Evidence of early human disturbance in high elevation upper Nilgiris based on paleofire records and lipid biomarkers

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Humans have extensively altered the global environment, changed the ecosystem structure and disrupted the equilibrium between climate and vegetation. Human migration in response to prolonged or abrupt climate change during the Holocene has been recorded in many regions of the world, especially in temperate. Vegetation shifts in the past of tropical montane forest-grassland ecosystem mosaic in Nilgiris (India) is well documented using stable isotope studies and palynology. Here we present the results from geochemical and biological analysis of peat samples to understand fire-vegetation relationship and also to establish role of human in altering the stability of the ecosystem. We evaluated charcoal records to interpret paleofires, coprophilous fungal spores to understand levels of herbivory, n-alkane to infer past climate and vegetation shifts and faecal sterols to understand human interferences.

Macro and microcharcoal record show a local fire event ~3500 cal yr BP which also shows peak in coprophilous fungal spores. Study from mid elevation region of Nilgiris, recorded a local fire starting around 3500 BP lowering the tree cover state, possibly due large-scale land use changes for settled agriculture. The spike in coprophilous fungal spores count at around 3500 cal yrs BP indicates increased herbivory, which could be due to livestock introduction by the aboriginal tribes, in this case buffalo by the Todas. At the same time, expanding grasslands could also have facilitated an increase in the population of wild herbivores. Synergistic effect of climate and the anthropogenic disturbances experienced by the region played a key role in shaping the landscape mosaic in the region. The main objective of lipid biomarker analysis was to correlate the climatic and environmental condition obtained from various proxies to that of the previous paleoecological studies from the region. The n-alkane indices including average carbon length (ACL), C27/C31 ratio and Paq indicate dry arid conditions during the period and a characteristic shift towards grassland. Fire event recorded in our samples coincides with the C3 to C4 shift recorded in the previous studies from the region. Moreover, lipid biomarkers indicate increased ACL, lower peat accumulation and arid climatic signatures from the oldest sample dating back to 21000 cal yr BP. Fire is an important disturbance event influencing the vegetation and climate of the region. Sterol biomarker ratios of coprostanol and other phytosterols from the late-Holocene fire event sample also shows signatures of human and bovine faecal contamination. Modern samples also showed traces of faecal contamination which is expected since the study site is routinely visited by cattle and other livestock. Increased fungal spore count and traces of human/bovine faecal sterols from the sample provide compelling evidence for human presence in the region ~3500 cal years BP. We thus infer that the Todas migrated to the highest elevations of the Western Ghats in response

to prolonged or abrupt climate change in peninsular India, about 3500 yr BP or about 1500 years prior to what was previously thought.
First human influence in Western Ghats is reported around 12000 years and the early agri-pastoralism during the Neolithic Slowly the early inhabitants started adapting to the environment and actively manipulating the ecosystem for resources. Todas made extensive use of the Nilgiri grasslands and sholas for buffalo, as sources of building materials and the locale for ritual activities. The increased dung fungal spores coinciding with the fire event inferred from charcoal counts suggests domestication and grazing related landscape management by early inhabitant. Despite the lack of archaeological evidences from the region, our data provides promising evidences to link fire occurrence to early landscape management practices by aboriginal toda tribes. From the study it's clear that there is a fire followed by an increased herbivory and an associated vegetation change in the region. Occurrence of fire in the past not only reflect climatic factors but also the anthropogenic landscape management practices and cultural background.