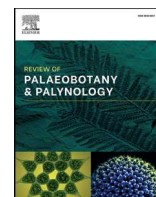




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## Intensification of pastoralism ~ 8 ka: Non-pollen palynomorphs analyses from the Rawatsera palaeolake sediments profile, Central Himalaya, India

Mohammad Firoze Quamar<sup>a,b,\*</sup>, Nagendra Prasad<sup>a,b</sup>, Maneesha M. ET<sup>a,b</sup>,  
Paulramasamy Morthekai<sup>a,b</sup>, Anoop K. Singh<sup>c,e</sup>, Lalit M. Joshi<sup>d</sup>, Bahadur S. Kotlia<sup>d,1</sup>,  
Dhruv Sen Singh<sup>e</sup>, Mohammad Javed<sup>a,e</sup>

<sup>a</sup> Birbal Sahni Institute of Palaeosciences, Lucknow 226007, India<sup>b</sup> Academy of Scientific and Innovative Research (AcSIR), Ghaziabad 201002, India<sup>c</sup> Department of Geology, School of Earth and Environmental Sciences, Babasaheb Bhimrao Ambedkar University, Lucknow 226025, India<sup>d</sup> Department of Geology, Kumaun University, Nainital 263001, India<sup>e</sup> Department of Geology, University of Lucknow, Lucknow 226007, India

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## ABSTRACT

The utility of non-pollen palynomorphs (NPP) as palaeoecological indicators and indicators of anthropogenic disturbances is rapidly growing because of their potential to comprehend palynological reconstructions of past communities and environments. Moreover, the initiation and development of pastoralism in India is poorly understood. We, in the present study, analyzed the NPP, especially the fungal NPP and the spores of coprophilous fungi (SCF), to understand the ecology, herbivore grazing (pastoralism) and human pressure during the Middle Holocene from a 2.75-m-long sediment profile from the Rawatsera palaeolake, Kumaun (Lesser Himalaya), India. The study demonstrated that between ~8327 and 8041 cal yr BP (Zone I), herbivore grazing and human pressure was noticed, based on the recovered SCF. Subsequently between ~8041 and 7406 cal yr BP (Zone II), the grazing activity (human pressure) intensified. Between ~7406 and 6999 cal yr BP (Zone III), compared to Zone I, pastoralism and local herbivore grazing increased. The detrended correspondence analysis also supports the findings of intensified herbivore grazing (pastoralism), based on the SCF. Moreover, soil erosion, compared to Zone II (~8041–7406 cal yr BP), was more during ~8327–8041 cal yr BP (Zone I), but comparatively increased during ~7406–6999 cal yr BP (Zone III) around the study area. Anthropogenic disturbance of varying degrees in the form of soil erosion (and grazing too) was, therefore, suggested, based on the recovery of fungal spores, especially *Glomus* sp., as well as the SCF during the Middle Holocene (~8327–6999 cal yr BP) from Kumaun, Central Himalaya, India.

## 1. Introduction

Non-pollen palynomorphs (NPP) are all 'extra' microfossils, excluding pollen grains, which survive chemical digestion during the pollen extraction process and appear on palynological microscope slides (van Geel, 2001). Moreover, NPP are a large and taxonomically heterogeneous group of remains of organisms within the size range of pollen grains (ca. 10–250 µm), living in diverse environments. NPP include fungal spores, algal spores, testate amoebae, as well as plant and zoological (animal) microremains. Among the fungal spores, the spores of coprophilous fungi (hereafter the SCF) serve as indicators of the local

presence of herbivores in relation to the existing vegetation (Graf and Chmura, 2006; Johnson et al., 2015). Over the last more than two decades or so, based on the changes in the relative abundance of the SCF, preserved in sedimentary profiles and coprolites, palaeoherbivory (as well as changes in population size) and palaeodietary analyses with respect to possible dietary changes have been made that may have contributed to the extinction of megaherbivores of the Pleistocene and Holocene Epochs (Quaternary Period) (Van Geel, 1978; Van Geel et al., 1983; Carrión et al., 2007; Pokharia et al., 2022; Britzius and Sirocko, 2023 and references cited therein). Moreover, the study of the SCF also provide information on ecology, diversity, niche partitioning, and

\* Corresponding author.

E-mail addresses: [mohdfiroze\\_quamar@gmail.com](mailto:mohdfiroze_quamar@gmail.com), [quamar\\_bot@yahoo.co.in](mailto:quamar_bot@yahoo.co.in) (M.F. Quamar).<sup>1</sup> Deceased.<https://doi.org/10.1016/j.revpalbo.2025.105288>

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