Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(4): 388-393
Received: 15-05-2017
Accepted: 14-06-2017

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Phytosociological status of the selected sites (Protected site) for assessing the effect of grazing in Kashmir Valley, India

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Abstract
Kashmir Valley located in the north-western folds of the Indian Himalayas, has vast land area (16%) under grasslands which play an important role in providing economic goods and ecosystem services to the society. Livestock, particularly the migratory flocks, are entirely dependent on these grasslands. They serve as bedrock for sustaining the core economic activity of livestock rearing in the region. Apart from sustaining this pivotal economic activity, grasslands harbor a rich and endemic biodiversity, and regulate the regional carbon, nutrient and hydrological cycles (Masood, 2003; Anonymous, 2014). The present investigation was conducted at protected site of Yousmarag area of Budgam district in Jammu and Kashmir, India during 2014-2015 with the aim to study the effect of grazing on floristic composition of selected site. The data pertaining to protected area (Kanidajan) revealed the presence of thirty six herb species in spring season, the highest density was shown by *Cynodon dactylon* (363300 ha^{-1}), maximum frequency was observed by *Achillea mill folium,* and highest abundance was reported in *Cynodon dactylon* (363300 ha^{-1}). It is evident from the data that out of the thirty six herbaceous species a total of thirty four were recorded in summer season, the highest density was shown by *Cynodon dactylon*, the maximum frequency (100%) was observed in *Achillea mill folium,* and maximum abundance was reported in *Cynodon dactylon* (448300 ha^{-1}). A total of twenty species were found in autumn season amongst the thirty six species reported at this site. Maximum density was again recorded in *Cynodon dactylon* (215800 ha^{-1}), maximum frequency (100%) was recorded in *Cynodon dactylon* and highest abundance was reported in *Cynodon dactylon*. In all three seasons, it was observed that *Cynodon dactylon* (37.43ha^{-1}) had maximum importance value index (IVI).

Keywords: grasslands, grazing, density, frequency and importance value index (IVI)

Introduction
In the Indian Himalaya, the grasslands occupy about 35% of the geographical area. The different types of the Himalayan grasslands include the warm temperate grasslands, cold temperate and subalpine grasslands, alpine meadows, the steppes of cold-arid regions, and the alpine scrub. Although, they differ from one another in terms of origin, structure and composition; nevertheless they all support a large number of wild herbivores, domestic livestock, and agro-pastoral activities (Rawat, 1998) [12]. The Indian Himalaya system comprises various mountain ranges which run parallel to each other, and contains a tremendous diversity in ecology, terrain, elevation, climate, resource availability, ethnicity, agricultural activities, flora and fauna. Steep topography, prolonged and severe cold winters, shallow soils and lack of irrigation etc., have limited the choice of agricultural activities, with livestock rearing being one of the most important occupations in the region. The temperate/alpine pastures are spread across elevations higher than 2000 m in the Eastern and Western Himalayas including Jammu and Kashmir, Himachal Pradesh, Uttarakhand, West Bengal, Arunachal Pradesh and Sikkim states. The alpine and subalpine meadows suffer from general degradation, with an increasing incidence of unpalatable species and erosion due to overgrazing. These grasslands and pastures, besides being a major source of forage for livestock, provide habitat for a large variety of wild animals and birds, and for endangered species of plants, many of which have an ethnobotanic value (Roy AK; Singh JP. 2013) [13]. In recent studies (Singh *et al.* 2009; 2011) [17, 18], the monitoring and mapping of grasslands of the Himalayan region (Himachal Pradesh, Sikkim, Jammu and Kashmir states) during 2007−12 with modern tools and techniques, viz. GIS, RS, GPS and FSGT, were used in conjunction with ground-truthing to assess the extent of grasslands and their productivity. A reconnaissance survey of the grasslands of India was conducted from 1954 to 1962, revealing 5 major ecosystems based on vegetation composition and distribution, primarily governed by

climatic factors, latitude, elevation, topography and seasonal patterns of soil moisture (Dabadghao and Shankaranarayan 1973) [4]. The 5 types were: Sehima - Dichanthium grasslands; Dichanthium - Cenchrus - Lasiurus grasslands; Phragmites - Saccharum - Imperata grasslands; Themeda - Arundinella grasslands; and temperate/alpine grasslands. In Himachal Pradesh (IRSP6L3 2008), grasslands occur on 16.5% of the total area, occupying 15.3, 21.6, 18.0 and 15.3% of geo-climatic zones 1 (Low hill subtropical), 2 (Mid-hill subhumid), 3 (Mid-hill temperate wet) and 4 (High hill temperate), respectively. Forage production from high hills was recorded as 4.0 t/ha/yr (fresh weight) and 1.1 t/ha/yr (dry matter), with an average crude protein concentration of 11.3% (Singh *et al.* 2009) [18]. In Jammu and Kashmir (IRSP6L3 2009 and 2010 data), 4.3% of the total geographical area was under productive grasslands, whereas the area of other grazing lands, including scrub and other unpalatable swards, was 9.8% of the total. The areas under productive grasslands in Jammu, Kashmir and Ladakh were 3.5, 13.2 and 5.8%, respectively. India's livestock sector is one of the largest in the world, with a livestock population around 623 M, which is expected to grow at a rate of 0.55% in the coming years. India has 56.7% of the world's buffaloes, 12.5% of the cattle, 20.4% of the small ruminants, 2.4% of the camels, 1.4% of the equines, 1.5% of the pigs and 3.1% of the poultry. The livestock population, over the years, has shown a steady growth on 2 broad fronts, namely: (i) in the number of stall-fed bovine livestock, including buffaloes and crossbred cows, owned mainly by people with arable land and resources to grow or procure green fodder; and (ii) in the number of small ruminants like goats and sheep, surviving mainly by free grazing the available pasture lands and tree foliage (Anon. 2011) [2].

Materials and Methods

The valley of Kashmir is situated in western Himalayan range, extends between 32°-20' to 34°-54' N latitude and 73° - 55' to 75° - 35' E longitude. The total geographical area of the valley is about 159480 km^{-2} with the total forest area of 8126 km^{-2} (50.95 %), with an average altitude of 1850 m asl. The minimum and maximum temperature ranged between – 4.41 ^{O}C in January to 29.34 ^{O}C in July respectively. The average annual precipitation ranges between 949 –1,100 mm mostly in the form of snow, which covers the mountainous belts for 160 - 195 days/year. The study was conducted in Doodh Ganga range of Budgam district of Jammu and Kashmir. In this area grasslands with varying degrees of protection exist. Study was conducted protected site for satisfying the objective laid out for this study.

Floristic composition

Presence or absence of species was recorded during each sampling season at selected site (Curtis and McIntosh, 1950) [3].

Density

Density number of individuals of a species that occurs within a given sample unit or study area. It was recorded as:

$$\text{Density} = \frac{\text{Number of individuals of the species}}{\text{Total number of quadrats studied}}$$

Frequency

Frequency is the number of times a plant species is present in a given number of sample units. It was calculated by the formula:

$$\text{Frequency (\%)} = \frac{\text{Number of quadrats in which the species occurred}}{\text{Total number of quadrants studied}} \times 100$$

Abundance

Abundance is a component of biodiversity and refers to how common or rare a species is relative to other species in a defined location or community. It was calculated by the formula:

$$\text{Abundance} = \frac{\text{Total number of individuals of a species in all quadrates}}{\text{Number of quadrants in which the species occurred}} \times 100$$

Importance Value Index

This index is used to determine the overall importance of each species in the community structure. The important value index (IVI) for each site was worked out by using formula given by Misra (1968).

IVI = RF + RD + RA

Where,

$$\text{RF (relative frequency)} = \frac{\text{Frequency of individual species}}{\text{Frequency of all species}} \times 100$$

$$\text{RD (relative density)} = \frac{\text{Density of individual species}}{\text{Density of all species}} \times 100$$

$$\text{RA (relative abundance)} = \frac{\text{Abundance of individual species}}{\text{Abundances of all species}} \times 100$$

Result and Discussion

1. Spring season

The data pertaining to protected area (Kanidajan) revealed the presence of thirty herb species in this season. Highest density was shown by *Cynodon dactylon* (363300 ha^{-1}) followed by *Thymus linearis* (188300 ha^{-1}) *Trifolium pratense* (172500 ha^{-1}) *Taraxacum officinale* (157500 ha^{-1}) *Achillea millifolium* (156600 ha^{-1}) (Table-1). Maximum frequency was observed by *Achillea millifolium, Cynodon dactylon, Fragaria nubicola, Poa perennis, Sorghum helpensis, Taraxacum officinale, Thymus linearis, Trifolium pretense* and *Tulipa stellata* i.e 100%. Whereas, lowest in *Silene vulgaris* (25%) (Table-2). Highest abundance was reported in *Cynodon dactylon* (363300 ha^{-1}) followed by *Thymus linearis* (188300 ha^{-1}), *Trifolium pratense* (172500 ha^{-1}), *Taraxacum officinale* (157500 ha^{-1}) and *Poa annua* (148300 ha^{-1}) and lowest in *Medicago denticulata* (29100 ha^{-1}) (Table-3. In this season maximum IVI was recorded for *Cynodon dactylon* (29.23 ha^{-1}) followed by *Thymus linearis* (23.37 ha^{-1}), *Trifolium pretense* (18.95 ha^{-1}), *Achillea millifolium* (17.25) and *Poa perennis* (16.65 ha^{-1}), with minimum for *Pedicularis punctata* (3.77 ha^{-1}) (Table-4). However, *Artemesia absinthium, Chenopodium album, Clinopodium vulgare, Stachys floccosa, Trifolium repens* and *Viola odorata* were not found in this season.

2. Summer season

It is evident from the data that out of the thirty six herbaceous species a total of thirty four were recorded in this season. *Cynodon dactylon* (448300 ha^{-1}) recorded the maximum density followed by *Thymus linearis* (289100 ha^{-1}), *Achillea millifolium* (270800 ha^{-1}), *Trifolium pretense* (244100 ha^{-1}) and *Poa annua* (217500 ha^{-1}) and lowest in *Pedicularis punctata* (30800 ha^{-1}) (Table-1). During this season, the maximum frequency (100%) was observed in *Cynodon dactylon, Achillea millifolium, Fragaria nubicola, Malva*

neglecta, Plantago lanceolata, Poa annua, Sorghum helpensis, Taraxacum officinale, Thymus linearis and *Trifolium pratense* and the least in *Lolium perenne* (33.33%) (Table-2). Maximum abundance was reported in *Cynodon dactylon* (448300 ha^{-1}), followed by *Achillea millifolium* (270800 ha^{-1}), *Poa perennis* (217500 ha^{-1}), *Thymus linearis* (289200 ha^{-1}) and *Trifolium pratense* (244200 ha^{-1}) and lowest in *Medicago denticulata* (55500 ha^{-1}) (Table-3. The data tabulated in (Table-4) revealed that in summer season *Cynodon dactylon* (20.26 ha^{-1}) was having maximum IVI followed by *Thymus linearis* (17.45 ha^{-1}), *Mentha longifolia* (16.96 ha^{-1}), *Trifolium pretense* (15.92 ha^{-1}) and *Sorghum helpensis* (15.22 ha^{-1}) with minimum in *Lolium perenne* (3.13 ha^{-1}). However, *Chenopodium album, Viola odorata* were not found in this season.

3. Autumn season

A total of twenty species were found in this season amongst the thirty six species reported at this site. Maximum density was again recorded in *Cynodon dactylon* (215800 ha^{-1}) followed by *Trifolium pratense* (117500 ha^{-1}), *Trifolium repens* (84100 ha^{-1}), *Sorghum helpensis* (93300 ha^{-1}) and *Trifolium repens* (84100 ha^{-1}) and lowest in *Taraxacum officinale* (6800ha^{-1}) (Table-1). Maximum frequency (100%) was recorded in *Cynodon dactylon, Rumex dentatus, Sorghum helpensis, Thymus linearis,* and *Trifolium pretense,* whereas minimum (16.66%) in *Silene vulgaris* (Table-2). Highest abundance was reported in *Cynodon dactylon* (215800 ha^{-1}) followed by *Trifolium pratense* (117500 ha^{-1}), *Trifolium repens* (112200 ha^{-1}), *Sorghum helpensis* (93300 ha^{-1}) and *Plantigo major* (82100 ha^{-1}) and lowest in *Rumex dentatus* (20800 ha^{-1}) (Table-3). In autumn season it was observed that *Cynodon dactylon* (37.43ha^{-1}) had maximum IVI followed by *Trifolium pratense* (26.68 ha^{-1}), *Trifolium repens* (26.08 ha^{-1}), *Sorghum helpensis* (23.27 ha^{-1}), and *Thymus linearis* (14.86 ha^{-1}) with minimum in *Taraxacum officinale* (2.49 ha^{-1}) (Table-4). However, *Capsella bursa pastoris, Lolium perenne, Medicago denticulate, Mentha longifolia, Myosotis arvensis, Pedicularis punctate, Prunella vulgaris, Ranunculus hirtellus* and *Tulipa stellate* were not observed in this season.

Table 1: Density (ha^{-1}) under different seasons at protected site in Kashmir Valley.

S. No.	Name of the Species	Spring	Summer	Autumn
1	*Achillea millifolium*	156600	270800	25800
2	*Artemesia absinthium*	-	59100	23300
3	*Capsella bursa pastoris*	42500	110800	-
4	*Chenopodium album*	-	-	33300
5	*Clinopodium vulgare*	-	72500	30800
6	*Cynodon dactylon*	363300	448300	215800
7	*Daucus carota*	32500	67500	23300
8	*Fragaria nubicola*	72500	122500	17500
9	*Geranium rotindifolia*	40800	98300	18300
10	*Lolium perenne*	68300	37500	-
11	*Malva neglecta*	78300	167500	25800
12	*Medicago denticulata*	26600	50800	-
13	*Mentha longifolia*	41600	118300	-
14	*Mentha spicata*	50800	99100	16600
15	*Myosotis arvensis*	30800	50800	-
16	*Pedicularis punctata*	20800	30800	-
17	*Pennisetum orientale*	31600	119100	9100
18	*Plantigo lanceolata*	50800	89100	26600
19	*Plantigo major*	30800	47500	34100
20	*Poa annua*	148300	217500	53300
21	*Potentilla nepalensis*	47500	108300	25300
22	*Prunella vulgaris*	57500	92500	-
23	*Ranunculus hirtellus*	18300	80800	-
24	*Rumex dentatus*	69100	80800	20800
25	*Rumex nepalensis*	81600	64100	31600
26	*Silene vulgaris*	19100	57500	10800
27	*Sorghum helpensis*	106600	195000	93300
28	*Stachys floccosa*	-	51600	33300
29	*Taraxacum officinale*	157500	70830	6800
30	*Thymus linearis*	188300	289100	54100
31	*Trifolium pratense*	172500	244100	117500
32	*Trifolium repens*	-	155800	84100
33	*Tulipa stellata*	111600	55800	-
34	*Veronica laxa*	30800	145800	15100
35	*Veronica persica*	37500	135800	35200
36	*Viola odorata*	-	-	41660

Table 2: Frequency (ha^{-1}) under different seasons at protected site in Kashmir Valley.

S. No.	Name of the species	Spring	Summer	Autumn
1	*Achillea millifolium*	100	100	58.33
2	*Artemesia absinthium*	-	66.66	41.66
3	*Capsella bursa pastoris*	58.33	83.33	-
4	*Chenopodium album*	-	-	91.66
5	*Clinopodium vulgare*	-	58.33	66.66

6	*Cynodon dactylon*	100	100	100
7	*Daucus carota*	50	66.66	83.33
8	*Fragaria nubicola*	100	100	33.33
9	*Geranium rotindifolia*	41.66	83.33	50
10	*Lolium perenne*	75	33.33	-
11	*Malva neglecta*	75	100	91.66
12	*Medicago denticulata*	91.66	91.66	-
13	*Mentha longifolia*	58.33	91.66	-
14	*Mentha spicata*	66.66	75	75
15	*Myosotis arvensis*	41.66	58.33	-
16	*Pedicularis punctata*	33.33	25	-
17	*Pennisetum orientale*	41.66	91.66	25
18	*Plantigo lanceolata*	91.66	100	33.33
19	*Plantigo major*	83.33	66.66	41.66
20	*Poa annua*	100	100	66.66
21	*Potentilla nepalensis*	75	91.66	50
22	*Prunella vulgaris*	75	83.33	-
23	*Ranunculus hirtellus*	33.33	91.66	-
24	*Rumex dentatus*	58.33	75	100
25	*Rumex nepalensis*	66.66	58.33	50
26	*Silene vulgaris*	25	41.66	16.66
27	*Sorghum helpensis*	100	100	100
28	*Stachys floccosa*	-	41.66	75
29	*Taraxacum officinale*	100	100	25
30	*Thymus linearis*	100	100	100
31	*Trifolium pratense*	100	100	100
32	*Trifolium repens*	-	83.33	75
33	*Tulipa stellata*	100	91.66	-
34	*Veronica laxa*	58.33	91.66	33.33
35	*Veronica persica*	50	75	58.33
36	*Viola odorata*	-	-	83.33

Table 3: Abundance (ha^{-1}) under different seasons at protected site in Kashmir Valley.

S. No.	Name of the Species	Spring	Summer	Autumn
1	*Achillea millifolium*	156700	270800	44300
2	*Artemesia absinthium*	-	88800	56100
3	*Capsella bursa pastoris*	72900	133100	-
4	*Chenopodium album*	-	-	36300
5	*Clinopodium vulgare*	-	124300	46300
6	*Cynodon dactylon*	363300	448300	215800
7	*Daucus carota*	65100	101300	28200
8	*Fragaria nubicola*	72500	122500	52500
9	*Geranium rotindifolia*	98200	118200	36700
10	*Lolium perenne*	91200	112500	-
11	*Malva neglecta*	104400	167500	28100
12	*Medicago denticulata*	29100	55500	-
13	*Mentha longifolia*	71400	129100	-
14	*Mentha spicata*	76300	132200	22200
15	*Myosotis arvensis*	73400	87100	-
16	*Pedicularis punctata*	62500	123300	-
17	*Pennisetum orientale*	76100	130200	36700
18	*Plantigo lanceolata*	55500	89200	80100
19	*Plantigo major*	37300	71300	82100
20	*Poa annua*	148300	217500	80100
21	*Potentilla nepalensis*	63300	118100	50100
22	*Prunella vulgaris*	76700	111200	-
23	*Ranunculus hirtellus*	55200	88100	-
24	*Rumex dentatus*	118600	107700	20800
25	*Rumex nepalensis*	122500	167100	63300
26	*Silene vulgaris*	76700	138100	32500
27	*Sorghum helpensis*	106700	195200	93300
28	*Stachys floccosa*	-	124100	44400
29	*Taraxacum officinale*	157500	70800	23300
30	*Thymus linearis*	188300	289200	54200
31	*Trifolium pratense*	172500	244200	117500
32	*Trifolium repens*	-	187200	112200
33	*Tulipa stellate*	111700	61100	-
34	*Veronica laxa*	52900	159100	45100
35	*Veronica persica*	75200	181100	60200
36	*Viola odorata*	-	-	50100

Table 4: Importance Value Index under different seasons at protected site in Kashmir Valley.

S. No.	Name of the Species	Spring	Summer	Autumn
1	*Achillea millifolium*	17.25	16.96	7.73
2	*Artemesia absinthium*	-	5.29	6.58
3	*Capsella bursa pastoris*	6.27	8.02	-
4	*Chenopodium album*	-	-	11.15
5	*Clinopodium vulgare*	-	5.39	8.89
6	*Cynodon dactylon*	29.23	20.26	37.43
7	*Daucus carota*	4.96	5.97	8.81
8	*Fragaria nubicola*	10.69	9.21	5.00
9	*Geranium rotindifolia*	5.18	8.00	6.18
10	*Lolium perenne*	9.22	3.13	-
11	*Malva neglecta*	10.67	12.15	9.86
12	*Medicago denticulata*	6.50	6.11	-
13	*Mentha longifolia*	6.29	9.40	-
14	*Mentha spicata*	7.23	7.60	7.43
15	*Myosotis arvensis*	4.42	4.70	-
16	*Pedicularis punctata*	3.77	2.43	-
17	*Pennisetum orientale*	4.74	9.13	2.83
18	*Plantigo lanceolata*	8.64	8.42	6.30
19	*Plantigo major*	7.17	4.86	8.20
20	*Poa annua*	16.65	12.81	12.86
21	*Potentilla nepalensis*	7.78	8.86	8.79
22	*Prunella vulgaris*	9.15	7.95	-
23	*Ranunculus hirtellus*	3.38	7.40	-
24	*Rumex dentatus*	8.33	8.07	9.85
25	*Rumex nepalensis*	10.95	7.15	8.54
26	*Silene vulgaris*	3.34	4.53	2.96
27	*Sorghum helpensis*	13.94	15.22	23.27
28	*Stachys floccosa*	-	4.73	10.97
29	*Taraxacum officinale*	16.85	7.75	2.49
30	*Thymus linearis*	23.37	17.45	14.86
31	*Trifolium pratense*	18.95	15.92	26.68
32	*Trifolium repens*	-	11.59	26.08
33	*Tulipa stellate*	14.15	5.85	-
34	*Veronica laxa*	5.38	9.11	4.58
35	*Veronica persica*	5.55	8.58	9.67
36	*Viola odorata*	-	-	12.01

Discussion

Grazing animals affect the performances of plants directly and indirectly. Direct impacts of grazing, which were associated with alteration in plant composition, plant physiology and morphology resulted from defoliation and trampling by grazers. The indirect impacts stimulate plant responses to defoliation in many ways which were not readily simulated by clipping experiments. The major goal of the study is to understand that how grazing affects the structure of plant community, biomass production and soil organic carbon. The IVI of the *Cyanodon dactylon* (Table 4) was higher in the all three prominent seasons. Although density as well as frequency and abundance were also recorded maximum for *Cyanodon dactylon* (table 1, 2 and 3). *Cyanodon dactylon* makes good quality hay and haylage. As a fine-stemmed leafy species, *Cyanodon dactylon* cures quickly. It can be tightly packed in bales and maintain good nutritive value during storage (Hacker *et al.*, 1998) [5]. *Cyanodon dactylon* is a valuable fodder grass that can be grazed (it withstands heavy grazing) or used in cut-and-carry systems. It is useful for hay, silage and pelletizing. It may be used for soil conservation (as a soil binder) and as lawn and turf grass (Ecocrop, 2012; Cook *et al*., 2005; Hanna, 1992).

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