CHAPTER IX

SUMMARY
The study was carried out in the natural grasslands of Kundah Plateau of Western Ghats, which is located in the Nilgiris district, Tamil Nadu, India. It lies at latitude 11°13'N and longitude 76°39'E at an elevation range of 2150 to 2450 metres above M.S.L. The grasslands extends over an area of 1,000 hectares and is effectively protected as a reserve forest. The soil is moderately fertile, black, clayey loam and is extremely shallow. The temperature falls to 9 - 10°C during winter and reaches as high as 29°C in the summer-months. The area receives copious rainfall to the extent of 3150 mm per annum through south-west and north-east monsoons and the relative humidity ranges from 42 to 98%. The area is subjected to high velocity winds especially during July and August. The perennial grass Cymbopogon polynesuros is dominant throughout the year. The grassland is interspersed with shola pockets according to topography and the area is inhabited by a rich variety of wildlife.

Fire, natural or man made, usually occurs in summer months. During the second week of April, 1992, a surface fire wiped off large areas of grassland sparing a patch of about 60 hectares off a shola ingression. An alleged tribal fire occurred again in the first week of April, 1993 in the burned area, clearing few hundred hectares. Enquiries revealed that the burned patch of grassland usually escapes surface fire as it is isolated by a stream and adjoining shola forest from the rest of the grassland. However, it was known that both the sites were burned in the summer month of 1991. Observations were made on soil properties, beneficial microbial populations and biomass production for a period of 2 years from April, 1992 onwards both at the naturally isolated unburned patch and burned areas of the grasslands.
The soil properties studied include physical properties such as moisture content, water holding capacity, and bulk density, chemical properties like pH, electric conductivity, and N, P and K contents, and biological properties like organic matter content, CO₂ evolution, and activities of the soil enzymes amylase, cellulase, invertase, and phosphatase.

Among the physical properties, moisture content, water holding capacity, and bulk density were not significantly altered by fire. While the soil moisture and water holding capacity increased with the soil depth, the reverse was good in the case of bulk density. Few chemical properties like pH, electric conductivity, and P content were also comparable between sites and soil layers. On the other hand, K content increased significantly in all the three layers in the burned site while the N content was markedly lower in the first year of burning in the A₁ and A₂ layers only. Generally, the month of burning and a couple of subsequent months were characterized by pronounced decreases in the N and P contents.

The A₁ layer of soil registered higher levels of organic matter content, CO₂ evolution, and the activities of soil enzymes like amylase, cellulase, invertase, and phosphatase. With the exception of initial decreases, surface fire was not found to alter the organic matter content significantly. On the other hand, CO₂ evolution and the activities of the studied soil enzymes recorded significant increases in the burned site.

The populations of beneficial microorganisms studied were nitrogen fixing microorganisms, phosphate solubilizing microorganisms, vesicular-arbuscular mycorrhizal (VAM) fungi, and litter decomposing fungi. All the three N fixation microorganisms, viz., *Rhizobium*, *Azospirillum*, and *Azotobacter* significantly improved their
populations in the post-fire community. The rhizobial nodular count as observed in the dominant legume *Rytlosia trinervia* also was significantly enhanced by fire during the second year (1993 - 94) of observation. However, in the first year, the nodule number was comparable between sites. Among the phosphate solubilizers, the populations of bacteria and fungi were significantly increased by fire whereas the actinomycete population remained unaltered. Altogether 36 species of microfungi capable of solubilizing insoluble tricalcium phosphate were recorded, their population densities varying between sites according to individual species. The most efficient P-solubilizers among them were *Absidia ramosa, Gongronella butleri, Mortierella spinosa, Mucor racemosus, Rhizopus nigricans, R. stolonifer, R. oryzae, Aspergillus fumigatus, A. nidulans, A. niger, Thielavia terricola and Chaetomium lunasporium.*

The VAM status of the study sites was assessed both in terms of the percentage root colonization of the dominant grass *Cymbopogon polyneuros,* the dominant legume *Rytlosia trinervia* and the 'other species' *Strobilanthis kunthianus* and the rhizosphere spore count. VAM colonization showed initial decreases following burning in all the three species, which in the later months was made more than good when compared with the unburned site. The spore density assignable to *Acaulospora, Gigaspora, Glomus, Sclerocystis* and *Scutellospora* species ranged between 1641 and 3605 spores per 100 gram dry soil. Among them, *Glomus* was the predominant genus followed by *Acaulospora* while *Sclerocystis* was poorly represented. Though surface fire generally enhanced spore density, statistically significant increases were observed only in *Acaulospora* and *Sclerocystis* during 1992 - 93 and *Scutellospora* during 1993 - 94.
The litter decomposition as measured by weight loss was slightly faster in the burned site when compared to unburned site. The soil moisture content between the two sites, however, was comparable. When the surface and buried litter were compared, the rate of decomposition was higher in the latter, so also the moisture content. In both the sites, the decomposition of litter progressed, their macronutrient (N, P and K) content decreased. However, these decreases were relatively higher in the burned site. When a comparison was made between nutrients with respect to their relative rates of depletion, the percentage decrease of N was the lowest.

A total number of 101 species of microfungi were identified from the different grades of decomposing *Cymbopogon polyneuros* litter. The same species were also isolated from the grassland soil. A number of microfungi were exclusively present either in unburned or burned site whereas many were common to both the sites. The association of fungal species was specific to the grade of the decomposing litter. The mycophagous insect called fungus ghat (*Mycetophilidae*) was invariably associated with Grade III litter. Earthworms and nematodes were also seen in the proximity of decomposing litter bags, but termite activity was not evident.

Aspects related to community metabolism such as biomass, production, turnover and disappearance of the above ground, belowground and litter components were investigated for a better evaluation of the effect of surface fire. The biomass of the community at different compartments viz., grasses, legumes and 'other species', varied considerably over the period of observation. Though burning seemed to decrease the total aboveground biomass in the early
stages, higher biomass values were obtained in later stages. In the unburned site, however, the aboveground biomass remained more or less static. The belowground biomass, unlike its aboveground component was not significantly altered by fire. The accumulation of litter biomass steadily increased throughout the year right from burning month but it remained static in the unburned site.

The net primary production of the Kundah grasslands was very high in the range of 5294.54 - 6962.88 g/m²/year and the maximum contribution was made by the grasses. After fire, the net community production in terms of aboveground, belowground and litter parts showed a pronounced increase. However, the increases in the latter two components were statistically not significant.

The grassland has the potential to replace the entire aboveground biomass approximately in an years time as indicated by its high turnover rates. A further increase in the turnover rate in the burned site would indicate effective recycling of nutrients under stress. The lower turnover rates for belowground parts would ensure storage of resources and thus help in the survival of the community.

The belowground/aboveground biomass ratio of the community which was always less than one indicates the favourable environmental conditions for the predominance of aboveground parts in the Kundah grasslands. System transfer function also showed that more dry matter was diverted towards aboveground parts as compared to belowground parts. Fire increased the transfer rates of dry matter between the components thus disturbing the community's natural development. Thus it may be concluded that surface fire in Kundah grasslands
disturbs the community dynamics and keeps it at a highly productive seral stage. The microbial activity in general and the beneficial microbial populations in particular also showed concomitant increases in the post-fire community maintaining the high productivity.