CHAPTER ##

GENERAL DISCUSSION
The grasslands of Chhattisgarh region are situated on poor soil called locally as "Bhata soil". They have low organic content and are infertile, therefore the cultivation is not done on these soils and these grasslands come up naturally. The condition of "Bhata soil" of Raipur is precarious. The grassland vegetation of working site (Tarenga village) is rather poor and even during the monsoon season it produces scanty vegetation. The grasses species with few exceptions are mostly dominated by unpalatable species. The situation becomes more serious due to free grazing in the area. The grazing animals do not allow grasslands to attain their maximum development and the palatable species are replaced by nonpalatable species. This has a profound effect on the composition, structure, physiogromy and mineral status of the grasslands. In the present investigation, the impact of grazing on the biomass structure and mineral status has been studied around Tarenga village (District Raipur) during 1989-90.

Protection of a portion of grazed grassland on Bhata waste for a very short duration does not appreciably affect its species composition (Verma 1978). However, Naik (1973) stated that the number of species remained less in the grazed plot and when protection is given to such a plot it has resulted in an increase in the number of species. In the present investigation there was a change in the species composition when two years protection was given to the grazing land. Very similar
to the present findings, Bansal (1975) has recorded a change in the species composition when 3 years protection was given to the grazed grassland at Bilaspur. However, Verma (1978) did not find appreciable effect, when protection was given to the grazing land at Raipur. The total number of species was 26 at the protected and 17 species at the grazed site respectively. Of the total, 13 species were new at the protected site. 4 species of the grazed site did not show its presence at the protected site. Bansal (1975) and Verma (1978) have reported higher number of species from the Bhata soil of Bilaspur and Raipur.

The green biomass of the protected site increased continuously after May to a peak value of 291.18 g m$^{-2}$ in August. Chaudhary (1972), Gupta (1976), and Gupta et al. (1981) have also reported peak biomass in August. On the other hand Bansal (1975), Verma (1978) and Jaiswal (1990) for Bhata soil grasslands of Chhattisgarh and Jain (1971), Misra and Bajpai (1971), Mall and Billore (1974), Singh and Yadav (1974). Trivedi and Misra (1979) and Bhargava and Ratnam (1981) for other Indian tropical grasslands have reported peak green biomass in the month of September. Whereas, Naik (1973), Mehta (1977), Trivedi and Mishra (1979), Agnihotri (1979), Pandey and Sant (1980), Shrivastava (1983) and Misra and Misra (1984) while working on different tropical grasslands of India have reported peak biomass in the month of October. The green biomass fluctuated after August except a rise in January which was due to winter rains. The
impact of grazing is seen only on the quantity of green biomass rather than on the trend, although the grazed site was under continuous grazing. It might be due to the very poor vegetation developing on bhata soil. The peak green biomass of 87.96 g.m$^{-2}$ was recorded in August which is very similar to Shrivastava (1983) for the grazed grassland of Ambikapur.

The standing dead vegetation is the transition stage between live green biomass and litter. Very similar to the findings of Shrivastava (1983), there was no definite trend of standing dead biomass at both the sites except that high values of standing dead biomass were recorded from September to February in the present investigation. The reason assigned to the high values of standing dead biomass from September to February was the gradual transfer of green biomass to the standing dead biomass by the annual plants after completing their life cycle. As expected, the average annual standing dead biomass was greater at the protected site than at the grazed.

The total aboveground biomass of the protected site increased after June and reached its peak in August (351.42 g.m$^{-2}$) and then declined. Whereas, Bansal (1975) and Verma (1978) have reported peak biomass in September, while Jaiswal (1990) has reported peak biomass in October for different bhata soil grasslands of Chhattisgarh. The aboveground biomass again increased in January and February. The increase of biomass in January and February is assigned to winter rains which caused fresh sprouting of perennial species. The grazed site did not show any trend except that a peak value (136.18 g.m$^{-2}$) of total aboveground biomass occurred in January.
The standing crop of litter was completely absent in the rainy season at both the sites. The absence of litter in the rainy season is attributed to the complete disappearance of litter as a result of increase of microbial activity under favourable temperature and moisturous conditions in the rainy season. The litter increased continuously from October and reached its maximum value in January (582.48 g.m⁻²) at the protected site and February (313.18 g.m⁻²) at the grazed site. The increase of ground litter after October is assigned to the gradual transfer of aboveground plant parts to the litter compartment by the annuals which complete their life cycle at the end of rainy season and later on perennial species.

The belowground biomass of the protected site increased from June to September due to rapid absorption of minerals for aboveground growth. The increase of belowground biomass after November might be due to the downward translocation of organic matter from the dying aboveground plant parts. The belowground biomass data of grazed site did not show a regular trend mostly due to continuous grazing of aboveground plant parts resulting upward movement of material in varying amount in different months.

The belowground/aboveground ratio was maximum during summer at both the sites, obviously due to rather poor amount of aboveground biomass than the belowground biomass in the summer months. The ratio was higher at the grazed site than at the protected site except in April. This is apparent from the fact that a continuous grazing removed the aboveground biomass but the belowground parts were not affected to a considerable extent.
In multi species community, all species may not reach their maximum growth at the same time (Odum 1960) and hence their greatest individual weight may not be attained at the time of maximum community biomass. Three methods are used to determine the aboveground net production and each method has its own merits and demerits. Looking into the merits and demerits of each method, the summation of peak biomass of individual species has got lesser chances of error. The aboveground net production by the summation of peak biomass of individual species was 1068.92 g.m$^{-2}$ yr$^{-1}$ at the protected site and 274.18 g.m$^{-2}$ yr$^{-1}$ at the grazed site.

The annual belowground net production of the grazed site (1025.90 g.m$^{-2}$ yr$^{-1}$) was greater than that of the protected site (481.69 g.m$^{-2}$ yr$^{-1}$). Sims and Singh (1971) observed that efficiency of belowground net production was greater in grazed grassland. In the present investigation the turnover value was less than unity at the protected site and very high at the grazed site, indicating that the replacement of belowground parts at the grazed site was faster than the protected site and showed complete replacement within the same year.

The total net production was 1550.61 g.m$^{-2}$ yr$^{-1}$ and 1300.08 g.m$^{-2}$ yr$^{-1}$ for the protected and grazed sites respectively. The total net production for the protected and grazed sites was very high in comparison to the earlier work for bhata soil grasslands of Chhattisgarh region (Bansal 1975, Verma 1978 and Jaiswal 1990).
The high rate of litter disappearance was obtained during the period from 20 February to 19 March at the protected site and from 20 January to 19 February at the grazed site. The high rate of litter disappearance during January to March might be due to winter rains accelerating the process of disappearance. Naik (1973) stated that increase in the rate of disappearance is observed when occasional showers occurred during post monsoon months.

The herbage intake was greater than that reported by Pearson (1965) and Singh et al. (1975) but the value reported by Shrivastava (1983) is nearer to the present work. The present findings indicate that the grazed site is under heavy grazing pressure.

The values given in the budget of dry matter dynamics are not as informative as the transfer rates between different biological components of the two sites, when the values are compared with bhata soil grassland of Raipur (Verma 1978), the present values differ considerably. However, the values may be favourably compared with the values of Ujjain (Misra 1973), Ratlam (Billore 1973), Kurukshetra (Singh and Yadav 1974), Mandla (Agnihotri 1979) and Ambikapur (Shrivastava 1983) to some extent.

Soil is the main source of necessary mineral elements and an important component of ecosystem. In the working site-woil, the nitrogen ranged between 0.002 - 0.009 percent and phosphorus ranged between 0.001 - 0.007 percent respectively. The values
are less than the normal values given by Bear (1964). The percentage of soil nitrogen at the protected site gradually increased after July and reached its maximum in September and fluctuated thereafter. Whereas at the grazed site it increased after May and remained high up to December. The high concentration of nitrogen during rainy season might be due to the nitrogen added to the soil along with rain water and also due to the activity of the microorganisms. The concentration of soil phosphorus at both the sites fluctuated throughout the year. The trend of concentration of these elements in the soil was nitrogen > phosphorus.

The percentage of nitrogen and phosphorus in the aboveground plant parts varied significantly in different months and in different species at both the sites. The percentage of nitrogen and phosphorus in the green aboveground plant parts of different species was higher than the aboveground dead plant parts in different months at the protected and grazed sites. The higher percentage of these elements in the living aboveground plant parts might be due to the withdrawal of these elements before senescence. The percentage of nitrogen in the green aboveground parts of the plants were generally high in the month of August at both the sites and declined later on. Whereas, the percentage of phosphorus in the green aboveground plant parts of all the species of the protected and grazed sites was high up to December. Very similar to the present findings, many workers (Bernard and Solsky 1977, Bernard and Fitz 1979, Bernard and
Mellisa 1979 and Woodmansee and Duncan 1980) have shown that in the herbaceous plants initially there was a rise of concentration of these elements when new tissues were formed but declined later on as the tissues aged. In *Eragrostis viscosa* the concentration of nitrogen was high throughout the year but *Eragrostis tenella* showed high concentration in the rainy season only. However, the trend of phosphorus concentration did not deviate from other species. The percentage of nitrogen and phosphorus in *Zornia gibbosa* of the protected site was high upto November and September respectively. *Indigofera linifolia* of the grazed site did not show seasonal trend of nitrogen but it showed higher percentage of phosphorus upto October. In the most dominant forbs of the two sites, *Evolvulus alsinoides* has shown higher percentage of nitrogen between November and January but phosphorus percentage was fluctuating throughout the year.

Nitrogen and phosphorus stored in the aboveground parts return to the soil through the litter fall. The percentage of nitrogen and phosphorus in the litter was high in the winter months. The high concentration of these elements in the litter might be due to the addition of nitrogen and phosphorus rich flowers and seeds of annual species. On the other hand, Woodmansee and Duncan (1980) stated that the increase of nitrogen and phosphorus in the litter in winter is due to the increase of nitrogen phosphorus rich soil microflora and microfauna resulting increase in the concentration of litter.
The underground parts of the plant absorb mineral elements from the soil and supply it to the aboveground parts. The concentration of nitrogen in the belowground parts did not show any noticeable trend except that low concentration during rainy season and high in summer at both the sites. The reason assigned to the low concentration during rainy season is the translocation of nitrogen to the fast growing aboveground parts. The high concentration of nitrogen in the summer months is attributed to the downward movement of nitrogen from the dying aboveground parts showed a more or less similar trend but with frequent fluctuations.

The nitrogen and phosphorus content (mg.m$^{-2}$) in the aboveground plant parts (green, dead and total) of different species varied considerably throughout the year. It is due to the variation in the quantity of biomass and concentration of nitrogen and phosphorus in different months. The most dominant species among the grasses-sedges category, *Eragrostis viscosa* of the protected site did not show regular trend. Whereas, nitrogen and phosphorus contents in the most dominant legume *Zornea gibbosa* increased after July and reached its peak in September, declined thereafter. Woodmansee and Duncan (1980) have observed that in a legume *Trifolium* sps. the phosphorus content increased up to a peak standing crop and
then declined. The dominant forb *Evolvulus alsinoides* did not show a steady trend and fluctuated throughout the year with the fluctuation of monthly biomass. The impact of grazing was quite evident at the grazed site. There was no definite trend of nitrogen and phosphorus contents in any of the categories and species, only 3 species at the grazed site *Eragrostis tenella* *Evolvulus alsinoides* and *Evolvulus nummularius* showed an increasing trend in the rainy season. *Eragrostis tenella* being a nonpalatable species and possibly *Evolvulus alsinoides* and *Evolvulus nummularius* being a prostrate species escaped and showed a normal trend of nitrogen and phosphorus accumulation.

The standing state of nitrogen and phosphorus (mg m$^{-2}$) in the total aboveground green plant parts increased after May to September and August at the protected site and grazed sites respectively and fluctuated thereafter. The increasing trend of these elements after rainy season were mainly due to the decreased biomass and partly due to the decreased rate of mineral uptake by the aging plants.

The amount of nitrogen and phosphorus in the litter varied considerably at both the sites throughout the year, mainly due to the fluctuation of litter present in different months at both the sites.

The nitrogen content in the belowground plant parts increased continuously after June to September and the phosphorus content increased after July right upto December. The increase of these elements might be due to the rapid absorption so as to
meet the need of fast growing aboveground shoot. Whereas, the increasing trend of nitrogen continued till December at the grazed site for supplying nitrogen to the new shoots appearing continuously due to grazing. On the contrary phosphorus content at the grazed site fluctuated throughout the year. It might be due to the upward movement of phosphorus in varying amounts in different months.

The total amount of nitrogen and phosphorus (aboveground + belowground) increased continuously during rainy season at both the sites. The impact of grazing is seen only on the quantity of these elements present in different months rather than on the trend in the rainy season. The nitrogen and phosphorus content of different months depended upon each other and on the biomass as well at the protected site. This is apparent from the significant positive correlation between nitrogen with biomass ($r = +0.87$), phosphorus with biomass ($r = +0.80$) and nitrogen with phosphorus ($r = +0.73$). The impact of grazing is seen on the relationship of these elements with the biomass at the grazed site. This is apparent from the insignificant correlation between nitrogen with biomass ($r = +0.12$) and phosphorus with biomass ($r = +0.18$). However, no impact was seen on the mutual relationship of these elements. This is obvious from the significant positive correlation between nitrogen and phosphorus ($r = +0.74$).

The nitrogen and phosphorus uptake by the aboveground plant parts was maximum during rainy season at the protected site. The maximum uptake of nitrogen and phosphorus during rainy season shows that the young plants are more active not only in nitrogen
uptake but also in phosphorus uptake for vegetative growth. At the grazed site the maximum uptake of phosphorus was in the rainy season but nitrogen uptake was maximum during winter. The maximum uptake of nitrogen in the winter season at the grazed site shows that the grazed plants require more nitrogen even after rainy season for continuous vegetative growth. The uptake of nitrogen and phosphorus by the belowground part was maximum during winter season at the protected site. The maximum uptake of nitrogen and phosphorus during winter might be due to greater absorption of these elements. The maximum uptake of these elements at the grazed site was in the summer season. The total annual uptake of 2 nutrients in the plant biomass of both the sites followed a trend of

Nitrogen and phosphorus stored in the plant return to the soil through litter decomposition and belowground disappearance. The release of nitrogen and phosphorus through litter decomposition was maximum during 20 February - 19 March at both the sites. However, on weight basis the maximum rate of release was between 20 February - 19 March at the protected site and between 20 January - 19 February at the grazed sites. The reason assigned is the faster rate of microbial activity on litter after winter rains to release greater amount of nitrogen and phosphorus from the litter. The release of nitrogen through belowground disappearance was maximum in the winter season at the protected site, while in the rainy season at the grazed site. The phosphorus release through belowground disappearance was maximum during summer and rainy seasons for the protected and grazed sites both.
The mineral budget of the two sites reflects that 45.78% nitrogen, 9.38% phosphorus at the protected site and 49.56% nitrogen, 10.27% phosphorus at the grazed site were circulated in the biotic system and remaining in the soil compartment. Of the entire uptake of nitrogen and phosphorus, 56.83 and 28.03 percent at the grazed site returned to the soil compartment from the biotic compartment annually. The annual loss of these elements through herbage intake from the grazingland were nitrogen 23.78 percent and phosphorus 40.26 percent but the amount of nitrogen and phosphorus return through feces and urine of the cattle has not been estimated.

In the light of the present findings it may be concluded that the present bhata soil grasslands are really very poor and the grazed site is under heavy grazing pressure. The soil of the two sites are very poor in nitrogen content. If the grazinglands are not properly maintained it will lead to the further deterioration-cum-degradation and the palatable species will be completely replaced by the nonpalatable species.