ISSN : **2583-3189 (E), 2583-0775 (P)**
Year-05, Volume-05, Issue-01

AMOGHVARTA

ISSN : 2583-3189

Evaluation of Biomass Yield in Unprotected Grassland of Champa, Chhattisgarh

ORIGINAL ARTICLE

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Abstract

Grasslands are regions where the primary vegetation consists of grasses. In addition to grasses, these areas may also contain sedges, rushes, and various proportions of legumes such as clover, along with other herbaceous plants. These ecosystems are characterized by monocotyledons, which are plants with narrow leaves that grow from the base. They exhibit a notable resilience to intensive grazing (C.E. Devine, 2016). Grasslands are typically expansive, continuous, and relatively flat regions dominated by grasses. They are commonly situated between temperate forests at higher latitudes and deserts at subtropical latitudes. This study was conducted in a grassland area in Champa, Chhattisgarh, which has an average elevation of 253 meters (830 feet). Champa is located between latitudes 21°39'54" N to 22°18'05" N and longitudes 82°15'55" E to 83°22'17"E. The quadrat size was determined using the species-area curve method, with sampling conducted on a monthly basis. Below-ground plant parts were estimated using the monolith method, with dimensions of 25 x 25 x 30 cm. The grassland community consisted of 17 species, including 9 grasses and 8 non-grasses.

Key Words

Grazed grassland, Net primary production, Aboveground, Belowground.

Introduction

Grasslands are natural habitats for grazing animals and provide them with food. Grasslands are the seral stages of succession and they are to be maintained by fire and grazing. Grass plants have short lifespans, contributing significant organic matter to the soil. Their rapid decay leads to the formation of humus. The resulting dark grassland soil is well-suited for cultivating food crops. Grassland prevent soil erosion. Grassland are used as food and fodder. Maintain nitrogen and phosphorus cycle. While grasslands are predominantly used for livestock and forage production, they also have numerous other applications. Grasslands, commonly referred to as rangelands, offer forage and habitat for domestic animals and wildlife.

Grasslands are one of the most important of terrestrial ecosystems types. In India, grassland areas are often overgrazed, with the number of grazing animals exceeding the grassland's capacity to sustain them. This overgrazing results in a lack of plant cover, leading to soil erosion. The total dry weight of material present in the ecosystem at any given time is referred to as biomass. The rate of biomass production is called productivity. The biomass and productivity of grassland ecosystem types of world have received much attention (Murphy 1975; Numata 1979; Wielgolaski et al. 1981). As the grassland is ecologically fragile and sensitive to the climate changes (Qi et al. 2012). Anderson et al. (2006) concluded that the role of grazing in regulating the function and structure of the grassland ecosystem. The influence of grazing on plant and soil mainly effected from the animals trample (Yates, 2000), that do not allow grassland to attain their fullest development. Grazing is also associated with changes in soil organic content, such as Nitrogen (N), Phosphorous (P), Potassium (K), and pH values in soil (Yates, 2010). Almost 50% of the worlds terrestrial land base is grazed by domestic livestock (Havstad 2008). The impact of grazing on productivity and mineral status was investigated by studying the biomass structure and mineral status of grazed grasslands in Champa during 2020-21. Our study aims to evaluate the grazing impact on biomass. Indian grasslands are heavily influenced by climatic factors and various biological interactions. Human activities have significantly affected grasslands worldwide, with much of the area being converted to agricultural land. As a result of extensive human interference, finding pristine grasslands in our country is challenging.

Grassland vegetation primarily consists of a variety of annual and perennial grasses mixed with legumes and forbs. Traditionally, ecological studies assess productivity as a fundamental aspect of ecosystem function, which has garnered considerable attention in recent years. There is now substantial information available on primary production and turnover parameters for grasslands in tropical and temperate regions. Tiwari and Singh (1981) highlighted the important contributions of grassland communities' production in India. Litter decomposition plays a crucial role in terrestrial ecosystems by maintaining productivity and regulating the availability of nutrients essential for plant growth. Basic processes of decomposition in their study namely as biological action withering and leaching are the key factor affecting decomposition (Kar 2013).

Material and Method

Climate condition

The study was conducted in a grassland at Champa (C.G.). Champa has an average elevation of 253m(830feet). It is situated between north 21°39'54" to 22°18'05" and east longitude82°15'55" to 83° 22'17". Champa is a sub-tropical region. The temperature here remains moderate throughout most of the year, except during the summer months from March to June, when it can reach approximately 46°C. Champa has a hot and semi-humid climate. The soil at the study site had a moderately acidic pH of 6.

Collection of Sample and Identification

The study involved monthly random sampling of above-ground biomass in the grassland. A harvest method used for sampling of plant parts. A quadrate $0.25m^{-2}$ was used for this purpose. The size of the quadrate was determined using the species-area curve method. Clipping of aboveground plant parts within the quadrate were harvested at close to the ground level with the help of scissors. The clipped sample aboveground biomass of each quadrate were collected separately species-wise in polythene bags. The productivity of each plant material category (live green, standing dead, litter, and below-ground parts) was determined by aggregating the biomass increments observed in each respective compartment throughout the study period. The below-ground plant parts were collected by monolith method (Weaver and Dariand,1949) 3 monoliths of 25 x 25 x 30cm, The belowground part sample in the monoliths were carefully washed. The ground litter was collected quadrate wise separately.

Aboveground net primary productivity was calculated as the sum of increments in the live green and standing dead compartments. Litter and below-ground parts were quantified by summing the positive biomass increments in grams per square meter per year. Similarly, calculation of litter disappearance (LD) was done by subtracting the total litter during the year from the difference between final and initial litter biomass (Golley,1965). Total net primary productivity was calculated by summing the values of aboveground net production and belowground net production of the community.

Table 1: Biomass (gm-2) of different species during the study period

Month	Live Green			Standing dead	Litter	Aboveground		Below ground	Total
	Grasses	Non grasses	Total			LG+SD	LG+SD +L		
July	36.05	32.08	68.13	28.3	--	96.43	96.43	188.54	284.97
August	65.04	50.12	115.16	29.01	--	144.17	144.17	87.25	231.42
September	92.42	66.21	158.63	76.58	23.75	235.21	258.96	192.68	451.64
October	90.28	61.35	151.63	36.54	37.52	188.17	225.69	198.55	424.24
November	85.7	56.16	141.86	31.26	74.18	173.12	247.3	190.44	437.74
December	76.14	55.24	131.38	62.16	68.19	193.54	261.73	210.29	472.02
January	89.34	60.45	149.79	73.25	71.86	223.04	294.9	199.33	494.23
February	59.12	49.05	108.17	63.05	36.41	171.22	207.63	248.52	456.15
March	34.82	51.11	85.93	67.5	72.02	153.43	225.45	89.73	315.18
April	28.22	29.16	57.38	45.01	71.25	102.39	173..64	74.62	248.26
May	21.08	23.84	44.92	32.04	24.54	76.96	101.5	76.59	178.09
June	31.65	22.57	54.22	48.53	--	102.75	102.75	158.61	261.36
July	42.17	35.36	77.53	27.91	--	105.44	105.44	195.7	301.14
Total	**752.03**	**592.7**	**1344.73**	**621.14**	**479.72**	**1965.87**	**2445.59**	**2110.85**	**4556.44**

*(**Source:** Autor won calculation based on Secondary Data)*

Result and Discussion

Table 1 shows the monthly variation of various biomass compartments within the community. The peak green biomass of grasses occurs during September 92.42gm-2 and minimum in May 21.08gm-2. The maximum production of live green non-grass biomass was found to be 66.21 gm-2 in September and minimum in June 22.57gm-2. The total aboveground standing biomass in the study site was minimum July 28.3gm-2 and maximum76.58gm-2 in September and reached its maximum of 74.18gm-2 in November. The below ground biomass values in site between 76.96gm-2 April to 248gm-2 February. The total aboveground biomass of increased76.96gm-2 in May to 223.04gm-2 in January it exhibited fluctuations throughout the year.

The results of the study indicated that the live green biomass (grasses, non-grasses, and total live green) in the grazed site did not exhibit a clear trend. It peaked in September and reached a minimum of 44.92 gm^{-2} in May. Standing dead biomass peak in 76.58gm-2 in September and minimum in July 27.91. The total aboveground biomass, which comprises the sum of total live green biomass and standing dead biomass, was found to be at its minimum in the month of May 76.96gm-2 and maximum in November 235.21gm-2.

The litter biomass of the community did not exhibit any discernible trend. The value of litter biomass minimum in September 23.75gm-2 and maximum in month of November 74.18gm-2. Litter was completely absent during June, July, and August. The total biomass of the community (aboveground, belowground) ranges from 178.09gm-2 in May and maximum 494.21 gm-2 in January. The annual non grass production recorded 592.70gm-2. Total live green values recorded within the range of minimum and maximum during May 21.08gm-2 and September92.42gm-2. The annual net live green production 1344.73 was contributed 52.94% by grasses and 47.05% by non-grasses. The standing dead production was found to be 621.14 gm-2 per year.

Conclusion

Based on the current findings, the grazed sites are experiencing intense grazing pressure, which may lead to further degradation of these elements in the future. Grazing significantly affected species richness. The annual net aboveground production in this grazed grassland was observed to be 752.03 gm-2 per year. Litter production in the community was evident from September to May, with no litter observed during June, July, and August. This absence could be attributed to rapid litter decomposition. Grazing reduced aboveground primary production. Primary production variation was influenced not only by rainfall but also by atmospheric temperature and soil conditions, all of which were found to be conducive to the growth and development of all species.

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