

## ABSTRACT

Ungulate remains from Siwaliks of Pakistan provide a long and continuous record of diverse geochronologic ranges and ecological niches that in turn help to explore paleoenvironments of Pakistan Siwaliks. Ecomorphic data of ungulates dental material via hypsodonty, dental microwear, mesowear type-I, II and type-III methods was collected in the present study and on comparison of dental ecomorphic data of 163 taxa of ungulate remains with standardized data of their extant communities revealed a baseline data which helped for reconstruction of paleoenvironment of the target area. In the early Miocene (18.3-15 Ma), the paleocommunities of suids, tragulids, giraffids, anthracotheres and boselaphines have been found to give rise to 2 lineages each. However, rhinos and proboscideans have evolved into 3 to 4 lineages. Ecometric analysis has shown the predominance of browsers (50%), followed by frugivores (16.7%), mixed feeders in closed habitat (16.7%), and omnivores (15-17%) in forested habitats. In the middle Miocene (14.2-11.2 Ma), the paleocommunity has exhibited maximum species diversity that documented 54 lineages of ungulates including *Sivapithecus* sp. Un till 11 Ma, on the basis of baseline data the proportions of browsers gradually decreased, forest frugivorous and mixed feeder in closed habitats increased, however, the lineages showed no significant changes in their dietary adaptations. By 11 Ma, mixed feeding in open habitat taxa appeared with predominance of forest frugivores (35%) and browsers (32.5%). There was decreasing proportions of frugivore/selective browsers (35-16%), browsers (32-23.3%) and mixed feeders in closed habitats (19-16%) and increasing prevalence of mixed feeders (2.7-28%) in open habitats and grazers (0-4.64%) at 8 Ma. The latest Miocene (8-6.5 Ma) of the Siwaliks chronicled the progression of great faunal turnover event during which a significant number of long lasting lineages belonging to hipparionine horses, rhinoceroses, boselaphines, sivatherines, antelopes and tragulids altered their feeding adaptations from browsing to mixed feeders in open habitats/grazers. Most of the lineages of mixed feeders in closed habitats and frugivores gradually became extinct before 7 Ma, whereas, successive influx of lineages of mixed feeders in open habitats, grazers with stable turnover of browsers and omnivores progressed during 6.5-0.5 Ma.

The mesowear, microwear data from late Miocene and hypsodonty based ecomorphic data (18.3-0.5 Ma) has provided succession of the paleocommunities in Siwaliks which portray the evolution of the siwaliks ecosystem depicting the change from closed vegetation system (18.3-8.5 Ma) to semi-closed one and from semi-closed vegetation (8.5-6.5 Ma) to open vegetation system (6.5-0.5 Ma). The climate appears to have been evolved from humid and warm to dry seasonal and monsoonal one. The paleoclimate and vegetation succession has been found to lead to a cascade of diverse environmental mosaics ranging from tropical multi-canopied forest in the early Miocene to tropical evergreen forest during the middle Miocene. Thenceforth, moist deciduous canopy forest (11-10 Ma), dry deciduous forest (at ~9 Ma), mosaics of dry deciduous forest and temperate woodland (at ~8.5 Ma), woodlands with limited patches of deciduous forest, wooded savannas (8.5-6.5 Ma) progressed. The wooded savannas with guilds of grassy savannas (6.5-4 Ma) interspersed with deciduous forests and woodlands (4-3 Ma) and mosaics of wooded and grassy savannas (3-2 Ma) ecosystems evolved. The disappearance of most of the forested patches and prevalence of pure grasslands occurred during 2-0.5 Ma. This study provides a comprehensive account of the paleoenvironment of Pakistan Siwaliks in relation to mammalian biostratigraphic and paleoecologic processes at an evolutionary scale.