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LETTER TO THE EDITOR

Late Quaternary micromammals and the precipitation history of the southern Cape, South Africa — comment on the published paper by Faith et al., *Quaternary Research* (2019), Vol. 91, 848–860

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INTRODUCTION

Faith et al. (2019) have recently undertaken an impressive envirometric study of the relative abundances of modern and fossil mammalian microfauna from various regions in southern Africa in an attempt to obtain an aridity index that correlates strongly with mean annual precipitation. They do so under the assumption that variability in relative abundances and distributions of microfauna is affected indirectly, if not directly, by climatic factors that influence habitats in which the mammalian taxa are situated. They use data from as many as 123 localities for which modern climatic data are available in southern Africa. Through statistical ordination they attempt to infer palaeoclimates from fossil assemblages, notably from Boomplaas (Deacon, 1979; Avery, 1982) and Byneskranskop 1 (Schweitzer and Wilson, 1982), both of which have important late Quaternary sequences in the Western Cape Province of South Africa.

Faith et al. (2019) make a controversial conclusion regarding palaeoclimates during the time of the last glacial maximum (LGM) when mean annual temperatures were about 5°C lower than present-day conditions (Thackeray, 1987). Notably, they infer that palaeoenvironments adjacent the Boomplaas Cave in the LGM were associated with winter rainfall in "humid" (relatively high rainfall) conditions. The same inference has been expressed by Chase et al. (2017, 2018). This is counter to the conclusion reached (inter alia) by Deacon et al. (1984), based on mammalian microfauna as well as pollen and charcoal. The Deacon et al. (1984) study inferred that the LGM at Boomplaas was cold and dry. There is a need to address the conflicting situation. Was the time of the LGM in parts of the Western Cape Province characterised by high or low precipitation? The question has a long history in the context of palaeoenvironmental studies in South Africa; see, for example, Chase and Meadows (2007), Faith (2013), Sealy et al. (2016), and Chase et al. (2018). This brief study serves to re-examine the results obtained by ordination (Faith et al., 2019) regarding an aridity index. Special attention is given to Boomplaas Cave, which has one of the best late Quaternary sequences in southern Africa with material that can be used as proxies for palaeoclimate. An objective is to determine whether at least part of the LGM, notably an episode dated between 22,000 and 20,000 cal yr BP (Pargeter et al., 2018) in the Boomplaas palaeoenvironment, can be described as cold and semiarid.

THE GWA (LGM) SAMPLE FROM BOOMPLAAS CAVE

GWA is the name for a layer at Boomplaas representing the period between 22,000 and 20,000 cal yr BP (Deacon, 1979). An important point that Faith et al. (2019) do not explore in detail in their study relates to the identification of modern samples that are close to the fossil assemblage from this layer, dating to the time of the LGM. Three such samples can be identified from the results shown in their Figure 5. They relate to current *semiarid* conditions. These three samples are from regions southwest of Boomplaas on the coastal plain adjacent Cape Agulhas, notably Bakenskop (34.45°S, 19.52°E), Potberg (34.38°S, 20.55°E) and De Hoop (34.45°

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S, 20.40°E). In terms of degree of aridity, the GWA assemblage corresponds almost identically to two semiarid late Holocene samples, DGL and BLD.

TEMPERATURE

In the case of the first factor (F1) in Thackeray's (1987) study of mammalian microfauna, there was a clear dichotomy between taxa with high loadings (notably *Saccostomus campestris* and *Crocidura hirta*, species known to occur primarily in relatively warm subtropical environments) and those with low loadings (notably *Otomys saundersiae* and *Myosorex varius*, species known to be found in more southerly, cooler environments, capable of tolerating cold conditions). It could thereby be inferred that F1 related primarily to temperature. A temperature index (SSF1) was calculated as a summary statistic based on F1 loadings for each species, and the relative abundance of the corresponding taxa. SSF1 values for 124 assemblages from nine sites in southern Africa were calibrated on an arbitrary scale ranging from 0 to 100, and these were calibrated in degrees Celsius.

Whereas Faith et al. (2019) focussed on degree of aridity or humidity in their study, it is indeed also important to consider the effect of temperature. The three modern samples similar to GWA are situated in areas with latitudes ranging between 34.38°S and 34.45°S, at least 1° south of the latitude of the inland Boomplaas site (33.39°S). The difference in latitude would relate at least in part to temperature. This observation is entirely consistent with Thackeray's (1987) conclusion that the GWA sample relates to a mean annual temperature of 11.7°C, substantially lower than modern conditions in the Boomplaas environment.

DISCUSSION AND CONCLUSIONS

The statistical analysis undertaken by Faith et al. (2019), using ordination, shows that the aridity index of the GWA episode of the LGM at Boomplaas relates closely not only to the aridity values of three modern samples that can be identified with semiarid conditions in regions adjacent Cape Agulhas, but also to those of similarly semiarid late Holocene (DGL and BLD) samples at Boomplaas (Faith et al., 2019, Fig. 5A and B). Furthermore (and importantly), a rodent species that is commonly represented in the GWA assemblage is *Myotomys (Otomys) unisulcatus*, the Karoo rat, which (as its name implies) is at present distributed in semiarid Karoo environments. This would strongly suggest that at least part of the LGM in the Boomplaas environment was semiarid within the GWA period dated between 22,000 and 20,000 cal yr BP.

The inference indicated above for Boomplaas is not incompatible with observations based on nitrogen isotope ratios from a hyrax midden at Seweweekspoort (SWP), which is situated 70 km west of Boomplaas in a modern environment that can also be described as semiarid. Palaeoclimates of the late Holocene (comparable to modern conditions) at SWP appear to have been about as semiarid as those of the LGM, associated with nitrogen isotope ratios ranging between −0.1 and 0 (Faith et al., 2019, Fig. 7E).

Using mammalian microfauna, Thackeray and Fitchett (2016) identified seasonality of rainfall and recognised that the southern Cape received winter precipitation during the LGM in the vicinity of Boomplaas. The latter conclusion is entirely in accordance with the recent study by Faith et al. (2019), but Thackeray and Fitchett (2016) suggested that the *amount* of (winter) rainfall was relatively low for the GWA period, during at least part of the cold LGM in at least some regions of the southern Cape, even if the influence of the westerlies was intensified at that time.

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