

## Biomass Fluctuation in Alpine Pastures of Kashmir Himalaya

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**Abstract :** In a free grazing alpine pastureland of Kashmir Himalayas, the plant biomass fluctuation had no definite trend at both grazed and protected sites. Above ground (live) biomass attained its peak value of  $146.1 \text{ g m}^{-2}$  at grazed sites in August and  $170.8 \text{ g m}^{-2}$  at fenced sites in the first week of September. Root:shoot ratio was higher at grazed site than at protected site. In alpine meadows of Kashmir Himalaya (Rupri marg), the seasonal grazing by the transhumant and nomadic grazing societies significantly affect the structural and functional attributes of alpine pasturelands of the state.

**Key words :** Biomass, grazing community, nomadic, transhumance, alpine, margs, pasturelands.

Alpine pastures in India occupy 1.52% of the total land area and are mainly concentrated in the four Himalayan states of Arunachal Pradesh, Sikkim, Uttar Pradesh, Himachal Pradesh and Jammu & Kashmir. Against 25.88% area under alpine pastures in the above states, the total area under alpine pastures in J&K State alone constitutes 59.33% of its total geographical area.

On these alpine pastures is dependent the economy of 2.0 lac Gujjars, 34,899 transhumance Bakkerwals, 18,039 Gaddies, 3,511 nomadic Changpas and 54,017 semi-nomadic Purigapas and other semi-sedentary grazing communities of the state.

An attempt has been made to analyze the fluctuations in above ground and below ground biomass of one of the alpine meadows in the Kashmir Himalaya.

### Materials and Methods

The study site was located (along one of the major oscillation routes of transhumance herdsman) in Pirpanjal mountain range of Kashmir Himalaya at 3400 m a.s.l. The study sites are situated in the lap of famous Dhakyar Peak (3650 m) surrounded by several Margs

(alpine pastures), in Rajouri district, popularly known as Rupri Marg, between longitude  $74^{\circ}35'$  to  $74^{\circ}40'$  East and latitude  $33^{\circ}25'$  to  $33^{\circ}35'$  North. Three sites were selected at different elevations, viz., Sewari (3200 m), Badjari (3400 m) and Bela (3600 m).

A quadrat (1.0x1.0 m) was selected for sampling. The changes in plant biomass were recorded following the harvest method (Misra, 1968). For the estimation of below ground biomass, soil monolith of 10x10x10 cm was excavated and washed with water. Plants with clear roots were taken out and packed in polythene bags. The plant material was separated into above ground live, above ground dead and under ground parts, dried at  $80^{\circ}\text{C}$  for 24 hours and weighed. The species-wise biomass analysis was not carried out as the study was concerned mainly with the total herbage production vis-a-vis livestock consumption in the pasture.

### Results and Discussion

The mean above ground live biomass at three sites was more in fenced areas than in protected areas. The above ground biomass at grazed site varied from  $56.1 \text{ g m}^{-2}$  to  $146.1$

Table 1. Biomass production in Rupri Marg (Dry weight, g m<sup>-2</sup>)

| Compartment       |   | 02.7.92 | 12.7.92 | 22.7.92 | 01.8.92 | 07.8.92 | 14.8.92 | 21.8.92 | 28.8.92 | 05.9.92 | 15.9.92 | 25.9.92 |
|-------------------|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Above ground live | g | 56.0    | 65.2    | 115.8   | 146.1   | 116.5   | 119.7   | 102.5   | 106.1   | 93.4    | 68.0    | 56.1    |
|                   | f | 52.0    | 84.0    | 127.3   | 124.3   | 137.8   | 127.5   | 153.3   | 125.5   | 170.8   | 94.0    | 125.1   |
| Above ground dead | g | 122.4   | 99.0    | 51.2    | 63.9    | 100.5   | 137.2   | 112.3   | 101.4   | 101.7   | 102.4   | 90.5    |
|                   | f | 78.3    | 122.3   | 79.0    | 78.3    | 114.0   | 80.5    | 82.5    | 92.6    | 105.3   | 115.8   | 108.3   |
| Litter            | g | 259.7   | 265.6   | 233.4   | 172.4   | 130.9   | 128.2   | 145.3   | 116.2   | 107.0   | 138.5   | 102.1   |
|                   | f | 366.6   | 363.3   | 272.3   | 156.6   | 143.6   | 80.3    | 74.3    | 112.5   | 59.3    | 48.3    | 69.0    |
| Below ground      | g | 1428.4  | 1496.6  | 1842.2  | 1528.1  | 1580.5  | 1502.8  | 1585.5  | 1413.7  | 1316.2  | 1454.8  | 1215.2  |
|                   | f | 1672.6  | 1765.3  | 2175.6  | 1841.3  | 1796.8  | 1443.3  | 1754.1  | 1817.5  | 1504.8  | 1667.0  | 1556.3  |
| R/S ratio         | g | 25.9    | 22.92   | 15.9    | 10.4    | 13.5    | 12.5    | 15.5    | 13.3    | 14.0    | 21.1    | 21.6    |
|                   | f | 32.1    | 21.0    | 17.0    | 14.4    | 13.0    | 11.3    | 11.4    | 14.5    | 8.8     | 17.7    | 12.4    |

g = grazed site

f = fenced site.

g m<sup>-2</sup>, while at protected site, it was 52.0 g m<sup>-2</sup> to 170.8 g m<sup>-2</sup>. Peak production of 146.1 g m<sup>-2</sup> was recorded on 1st August on grazed site and on 5th September on protected site. Production gradually increased from 2nd July to 1st August at grazed site, but at protected site, it increased upto 5th September and then declined. The below ground biomass was more at protected site than at grazed site. The biomass values at grazed site varied from 1215.2 g m<sup>-2</sup> to 1842.2 g m<sup>-2</sup> and at the protected site from 1443.2 g m<sup>-2</sup> to 2175.0 g m<sup>-2</sup>.

The standing dead biomass fluctuated throughout the year with maximum at the beginning, middle, and end of the grazing season. The mean standing dead biomass ranged from 51.2 g m<sup>-2</sup> to 137.2 g m<sup>-2</sup> at grazed site and 78.3 g m<sup>-2</sup> to 122.2 g m<sup>-2</sup> at the protected site.

The standing crop of ground litter, at all the sites, fluctuated throughout the grazing season, showing a trend of decline from snow melting to first snowfall. The mean litter at Rupri Marg biomass ranged from 102.1 g m<sup>-2</sup> to 259.9 g m<sup>-2</sup> at grazed site and 48.3 g m<sup>-2</sup> to 366.6 g m<sup>-2</sup> at the protected site. In both the cases, peak values were recorded just after first snow melt from the meadows and declined till snowfall (Table 1).

The difference in production of peak biomass, in case of grazed and protected sites, may be due to grazing. At individual site (Sewari, Badjari, Bela), the variation in biomass production was due to the grazing behaviour of animals and daily routes they followed for grazing.

In tropics, due to fluctuating rainfall and drought conditions, several peaks are recorded in green biomass production (Singh and Joshi, 1979), but in temperate grasslands, unimodal pattern of changes in green biomass have been recorded (Sims and Coupland, 1979), a trend also recorded in the present study. No set pattern of standing dead biomass fluctuation was recorded, except that the maximum values were recorded at the beginning, middle, and end of the season. Peak value at the beginning of season may be attributed to the transfer of recent dead category of green shoots that overwintered. Maximum values in middle and end of season are attributed to the effect of trampling and grazing.

The production of above ground biomass was maximum in August due to favourable environmental conditions. The production declined after September due to lowering of temperature and permafrost at high alpine. When compared with tropical grasslands, the values are comparatively low. Similar results

were reported by Singh (1968), Ambasht *et al.* (1972), Pandey (1978) and Ambasht (1988).

Higher values of below ground biomass production are in agreement with the observations recorded by Billore (1978). Higher values have been recorded in temperate and alpine areas than in tropics (Coupland, 1979). This is partly due to lower rate of turnover associated with lower temperature at high altitude. Lower values in growing season and higher value in the beginning of season, i.e., July, may be due to the accumulation of food material in winter and translocation of the same in the growing season to above ground parts. Numata (1979) observed that the absolute values of biomass depend on the latitude, altitude, soil fertility, weather and amount of soil moisture.

Fluctuations in above ground and under ground biomass production recorded in the study is mainly due to the effects of grazing, trampling, rainfall and the altitude. Maximum production is recorded at both grazing and protected sites in favorable temperature and rainfall conditions as recorded by other workers (Coupland, 1979).

In order to improve alpine pasturelands of Himalaya, the scientific management of these pastures needs to be considered holistically, promoting a balanced development of grassland- livestock and the grazing communities.

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#### References

- Ambasht, R.S. 1988. Studies on the biomass productivity of some tropical grazing lands and plantation forests. In *Rangelands Resource and Management*. (Eds. Panjab Singh and P.S. Pathak), pp. 38-44, IGRI, Jhansi.
- Ambasht, R.S., Maurya, A.N. and Singh, V.N. 1972. Primary production and turnover in certain protected grasslands of Varanasi, India. In *Tropical Ecology with an Emphasis on Organic Production* (Eds. P.M. Golley and F.B. Golley), pp. 43-50 University of Georgia, Athens.
- Billore, S.K. 1978. Ecology of grazing lands with reference to their structural and functional attributes. *D.Sc. Thesis*, School of Studies in Botany, Vikram University, Ujjain, India.
- Coupland, R.T. 1979. *Grassland Ecosystems of the World*, IBP-18. Cambridge University Press, U.K.
- Misra, R. 1968. *Ecology Work Book*. Oxford and IBM Publishing Co., Calcutta.
- Numata, M. 1979. *Ecology of Grasslands and Bamboo Lands in the World*. VEB Gustav Fischer Verlag Jena. pp. 182-196.
- Pandey, T.N. 1978. Seasonal variation in the biomass and productivity in a protected grassland of the Chakia Forest, Varanasi, India. *Ecology* 5(1): 37-42.
- Singh, J.S. 1968. Net above ground community productivity in the grasslands at Varanasi. In *Proceedings of the Symposium on Recent Advances in Tropical Ecology* (Eds. R. Misra and B. Gopal), pp. 631-654. ISTE Varanasi, India.
- Sims, P.L. and Coupland, R.T. 1979. Natural temperate grasslands producers. In *Grassland Ecosystems of the World* (Ed. R.T. Coupland), IBP-18, pp. 49-72. Cambridge University Press, U.K.
- Singh, J.S. and Joshi, M.S. 1979. Tropical grassland primary production. In *Grassland Ecosystems of the World* (Ed. R.T. Coupland), IBP-18, pp. 197-218. Cambridge University Press, U.K.