Research Paper

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Standing Crop Biomass of a Grassland Community of Mayurbhanj District, Odisha

BOTANY

KEYWORDS : Grassland community, Biomass, Livegreen, Standing dead, Litter, Belowground

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ABSTRACT

The standing crop biomass of a grassland community of Mayurbhanj district (22^0 11'N; 86^0 41'E) in the state of Odisha was studied following sequential harvest method as proposed by Odum (1960). The mean livegreen, standing dead and litter biomass of the community were found to be 460.85g m^{-2}, 269.67 g m^{-2} and 64.19 g m^{-2} respectively. The belowground biomass was found to be maximum in the month of September (698.24 g m^{-2}). The mean values of livegreen, standing dead and litter biomass, somehow, showed similarity with the grassland of Berhampur (Barik, 2006) whereas the maximum belowground biomass value of the community exhibited similarity with the grassland of Phulbani as reported by Behera (1994).

INTRODUCTION

Studies on biomass in a community are important from structural and functional point of view. It is the quantity of organic matter of a given area. It can be expressed as dry weight. The biomass gives an idea of the size of organisms that exist in a community and when it is referred to a particular period it is termed as "standing crop biomass." Review of literature reveals a lot of information on biomass structure in different climatic regions (Odum, 1960; Ovington *et al*., 1963; Golley, 1965 ; Porter, 1967 ; Dahlman and Kucera, 1965; Singh, 1967; Kelly *et al*., 1969; Vershney, 1972; Jain and Misra, 1972; Choudhury, 1972 ; Misra, 1973; Mall and Billore, 1974; Singh & Ambasht, 1975; Jain, 1976; Pandey, 1978; Misra, 1978; Trivedi and Misra, 1979; Rath, 1980; Naik, 1985; Patnaik, 1993; Behera, 1994; Barik, 2006 and many others). However very little work has been done on the grasslands of the northern belt of the state, Odisha. Keeping this in view, an attempt has been made to study the standing crop biomass structure of a grassland community of Mayurbhanj district. The results obtained in this study were also compared with other grassland communities of various climatological regions.

Study site and environment

The experimental site was selected at Jharpokharia (22^{0}11'N; 86^{0}41'E) situated at a distance of 40 kms from the North Orissa University and 35 kms from Baripada, the district headquarter of Mayurbhanj in the state of Odisha. The altitude of the site is above 92.4 m. The climate of the locality is monsoonal with three distinct seasons i.e. rainy (July to October), winter (November to February) and summer (March to June). The total rainfall during the study period was 1108 mm of which a maximum of 452 mm was recorded during July. The minimum and maximum atmospheric temperatures recorded during the study period were found to be normal. December showed the lowest temperature (11.53^{0}C) whereas May exhibited the highest temperature (37.35^{0}C). Table -1, represents the atmospheric temperature, number of rainy days and rainfall during the study period. The soil of the experimental site was found to be strongly acidic (pH = 4.77). The available phosphorus, potassium and organic carbon contents in the soil were found to be very low (Table -2).

MATERIALS AND METHODS

Harvest method of Odum (1960) was employed for the estimation of plant biomass. 10 quadrats of 50 cm x 50 cm size were randomly harvested / clipped, 1cm above the ground during the last week of each month. The samples were packed in polythene bags separately. The dead leaves, stems, seeds, flowers etc. lying on the ground, known as litter were hand-picked from each clipped plot, bagged and labelled. Roots including the remaining shoot bases were collected by excavating 25cm x 25cm cm monolith to a depth of 30 cm at the centre of each clipped plot.

Table-1: The atmospheric temperature, no. of rainy days and rainfall during the study period.

Month	Minimum temp. (°C)	Maximum temp.(°C)	Number of rainy days	Rainfall (mm)
December	13.22	26.71	--	--
January	11.97	26.63	01	19
February	16.55	28.66	04	22
March	19.57	33.18	02	19
April	23.65	37.28	07	26
May	25.09	37.35	06	64
June	25.21	34.60	11	117
July	24.70	32.37	21	452
August	24.40	31.88	14	231
September	23.86	30.43	14	140
October	20.55	31.46	02	13
November	17.40	28.13	03	05
December	11.53	25.97	--	--
Total			85	1108

Table - 2: The pH, conductivity, organic carbon (%), available phosphorus and potassium content of the soil of the study site (values are in mean ± SD, n=5 each).

Surface depth (cm.)	pH	Conductivity (S cm^{-1})	Organic carbon (%)	Available phosphorus (ppm)	Available potassium (ppm)
0 to 10	4.84 ± 0.134	0.50 ± 0.000	0.406 ± 0.153	0.14 ± 0.089	25.20 ± 1.987
10 to 20	4.76 ± 0.134	0.52 ± 0.045	0.316 ± 0.103	0.26 ± 0.089	25.40 ± 7.385
20 to 30	4.72 ± 0.130	0.50 ± 0.000	0.278 ± 0.091	0.24 ± 0.114	28.50 ± 6.473

All these samples were labelled properly and brought to the laboratory. All green plant materials were separated into different species components and were referred to as livegreen compartment. All yellow dry plant materials known as standing dead were separated from the mother plant. Some of the materials remaining at the ground level were separately collected using water floating technique. The belowground portion containing root, rootstocks, rhizomes etc. were washed with low pressure tap water. Care was taken not to leave any plant material escape during processing. All these materials i.e. livegreen, standing dead, litter and belowground compartments were first dried in the open and then transferred to the oven for drying at 80°C for 24 hours and weighed. The biomass values were expressed in g m^{-2}.

RESULTS AND DISCUSSION

The live green (grasses & non-grasses) biomass of the community exhibited a regular decline in trend from December (578.83 g m^{-2}) to May (250.04 g m^{-2}) and attained peak in October (629.24 g

m^{-2}). Onwards a decreasing trend of biomass value was observed till the end of the sampling period. The standing dead biomass gradually increased from December (226.54 g m^{-2}) and attained peak in the month of April (379.56 g m^{-2}) followed by a declining trend from June (362.48 g m^{-2}) to October (155.46 g m^{-2}).The litter biomass exhibited an increasing trend from December (33.52 g m^{-2}), became maximum in the month of June (106.48 g m^{-2}) and then a regular decrease in the value was observed till the end of the sampling period. The total aboveground biomass of the community was found to be minimum in the month of July (577.68 g m^{-2}) and maximum at the end of the sampling period i.e. December (820.91 g m^{-2}). However, no such increasing/ decreasing trend in the biomass value was observed during the study period. The belowground biomass values exhibited a declining trend from December (568.72 g m^{-2}) to April (457.52 g m^{-2}), then the value increased regularly and showed a peak in the month of September (698.24 g m^{-2}). Thereafter, it decreased till November (485.14 g m^{-2}).The total biomass of the community during the period of study was found to range between 1083.38 g m^{-2} and 1497.78 g m^{-2}. Maximum biomass value was observed in September and minimum in the month of May. A regular decrease in biomass value was noticed from December to May, the value then increased gradually up to the month of September followed by a decreasing trend till November (Table-3).

Table-3: Monthly variation in standing crop biomass in dry weight (g m^{-2}) of a Grassland community of Mayurbhanj district during the sampling period.

Month	Live green biomass	Standing dead biomass	Litter biomass	Above ground biomass	Below ground biomass	Total biomass
December	578.83	226.54	33.52	805.37	568.72	1374.09
January	552.34	260.18	54.36	812.52	547.00	1359.52
February	515.90	297.58	64.00	813.48	481.18	1294.66
March	417.62	357.04	77.84	774.66	464.42	1239.08
April	271.98	379.56	95.36	651.54	457.52	1109.06
May	250.04	355.18	93.70	605.22	478.16	1083.38
June	252.64	362.48	106.48	615.12	532.44	1147.56
July	311.14	266.54	79.42	577.68	597.42	1175.10
August	427.54	217.54	58.64	645.08	665.18	1310.26
September	604.16	195.38	55.08	799.54	698.24	1497.78
October	629.24	155.46	44.74	784.70	543.40	1328.10
November	596.16	194.74	36.56	790.90	485.14	1276.04
December	583.40	237.51	34.72	820.91	531.52	1352.43
Total	5990.99	3505.73	834.42	9496.72	7050:34	16547.06
Mean	460.85	269.67	64.19	730.52	542.33	1272.85

Table-4, 5 and 6 show the mean values of livegreen, standing dead and litter biomass respectively for different communities reported by various workers in different climatic regions. Comparison of these data revealed that in the present finding livegreen biomass was higher than those of the grasslands of South Carolina (Golley, 1965), South Florida (Porter, 1967), Tennessee (Kelly *et al.* 1969), New Delhi (Vershney, 1972), Ratlam (Mall & Billore, 1974) , Berhampur (Misra, 1978; Barik, 2006), Jhansi (Trivedi & Misra, 1979) and Phulbani (Behera, 1994) but lesser than the grassland of Rourkela (Naik, 1985). The standing dead biomass was found to be high compared to those reported by Choudhury (1972) , Misra (1973), Mall & Billore (1974), Misra (1978), Trivedi & Misra (1979), Patnaik (1993) and Behera (1994) but less than the values reported by Golley (1965), Kelly *et al.*(1969), Jain (1976) and Pandey (1978). Litter biomass of this investigation showed almost similar result to those of the grasslands of Chakia (Sing & Ambasht, 1975), South Orissa (Patnaik, 1993) and Berhampur (Barik, 2006).

Table -4. Mean aboveground livegreen biomass (g m^{-2}) of different herbaceous communities.

Author (s)	Year of study	Location	Type of community (dominated)	Mean live green biomass
Golley	1965	South Carolina	*Andropogon*	90.95
Porter	1967	South Florida	*Muhlenbergia*	119.40
Kelly *et al.*	1969	Tennessee	*Andropogon*	219.10
Vershney	1972	New Delhi	*Heteropogon*	333.80
Mall & Billore	1974	Ratlam	Sehima	104.10
Misra	1978	Berhampur	*Aristida*	342.70
Tribedi & Misra	1979	Jhansi	Sehima	197.60
Naik	1985	Rourkela	Mixed type	516.90
Behera	1994	Phulbani	*Heteropogon*	333.50
Barik	2006	Berhampur	Aristida	441.30
Present study	---	Jharpokharia	Chrysopogon	460.85

Table-5: Mean aboveground standing dead biomass (g m^{-2}) of different herbaceous communities.

Author(s)	Year of study	Location	Type of community (dominated)	Mean Standing dead biomass.
Golley	1965	South Carolina	*Andropogon*	335
Kelly *et al.*	1969	Tennessee	*Andropogon*	650
Choudhury	1972	Varanasi	*Dichanthium*	129
Misra	1973	Ujjain	*Dichanthium*	164
Mall & Billore	1974	Ratlam	Sehima	190
Jain	1976	Sagar	Heteropogon	338
Pandey	1978	Varanasi	Aristida	845
Misra	1978	Berhampur	*Aristida*	232
Trivedi & Misra	1979	Jhansi	Sehima	104
Patnaik	1993	South Orissa	*Heteropogon*	073
Behera	1994	Phulbani	*Heteropogon*	179
Barik	2006	Berhampur	*Aristida*	272
Present study	---	Jharpokharia	*Chrysopogon*	270

Table – 6: Mean litter biomass (g m^{-2}) of different herbaceous communities.

Author(s)	Year of study	Location	Type of community (dominated)	Mean litter biomass
Odum	1960	South Carolina	Forb	300
Ovington *et al.*	1963	Minnesota	Praire savana	279 1,365
Golley	1965	South Carolina	*Andropogon*	250
Choudhury	1972	Varanasi	*Dichanthium*	098
Misra	1973	Ujjain	*Dichanthium*	225
Singh & Ambasht	1975	Chakia	*Heteropogon*	065
Misra	1978	Berhampur	*Aristida*	057
Trivedi & Misra	1979	Jhansi	*Sehima*	044
Rath	1980	Berhampur	*Aristida* *Aristida* (Grazed)	055 034
Patnaik	1993	South Orissa	*Heteropogon*	062
Behera	1994	Phulbani	*Heteropogon*	049
Barik	2006	Berhampur	*Aristida*	065
Present study	---	Jharpokharia	*Chrysopogon*	064

Table-7, shows the maximum belowground biomass of various communities in different climatic regions. On comparison of the present finding with those of other grassland communities, the maximum belowground biomass value was found to be higher than the findings of Ovington *et al.* (1963), Singh (1967), Singh and Ambasht (1975), Behera (1994) and Barik (2006) but lesser than the values reported by Dahlman and Kucera (1965), Kelly *et*

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al. (1969), Jain and Misra (1972), Choudhury (1972), Misra (1973) and Pradhan (1994). The topography, phenology of the species, rate of evaporation, temperature variability, fertility of the soil etc. might have been responsible for the varition in various compartmental biomass values of the community in comparison to others.

Table– 7: Maximum belowground biomass (g m^{-2}) of different herbaceous communities.

Author(s)	Year of study	Location	Type of community (dominated)	Mean below ground biomass
Ovington *et al.*	1963	Cedar Creek	Prairie	669.5
Dahlman & Kucera	1965	Missouri	Prairie	1,901.0
Singh	1967	Varanasi	*Dichanthium*	583.0
Kelly *et al.*	1969	Tennessee	*Andropogon*	804.0
Jain & Misra	1972	Sagar	*Heteropogon*	1,537.3
Choudhury	1972	Varanasi	*Dichanthium*	1,008.0
Misra	1973	Ujjain	*Dichanthium*	925.0
Singh & Ambasht	1975	Varanasi	*Heteropogon*	184.1
Misra	1978	Berhampur	*Aristida*	743.2
Pradhan	1994	Bhubaneswar	*Aristida*	736.4
Behera	1994	Phulbani	*Heteropogon*	688.9
Barik	2006	Berhampur	*Aristida*	644.1
Present study	---	Jharpokharia	*Chrysopogon*	698.2

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