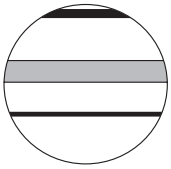

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Modern pollen distribution across Mizoram, northeastern India, impacted by regional climate and anthropogenic activities

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Abstract

Modern pollen-rain analysis was carried out for the first time across central, western and eastern regions of Mizoram, encompassing different regional climatic zones. The vegetation experiences massive ecological pressure as a consequence of environmental factors, including the monsoon winds from the Bay of Bengal, high temperature, precipitation conditions, and varied topography. Additionally, intense human activities in the state of Mizoram impact the forest landscape in the remote northeastern part of India. These include agricultural activities such as shifting cultivation (*Jhum*), commercial crop plantations such as banana, rubber, oil palm, tea, etc., pastoral activities and others. We collected moss cushion samples across transects in the central, western and eastern regions of Mizoram, to comprehend the impact of natural and anthropogenic factors on the modern vegetation and resultant pollen taxa on the surface deposits. The modern pollen data were analyzed statistically, including constrained redundancy analysis (RDA). The RDA analysis revealed the impact of bioclimatic variables on the pollen record, such as isothermality, precipitation in the warmest quarter and annual precipitation. The most significant variable was isothermality (bio_3) which indicated the dominance of anthropogenically impacted sites on the species distribution. Here, we identified that an interplay of climate- and anthropogenic-driven forcing were primarily controlling the modern vegetation and pollen-rain across Mizoram. The anthropogenic indicator pollen, such Poaceae (>50 µm), Caryophylaceae, Asteroideae, Cannabaceae, and Palmae at various sites reveal the impact of anthropogenic activities on the modern vegetation. The results reveal the impact of climatic zones, altitude gradients, anthropogenic activities and vegetation distribution on the pollen yield from the surface deposits.

Keywords

human impact, Mizoram, modern vegetation, pollen-rain, regional climate, shifting cultivation

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Introduction

The spatial coverage of modern pollen analogous enhances the interpretation of fossil pollen-based records for vegetation reconstruction, thereby improving the overall understanding of past vegetation and climate (Davis et al., 2013, 2020). The modern pollen-rain analysis based on quantitative assessment has been considered a suitable tool for assessing the modern vegetation that can provide a plausible understanding of extant vegetation and paleoclimatic reconstructions (Birks and Birks, 1980; Davis et al., 2013, 2020; Flenley, 1973; Liu and Lam, 1985; Moore and Webb, 1978; Wright, 1967). The study of modern pollen rain improves our understanding of modern forest types and overall forest diversity (Calcote, 1995; Xu et al., 2007; Zhang et al., 2017). Past landcover reconstruction based on relative pollen productivities (RPPs) has been utilized across the Northern Hemisphere successfully through the Regional Estimates of Vegetation Abundance from Large Sites' (REVEALS) model (Fyfe et al., 2013; Githumbi et al., 2022; Li et al., 2023; Mazier et al., 2012; Serge et al., 2023; Sugita, 2007; Trondman et al., 2016). The modern pollen records from the Eurasian region compiled in the Eurasian modern pollen database (EMPD), includes 8663 data sets having a spatial coverage in Europe and now extending toward northern and eastern Asia (Davis et al., 2020). There are limited modern pollen records from India and remote areas of Central, northern Asia and Middle East in the EMPD (Davis et al., 2020).

Northeastern India is well known for its biodiversity in terms of flora and fauna, as influenced by the altitude, topography and environmental variables. The modern forest types in this region range from tropical deciduous forests, to temperate, sub-alpine forests. The diversity in flora exemplifies northeastern India as a biodiversity hotspot. The modern vegetation analysis based on pollen-rain investigations in northeast India have been carried out in studies from Sikkim Himalaya (Dubey et al., 2018; Mehrotra et al., 2023), Darjeeling Himalaya (Ghosh et al., 2017), Arunachal Pradesh (Mehrotra et al., 2019), Assam (Basumatary, 2017;

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