoland, South Africa

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Archaeological deposits from Waterfall Bluff Rock Shelter (Eastern Cape) span from Marine Isotope Stage 3 (~39–29 ka) to the mid-Holocene (~8 ka), showing persistent human occupations. The site's consistent proximity to the shoreline and stable coastline over millennia makes it key for exploring human settlement patterns. This study reports on preliminary results of identifiable fauna from Marine Isotope Stage 3 to the Early Holocene layers at Waterfall Bluff. The identified species may suggest a mosaic environment, although caution is warranted given the small sample size. Furthermore, leopard seal remains were recovered in layers dating to the Last Glacial Maximum. This is the first direct evidence of a leopard seal recovered from Pleistocene and Holocene archaeo-faunal assemblages along the South African coast.

Significance:

Last Glacial Maximum (LGM) sites are rare in southern Africa. Waterfall Bluff in the Eastern Cape shows that human occupation persisted there from Marine Isotope Stage 3 to the mid-Holocene. A leopard seal tooth was identified in the LGM layers, making it the first evidence of this species recovered off South Africa's coast.

Introduction

During the Terminal Pleistocene, coastal archaeological records are scarce across southern Africa due to sea-level fluctuations, which results in a bias towards interglacial periods.[1] Excavations at Waterfall Bluff (WB), located in Mpondoland in the Eastern Cape, have documented repetitive occupations of the rock shelter by hunter-gatherers from the Marine Isotope Stage 3 (~39–29 ka) to the middle Holocene (~8–5 ka), including during the Last Glacial Maximum (LGM) and the glacial/interglacial transition.[1,2] The abundant remains of marine shellfish, fish, mammals and charcoal from coastal taxa demonstrate that Late Pleistocene hunter-gatherers routinely collected various resources from coastal zones.[1-3] Here, we describe a preliminary sample of WB fauna from the Marine Isotope Stage 3 to the Early Holocene to better understand the local palaeoenvironmental and palaeoecological conditions and the implications for hunter-gatherer subsistence.

Regional ecology

Eastern Mpondoland is known for its diverse landscapes, including deeply dissected plateaus extending from the Mthatha River mouth to the Umtamvuna River mouth. The area is currently dominated by sourveld grassland, forest vegetation and bushveld, including the Southern Coastal Forest, Southern Mistbelt Forest and Scarp Forest.[1,4,5]

The region is home to various animal species in different environments. Browsers such as bushbuck (*Tragelaphus scriptus*), blue duiker (*Philantomba monticola*) and grey rhebok (*Pelea capreolus*) are primarily found in environments that provide underbrush, including riverine underbrush, woodlands and coastal bush.[6,7] Grazers such as the southern reedbuck (*Redunca arundinum*), oribi (*Ourebia ourebi*) and bontebok (*Damaliscus pygargus*) prefer grassland environments with short grass for grazing and longer grass for cover.[6,7] Mixed feeders like the eland (*Tragelaphus oryx*) are versatile in their environmental needs, occurring in grassland biomes to woodlands.[6,7]

Site background

Waterfall Bluff (31°26'01, 1" S, 29°49'19.2" E) is located ~24 m above the modern coastline next to the Mlambomkulu River waterfall. The site's lithics assemblage is predominantly hornfels.[1] Botanical records show the presence of all major vegetation types found in the region today from the end of the Pleistocene to the Holocene.[2] These findings imply a complex mosaic of environments that would have supported varying plant and animal resources.

All excavated data have been mapped in 3D with total stations to millimetric accuracy using total stations tied into the Universal Transverse Mercator (UTM) grid system. More than 17 000 artefacts, faunal (terrestrial and marine) and plant remains have been plotted to date. Additional specialist samples for micromorphology, optically stimulated luminescence dating, charcoal, etc. have been similarly mapped in 3D.

The site's stratigraphic sequence follows natural layers consolidated into 'Stratigraphic Aggregates' (StratAggs), which are laterally continuous layers of sediments.[8] StratAggs can be subdivided into sub-Stratigraphic Aggregates (SubAggs), representing discrete anthropogenic, biogenic or geologic events. The Light Brown Coarse Sands (LBCS) are the earliest StratAgg with dates ranging from 37.6 ± 4.2 ka to 12.5 ± 1.2 ka dated via single-grain optically stimulated luminescence.[1] The Shell-Rich Clayey Sands (SRCS) StratAgg overlays the LBCS and is dated using Bayesian14C accelerator mass spectrometry model from 11 000 cal yr BP to ca. 10 500 cal yr BP[1] (Figure 1). For more detailed information about the excavation sequence, see Fisher et al.[1], Esteban et al.[2] and Karkanas et al.[8]

Method and materials

The fauna documented in this report was recovered from the early Holocene SRCS and the Late Pleistocene LBCS deposits during the 2016 excavations. Excavations were permitted by the Eastern Cape Provincial Heritage Resources Authority, permit #2/2/APM-PERMIT/15/03/001. The remains were analysed following Klein and

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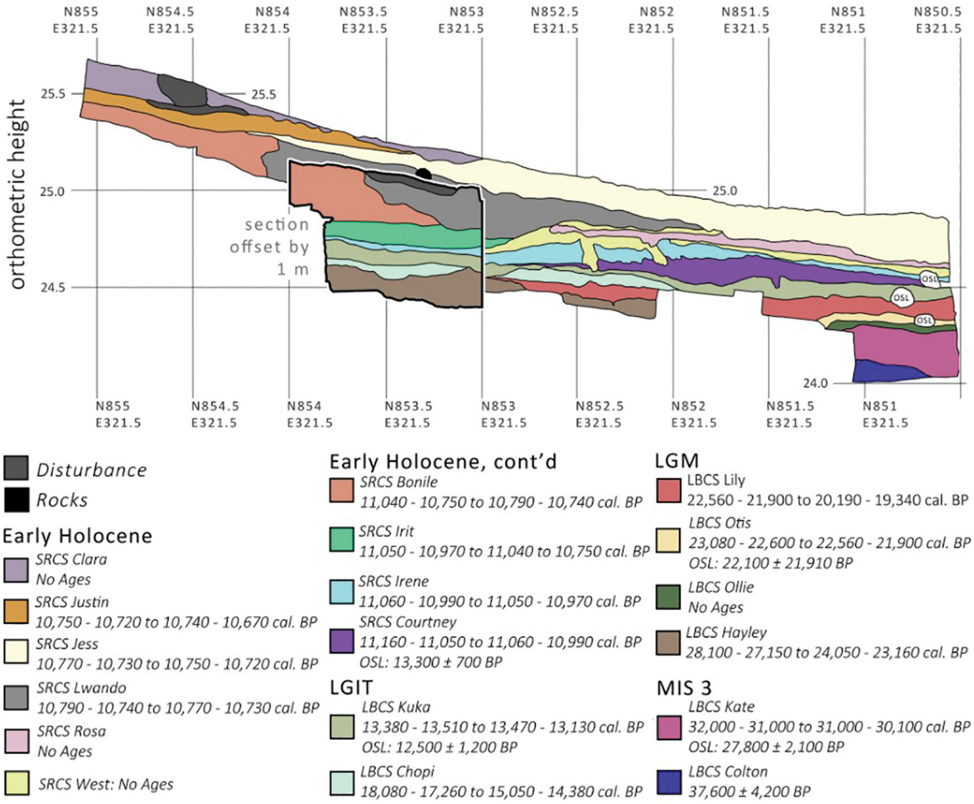

Source: Adapted from Fisher et al.[1], with permission

Figure 1: The ages and locations of SubAggs at Waterfall Bluff.

Cruz-Uribe[9] and Driver[10]. Fauna was compared to comparative faunal collections at the Ditsong National Museum of Natural History, Pretoria. Bovidae (bovids) not assigned to a Linnaean Family were categorised according to four size classes based on Brain[11] from the smallest (Bov 1; e.g. oribi) through to the largest (Bov 4; e.g. eland). Specimens that could only be identified as 'mammal' but whose size could be estimated were classed as Size 1 through 4. This report includes only specimens identified to taxa, presented according to the number of identified specimens (NISP). Ungulates were categorised as grazers, browsers and mixed feeders, following Skinner and Chimimba[6]. Table 1 presents the identified fauna. A taphonomic analysis was not conducted; however, observable marks such as cut marks, gypsum or manganese staining were noted.

Results

Most specimens (NISP = 65; 89%) were from SRCS deposits; a small portion (NISP = 10; 13.7%) was from LBCS layers (Table 1). Most recovered specimens were poorly preserved, showing extensive charring and water damage, likely due to proximity to the drip line. Additionally, the assemblage was extensively fragmented, with most specimens being less than 2 cm long. Approximately 10% showed anthropogenic modifications like cut and percussion marks. None of these bones could be assigned to a species except for a charred astragalus with cut marks from the SRCS Jess deposits that belonged to a blue duiker (CN004835, Lot 221).

Bovids are the most common taxa, while rock hyrax (*Procavia capensis*) was the most identifiable mammal species (NISP = 7; 20.6%). A seal tooth (CN47208, Lot 303) was recovered from the LBCS SubAgg Lily (Table 1) (Figure 2). The crown has three distinct cusps and is unlike those of the more common fur seal (*Arctocephalus* spp.), which are smooth with less pronounced lateral cusps. The trident-shaped postcanine tooth corresponds to the earless seal (Phocidae), of which four species occur along the southern African coast.[6] Although worn, the tooth matches the prominent, triple-cusped crown of leopard seals, which are used to sieve krill. Based on our assessment, the tooth does not resemble the other three Phocidae species and is most likely that of a leopard seal. Notably, at least three other bone fragments (a vertebra and two unidentified bone specimens) recovered from the LBCS and SRCS layers may also belong to seals; this is based on their relatively distinct internal morphology.

Discussion

Late Pleistocene environment

The LBCS yields a small faunal sample with only two identified bovid species; neither are exclusive grazers (Table 2). Eland are mixed-feeders adaptable to various environmental conditions. The common duiker (obligatory browser) requires bushes and trees for shelter, shade and forage.

The presence of fish and seal remains in the LBCS layers indicate that the site was within the foraging distance of the coast[1] (Table 1). The neocoastal site's location is adjacent to the narrow continental shelf meant it was

Table 1: Number of identified specimens (NISP) from Waterfall Bluff

Taxa	Common name	SRCS	LBCS	Total
Hydrurga leptonyx	Leopard seal		1	1
Cercopithecus pygerythrus	Vervet monkey	1		1
Procavia capensis	Rock hyrax	4	3	7
Sylvicapra grimmia	Common duiker		1	1
Tragelaphus oryx	Eland		4	4
*Syncerus afer**	African buffalo	1		1
Redunca fulvorufula	Mountain reedbuck	1		1
Redunca arundinum	Southern reedbuck	1		1
Redunca sp.	Reedbuck	2		2
Philantomba monticola	Blue duiker	1		1
Ourebia ourebi	Oribi	1		1
Damaliscus pygargus	Bontebok/blesbok	1		1
Pelea capreolus	Grey rhebok	2		2
Tragelaphus scriptus	Bushbuck	4		4
Raphicerus cf. *campestris*	Steenbok	5		5
Bovidae: Indet.	Bov 1	12		12
	Bov 2	10		10
	Bov 3	2		2
	Bov 4	4		4
Bathyergidae sp.	Mole rat		1	1
Hystrix africaeaustralis	Porcupine	1		1
Testudinidae	Tortoise	7		7
Varanus sp.	Monitor lizard	2		2
Aves	Bird – small	3		3
Total		67	10	75

SRCS, Shell-Rich Clayey Sands; LBCS, Light Brown Coarse Sands

**Given the racial offensiveness of the original species name* Syncerus caffer*, we follow recent recommendations for ethical scientific naming by Smith and Figueiredo[12] and Roksandic et al.[13] by removing the c and the second f from the offensive epithet.*

Table 2: Ungulate dietary categories at Waterfall Bluff based on the number of identified specimens (NISP) and the number of taxa (NTAXA)

Dietary preference	SRCS	LBCS	Total NISP	NTAXA
Grazers	7	0	7	5
Mixed feeders	0	4	4	1
Browsers	16	4	20	6

SRCS, Shell-Rich Clayey Sands; LBCS, Light Brown Coarse Sands

within the foraging range of the coast throughout glacial times.[1] The identification of several possible barnacle remains in the sample, along with previous finds of marine shellfish, also shows that WB hunter-gatherers were systematically exploiting coastal resources even when the coast was ~8 km away.[1-3]

The leopard seal tooth (Figure 2) is from SubAgg Lily in LBCS, dated to the LGM, with a modelled age range of 22 560–19 340 cal. BP.[1] Leopard seals are apex predators whose habitats are restricted to pack ice around the Antarctic and with a maximum range to the sub-Antarctic islands.[14,15] Thus, leopard seals could have occurred further north than their usual home ranges during the peak of the LGM, which could also lead to leopard seal bodies being washed up on the coasts near WB more frequently. This is the first occurrence of a leopard seal recovered from an archaeological site off the southern African coast. The only modern records of leopard seals in South Africa were in East London in 1946, Hout Bay in 1969[6], and a dead leopard seal reported to the East London museum in 1994. More recently, Kevin Cole, Principal Scientist at the East London Museum, spotted a living individual near Cove Rock in 2014 (Figure 3) (Cole K, personal communication). Another living specimen was sighted in 2021 at Kommetjie beach in Cape Town, and the same seal was sighted again in Yzerfontein on the West Coast.[16]

The presence of a leopard seal in LBCS at WB may suggest that their colonies occurred in territories beyond the Antarctic and sub-Antarctic oceans. It is also possible that this was an isolated instance of a leopard seal straying too far from its home range, or it may be the remains of a leopard seal body that was washed up on the shore from the closer northern ranges of its habitat. However, the colder climatic conditions during the LGM, characterised by local sea surface temperatures approximately 3°C lower than current levels (as indicated by core MD96-2048[17]), may have provided suitable environments for leopard seal colonies[18] – or their hunting ranges – to have spread further north[19]. Extended periods of sea ice persistence may have facilitated increased leopard seal populations during the LBCS. Furthermore, increased Antarctic ice may have cut off specific krill distribution ranges and spawning grounds – a major source of food for leopard seals – around the east Antarctic and Antarctic Peninsula. This would have compelled the krill to expand their distributive range northwards for breeding purposes and forced leopard seals to follow their food source.[19,20] Furthermore, WB is close to a river mouth that would have washed inland nutrients into the ocean, thus maintaining a constant level of ocean nutrients that would have supported and propagated the marine animals upon which leopard seals preyed.

Early Holocene environment

In the SRCS layers, the relative prevalence of bushbuck and reedbuck suggests a riverine environment.[7] Although browsers dominate in terms of NISP (Table 2), the relative abundance of reedbuck, African buffalo and bontebok/blesbok at WB indicates a grassy environment and the likely presence of permanent water nearby.[6,7] Esteban et al.[2] found that summer rainfall increased during the Early Holocene period, promoting moister environments that the southern reedbuck would have favoured. Species showing the presence of freshwater suggests that the nearby Mlambomkulu River may have persisted from the LGM, and incisions of palaeo-rivers on the now-submerged continental shelf indicate active riverine run-off during this time.[2] Mountain reedbuck and grey rhebok indicate rocky, steep-sloped habitats[6,7] similar to the landscape found along major river drainages in the region.

Blue duiker and vervet monkey remains from the SRCS (Table 1) indicate the presence of forests or thickets, which they require for cover and food.[6] Blue duikers often exploit monkeys' feeding habits and eat the fallen foliage and fruits that the monkeys drop while scavenging in the treetops.[6] Furthermore, cut marks on the blue duiker specimen indicate that hunter-gatherers, rather than carnivores, were the primary accumulator of these small bovids at WB.

Conclusion

Our sample is very small, so we must be cautious when using the fauna to infer palaeoenvironmental changes. However, the remains of water-dependent herbivores in our sample indicate a consistent source of fresh water nearby. Furthermore, the relatively equal distribution of grazers and browsers tentatively suggests a mosaic environment of interdigitated habitats in the region throughout the Pleistocene–Holocene transition period.

The identification of a leopard seal is the first direct evidence of this species recovered from Pleistocene and Holocene archaeo-faunal assemblages

Figure 2: Leopard seal tooth (#CN47208, Lot 303).

Credit: Kevin Cole, with permission

Figure 3: Kevin Cole and a leopard seal at Cove Rock, 2014.

along the southern African coast. This and other palaeoenvironmental data may indicate a substantial ecological shift in the coastal environment during the LGM. Excavations at WB are ongoing, and future analyses of larger faunal samples would better contextualise the site's palaeoecology.

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Data availability

The data supporting the results of this study are housed at the University of the Witwatersrand and are available upon request to the corresponding author.

Declarations

We have no competing interests to declare. We have no AI or LLM use to declare. Excavations at Waterfall Bluff were conducted under the auspices of the Eastern Cape Provincial Heritage Resources Authority, permit #2/2/APM-PERMIT/15/03/001-.

Authors' contributions

S.O.: Conceptualisation, methodology, faunal identification, data analysis, writing – initial draft. J.P.R.: Conceptualisation, methodology, faunal identification, data analysis, data curation, student supervision, writing – revisions. H.C.C.: Data collection, project leadership, funding acquisition, writing – revisions. I.E.: Data collection, project leadership, funding acquisition, writing – revisions. J.P.: Data collection, project leadership, funding acquisition, writing – revisions. E.C.F.: Data collection, project leadership, funding acquisition, writing – revisions. All authors read and approved the final manuscript.

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