IMPACT OF GRAZING ON COMMUNITY FEATURES AND BIOMASS OF HERBACEOUS SPECIES IN LANGATE FOREST DIVISION OF KASHMIR

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Introduction

Natural resources like forests, water and land under the impact of ever-increasing population are depleting at an alarming rate. Almost all fundamental needs in a rural household are biomass based. Several of these, viz., firewood, timber, medicinal plants, crop wastes, cow dung, leaf litter and others are collected freely from the immediate surroundings. As most of the people are unable to get these basic requirements, they resort to illicit felling and overgrazing in forests. In the process of free gathering of firewood and fodder, uncontrolled grazing and recurring fires, some drastic ecological changes occur causing considerable damage to the forest vegetation and the soil. The ill effects of these pressures give rise to many irreversible ecological crises and consequently the shattered economic sustainability. It is in this backdrop the present study was undertaken to illustrate various impacts of grazing on species composition and plant biomass of the Langate forests of Kashmir.

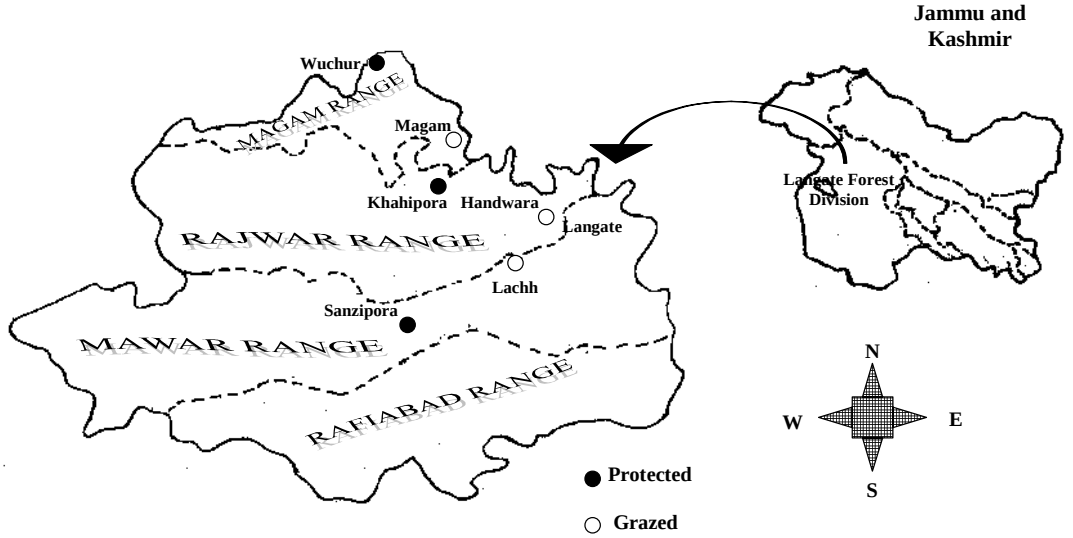
Material and Methods

The present investigation was carried out on the forests of Langate Forest Division in Kashmir during the year 2002-2003 (Fig. 1). The Division is situated between 34° 15' and 34° 45' N latitude and 73° 45' and 74° 35' E longitude and lies at an altitudinal range of about 1,650-3,500 m amsl, experiencing a sub-Mediterranean type of climate, characterized by marked seasonality with four distinct seasons in a year.

The Langate Forest Division extends over an area of 360.60 km^2 and occupies the northern-eastern slopes of Kazinag and Shamasbari Ranges. The drainage of most of the area is eastward with nallah Pohru forming its eastern boundary. The total human population of the study area as per the census report 2000 is 1,34,482 and the total population of livestock, comprising cattle, sheep, goats, horses and buffaloes, is 80,270.

The entire area of Langate Forest Division comprises four territorial ranges (Fig. 1). These include Rafiabad, Mawar, Rajwar and Magam ranges. Out of four ranges only three ranges falling in District Kupwara were investigated during the present study. Two sites representing protected and grazed areas were selected from each range. Khahipora, Wuchur and Sanzipora represented the protected areas while as Handwara, Magam and Lach represented the grazed areas from Rajwar,

Fig. 1



Langate Forest Division, showing various study areas.

Magam and Mawar ranges respectively. The Rafiabad range lying in District Baramulla was excluded.

In order to examine the grazing influence, two types of sites, protected and unprotected (those which were under very high grazing pressures especially during the growing season), were compared. To evaluate the Importance Value Index (IVI), ten replicates, each of 40cm x 40cm quadrats, were laid at random in each study area and data on density, frequency and abundance were obtained for the constituent species to calculate relative density, relative frequency and relative abundance (Ravinder *et al.,* 2004). The index of species diversity was calculated after Shannon-Weiner (1963). The index of species dominance was calculated after using the formula of Simpson (1949). The plant biomass of both protected and unprotected areas was calculated following Sharma (1975).

Results and Discussion

In the year long study the impact of grazing on the herbaceous community of the area revealed that some species (*Caltha palustris, Chenopodium album, Origanum vulgare* and *Podophyllum hexandrum)* were totally lost from the grazed areas and were restricted only to protected areas (Table 1, Fig. 2). The species, which were common to both the areas, differed significantly in their Importance Value Index (IVI) reflecting differential tolerance of plants to grazing pressures. The different classes of livestock viz. cattle, horses, sheep, goats and buffaloes have more or less definite preferences as to the type of vegetation and each affects the forest in a markedly different manner. The observations revealed that none of the plants exhibited a higher IVI throughout the year (Table 1). In spring, the highest value of IVI in the protected areas was registered for *Gagea elegans* (34.93),

Table 1

Seasonal IVI (mean values) of herbaceous species at protected and grazed sites in Langate Forest Division, Kashmir

Sl. No.	Species	Spring		Summer		Autumn		Winter	
		PR IVI	GR IVI	PR IVI	GR IVI	PR IVI	GR IVI	PR IVI	GR IVI
1	*Achillea millefolium*	7.97	7.67	8.67	7.33	7.76	7.06	9.15	9.90
2	*Ajuga bracteosa*	1.90	0	2.87	2.88	0	0	0	0
3	*Amaranthus caudatus*	9.91	7.78	9.81	7.28	0	0	0	0
4	*Androsace rotundifolia*	16.69	3.27	17.03	4.14	19.92	7.69	23.10	0
5	*Arisaema wallichianum*	8.38	0	8.28	5.81	10.58	7.25	9.80	8.78
6	*Caltha palustris*	8.53	0	8.14	0	9.10	0	10.45	0
7	*Campanula colorata*	5.29	5.46	5.08	5.18	0	0	0	0
8	*Cannabis sativa*	4.82	0	4.25	3.17	5.41	2.41	0	0
9	*Capsella bursa-pastoris*	6.58	7.67	6.72	0	7.75	3.32	10.71	5.80
10	*Carex fedia*	8.29	5.73	8.49	5.98	11.83	6.55	0	7.38
11	*Carduus nutans*	0	0	3.79	0	5.40	3.32	5.63	5.23
12	*Chenopodium album*	6.11	0	6.36	0	0	0	0	0
13	*Colchicum luteum*	9.82	20.20	9.43	20.35	0	0	0	6.36
14	*Cynodon dactylon*	19.46	68.26	14.46	64.50	19.99	64.08	24.40	90.83
15	*Duchesnea indica*	10.39	6.35	10.58	5.62	12.22	11.58	0	0
16	*Eragrostis* sp.	0	6.67	5.67	6.79	7.54	8.26	7.87	0
17	*Fragaria nubicola*	9.80	0	9.54	5.98	12.47	4.70	0	6.21
18	*Gagea elegans*	34.93	53.32	27.25	56.56	26.64	56.01	36.60	26.91
19	*Hedera nepalensis*	0	3.34	4.43	3.72	5.93	20.30	6.01	6.93
20	*Myosotis silvatica*	6.11	12.15	4.86	12.93	6.99	13.18	8.19	17.25
21	*Origanum vulgare*	0	0	6.70	0	6.98	0	7.36	0
22	*Plantago lanceolata*	4.58	3.77	3.57	3.17	5.72	0	6.73	0
23	*Podophyllum hexandrum*	2.08	0	0	0	0	0	0	0
24	*Potentilla nepalensis*	8.10	6.00	7.78	4.67	0	0	0	0
25	*Primula denticulate*	6.93	0	6.75	0	0	5.00	0	5.77
26	*Rannunculus laetus*	11.63	7.11	8.74	7.60	9.91	11.83	10.37	0
27	*Rumex nepalensis*	3.87	8.64	3.89	7.21	5.23	7.69	7.36	9.62
28	*Silene conoidea*	10.30	9.91	9.01	0	10.32	8.68	13.71	11.39
29	*Stellaria media*	5.75	2.51	5.72	2.45	7.52	4.10	7.46	5.77
30	*Taraxacum officinale*	5.29	4.21	5.72	3.30	5.40	2.41	8.51	5.35
31	*Thymus serphyllum*	34.43	17.52	35.39	12.42	39.95	2.41	42.98	19.88
32	*Trifolium repens*	10.61	15.96	10.88	16.7	15.04	17.04	16.56	19.63
33	*Utrica dioica*	7.35	7.94	7.61	7.60	8.70	8.56	9.80	11.34
34	*Viola indica*	6.58	0	6.72	6.57	7.75	7.09	7.87	8.78
35	*Viola odorata*	6.93	8.27	5.50	8.71	7.52	9.14	9.01	10.52

IVI = Importance Value Index; PR = Protected; GR = Grazed

Fig. 2

Over-grazing of the ground layer herbaceous vegetation
by sheep (top) and cattle (bottom) disturbing the biodiversity.

followed by *Thymus serphyllum* (34.43), *Cynodon dactylon* (19.46), *Androsace rotundifolia* (16.69) and the least IVI of 1.90 was recorded for *Ajuga bracteosa*. However, for the degraded sites the highest value of IVI was registered for *Cynodon dactylon* (68.26), followed by *Gagea elegans* (53.32), *Colchicum luteum* (20.2) and decreasing to a minimum of 2.51 for *Stellaria media* during the same period.

Summer season was characterized by maximum IVI value of 35.39 for *Thymus serphyllum,* followed by *Gagea elegans* (27.25), *Androsace rotundifolia* (17.03) and decreasing to a minimum of 2.87 for *Ajuga bracteosa* in case of protected areas. However, in the degraded areas, the highest IVI was obtained for *Cynodon dactylon* (64.50), followed by *Gagea elegans* (56.56), *Colchicum luteum* (20.35) and a minimum of 2.45 for *Stellaria media* in a decreasing order.

Features of autumn IVI are the highest values for *Thymus serphyllum* (39.95), followed by *Gagea elegans* (26.64), *Cynodon dactylon* (19.99) in a decreasing order. However, at degraded sites the highest IVI was registered for *Cynodon dactylon* (64.08), followed by *Gagea elegans* (56.01), *Hedera nepalensis* (20.30) and decreasing to the lowest of 2.41 for *Cannabis sativa*, *Taraxacum officinale* and *Thymus serphyllum* each.

The noteworthy feature of winter vegetation during the present investigation was the absence of species like *Amaranthus caudatus, Duchesnea indica, Fragaria nubicola, Ajuga bracteosa, Cannabis sativa, Potentilla nepalensis, Primula denticulata, Podophyllum hexandrum, Carex fedia* and *Chenopodium album* in both the areas. Among the existing species the maximum IVI for protected plots was reported for *Thymus serphyllum* (42.98), followed by *Gagea elegans* (36.60), *Cynodon dactylon* (24.40) as against the minimum of 5.63 for *Carduus nutans*. In the degraded plots, the highest IVI of 90.83 was registered for *Cynodon dactylon,* followed by *Gagea elegans* (26.91), *Thymus serphyllum* (19.88) and decreasing to the lowest for *Carduus nutans* (5.23).

From the above results, it is clear that the livestock has differential preferences for the type of vegetation and that the plant species also have differential tolerances for grazing. It is evident that species like *Androsace rotundifolia, Capsella bursa-pastoris, Cyanodon dactylon, Duchesnea indica, Plantago lanceolata, Potentilla nepalensis, Stellaria media, Taraxicum officinale* and *Thymus serphyllum* are preferred by grazing animals as the species depicted higher IVI values in protected areas. On the other hand, species like *Gagea elegans, Colchicum luteum, Myosotis sylvatica, Rumex nepalensis, Utrica dioica, Viola inica* and *Viola odorata* are resistant to grazing as these species recorded higher IVI values in degraded areas as compared to protected areas. The reason is that these species form monospecific stands in grazed areas. Further, even though *Cyanodon dactylon* is grazed by livestock, the higher IVI in grazed areas suggests its prolific power of clonal propagation under disturbed conditions, while its lower IVI in protected areas may be related to competition for light and space with other species.

The enumeration of plant species and the species diversity for different seasons revealed very significant temporal fluctuations (Table 2). The Shanon-Weiner

Table 2

Indices of diversity and dominance for herbs in different seasons of Langate Forest Division

Sites	Spring	Summer	Autumn	Winter
		Diversity Index		
Protected sites	2.96	3.12	2.91	2.68
Grazed sites	2.17	2.60	2.20	2.07
		Dominance Index		
Protected sites	0.07	0.06	0.07	0.08
Grazed sites	0.14	0.20	0.13	0.15

diversity index was found to vary between 2.68 (winter) and 3.12 (summer) for the protected areas in comparison to the degraded ones ranging between 2.07 (winter) and 2.60 (summer). Contrarily, the dominance was higher in degraded areas (ranging between 0.13 in autumn to 0.20 in summer) compared to protected ones exhibiting a range of 0.06 in summer to 0.08 in winter. The higher values of Shanon-Weiner diversity index in protected areas may be attributed to greater species number (species richness) as well as the more uniform distribution of individuals of the species. On the other hand, the higher values for dominance index in grazed areas are related to the fact that grazing restricts the growth of palatable species and those species which escape grazing or are avoided by livestock form more or less monospecific stands resulting in more clumped and less uniform distribution of individuals of unpalatable species.

A perusal of data in Table 3 reveals that the grazed areas showed low biomass values as compared to the protected ones for all the seasons (Table 3). The plant biomass for protected areas was maximum in summer (1221.56 g/m^2) and minimum in winter (290.62 g/m^2) as against the grazed areas having maximum value of 590.81 g/m^2 in autumn and minimum of 183.75 g/m^2 in winter. The low biomass in grazed plots revealed the consumption of foliage by grazing animals. The adverse effects of grazing were compounded by the fact that livestock was found to consume not only the leaves and stems but also the inflorescences of all the palatable species, thus decreasing the viability capacity of species in grazed areas. The tree species are less resistant than grasses, forbs and shrubs and are easily eliminated by browsing. Sings of grazing damage on the seedlings are evident across all sites but the intensity of damages vary across the sites depending upon the number of livestock grazing at the site. Most seedlings are either completely browsed off by livestock or removed by livestock herders while other have broken tops and branches due to browsing and trampling by livestock and slashing by herders. Damages are not only confined to palatable species but unpalatable species are affected too. The removal of organic matter in the form of

Table 3

Biomass (g/m²) of herbaceous vegetation at protected and unprotected sites in Langate Forest Division

Seasons	Grazed sites			Protected sites		
	Fresh Weight	Dry Weight	Biomass	Fresh Weight	Dry Weight	Biomass
Spring	79.16	42.31	264.43	114.47	71.06	444.12
Summer	170.05	91.16	574.75	354.46	195.45	1221.56
Autumn	173.42	94.53	590.81	369.00	180.73	1129.56
Winter	64.53	29.24	183.75	91.42	46.50	290.62

herbage biomass and trampling by grazing animals have caused edaphic changes at the grazed sites. This enhances soil erosion. The above findings are further corroborated by the works of other investigators while studying the effect of grazing on the structure and productivity of vegetation (Lewis, 1970; Kumar and Joshi, 1972; Lye and Lauritzen, 1975; Mwendera and Mohamad Salem, 1997). Contrarily to our findings, Chakravarti and Bhati (1971) observed no significant decrease in plant cover due to grazing in afforested dunes of Rajasthan although the authors noted some of the species decreasing in their coverage against an increase in others.

Conclusions

In conclusion, the growing grazing pressures not only seem to modify the natural forest ecosystem, but also reduce the rich biodiversity of plants and the productivity of constituent species.

In order to improve the biomass vis-à-vis controlled grazing in the study area, following steps need to be taken to tackle the problem of excessive grazing :

(1) involving the local people in the planning processes of forest management;

(2) regulated grazing encompassing a certain forest area for grazing and refraining grazing in strictly prohibited areas;

(3) improvement of forage resources and animal breeds;

(4) management and utilization of native fodder trees.

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SUMMARY

The impact of grazing on species composition and plant biomass has been evaluated for the herbaceous community in Langate Forest Division of Kashmir. In all 35 species were recorded from the study area. Among these, only four species namely *Caltha palustris, Chenopodium album, Origanum vulgare* and *Podophyllum hexandrum* were restricted to the protected regions. However, the species common to both the areas differed in their Importance Value Index (IVI), reflecting their tolerance to grazing pressures. The protected areas registered higher values for biomass as compared to the grazed ones.

कश्मीर के लंगटे वन मण्डल में वनस्पति समुदाय की विशेषताओं और शाकीय जातियों के जैवपुंज पर चराई का प्रभाव

हिलाल ए० लोन व अशोक के० पण्डित

सारांश

कश्मीर के लंगटे वन मण्डल को शाकीय समुदाय की जाति रचना और पादपों के जैवपुंज पर चराई से पड़ते प्रभाव का मूल्यांकन किया गया है। इस अधीत क्षेत्र से कुल मिलाकर 35 जातियां आलेखित हुई। इनमें से केवल 4 जातियां अर्थात् *कैल्था पालुस्ट्रिस, केनोपोडियम एल्बम, ओरिगैनम वल्गारे* और *पोडोफायलम हेक्जेण्ड्रम* सुरक्षित किए हुए क्षेत्रों में ही मिलती हैं। परन्तु दोनों तरह के स्थानों में समान रूप से मिलने वाली जातियों के अर्हा महत्व निर्देशांक में अन्तर मिलता है जो चराई से पड़ते दबावों के प्रति उनकी सह्यता प्रतिबिम्बित करता है। चराई किए जा रहे क्षेत्रों की तुलना में चराई से सुरक्षित किए गए क्षेत्रों में जैवपुंज की अर्हाएं ज्यादा ऊंची रही।

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