

## ABSTRACT

The eastern Lesotho highlands observe climate patterns distinct from adjacent lower altitude regions, representing a niche environment with unique biodiversity, comprising well-adapted but restricted biomes. With a heavy reliance on subsistence agriculture, Lesotho faces risks to both the economy and individual livelihoods, should current rates of climate change persist or intensify. Furthermore, eastern Lesotho serves as southern Africa's primary water catchment, with precipitation exceeding evaporation. Any changes in the climate and hydrological systems, as are likely under climate change scenarios, would compromise biomes, livelihoods, and water security both locally and regionally. Climate change research in eastern Lesotho, is thus of particular value, yet meteorological data are sparse and the palaeoenvironmental history remains poorly resolved.

This research presents the first multi-proxy Holocene palaeoenvironmental and palaeoclimatic reconstruction for eastern Lesotho. This reconstruction is developed from the results from pollen, diatom and sediment analyses, extracted from sediment cores obtained from two peat bogs at Sani Valley (~2,800 m.asl) and Mafadi Wetland (~3,390 m.asl), and from an exposed gully-sidewall profile at Sekhokong (~2,950 m.asl), approximately 1km south of the Sani Valley site. The reconstructions are temporally constrained by AMS radiocarbon dates obtained for all three sites.

Mafadi Wetland demonstrates marked differences to the lower altitude sites, including slower sedimentation rates, a decrease in pollen and diatom taxa diversity, and an increase in the relative abundance of ice-tolerant diatom taxa. The microtopography of the three sites influences the rates of sedimentation, sediment properties, pollen composition, and distinct palaeoenvironmental and palaeoclimatic reconstructions for each site. The Sekhokong record commences in the late Pleistocene, with a wet period from ~13,180-10,850 cal. yr BP, interrupted by a dry period from ~13,080-12,830 cal. yr BP. From ~10,550-6,420 cal. yr BP, the Sekhokong record indicates a drier climate with a slow transition to warmer, wetter conditions. The Mafadi Wetland record commences with cold, wet conditions from ~8,140-7,580 cal. yr BP, followed by a warmer, drier period from ~7,520-6,680 cal. yr BP. Thereafter, greater microclimatic differences are apparent. For Sekhokong, warmer, dry conditions are inferred for ~6,420-6,000 cal. yr BP, followed by cold, wet conditions from ~6,000-5,450 cal. yr BP. Warmer, dry conditions commence earlier at Mafadi Wetland, from ~6,160-5,700 cal. yr BP, coinciding with the initiation of a longer wet period at Sani Valley, from ~6,200-4,900 cal. yr BP. At Sekhokong, a dry, warmer period follows from ~5,450-3,700 cal. yr BP. At Sani Valley, drier conditions are evident from ~4,770-4,470 cal. yr BP, followed by a cold, wet period from ~4,460-2,260 cal. yr BP. For Mafadi Wetland, these cold, wet conditions endure longer, from ~5,600-1,100 cal. yr BP. This overlaps with similarly cool, wet conditions at Sekhokong, from ~3,650-1,200 cal. yr BP. By contrast, dry conditions are evident at Sani Valley, from ~2,260-1,350 cal. yr BP. For all three sites, ~1,000 cal. yr BP to present is characterised by progressive drying, with discrete wet events. Pronounced cold events are detected at ~12,660 cal. yr BP, ~8,400-8,000 cal. yr BP and ~150 cal. yr BP.

The results of this study indicate similarities with records from adjacent studies in western Lesotho and South Africa, although with notable variability in the timing of events. The palaeoenvironmental reconstructions for eastern Lesotho, and their comparison with existing studies, provide valuable information to improve the understanding of southern African Holocene climates, and to facilitate the development of high resolution, accurate climate models for the eastern Lesotho region.