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Full Length Article

Seasonal variation in biomass at the tropical rainforest of Western Ghats, Kodayar, Tamilnadu

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ABSTRACT

A field study was conducted in Kodayar to study the seasonal variation in biomass. The study revealed that there is much difference in the biomass during different seasons. The live shoot biomass in comparatively lesser during winter and its showed negative correlation with rainfall. The standard dead biomass is maximum during summer and no standing dead is recorded during certain months of post monsoon season. Litter biomass is maximum during summer and minimum during winter season. The litter biomass depends upon the canopy cover. During summer canopy cover is less, whereas during winter and monsoon season there is closed canopy. Below ground biomass showed negative correlation with air temperature. Variation in below ground biomass is influenced by species composition, nutrient availability and rate of rainfall. Total biomass is maximum during summer and minimum during rainy season. Light availability and soil moisture had a significant effect on total biomass.

Key words: Biomass, Kanyakumari district, Kodayar, Western Ghats.

INTRODUCTION

Biomass varies considerably not only among different types of ecosystems, but also among similar ecosystem and within one system year to year or season to season (Ahmedin et al., 2013). Kanyakumari district enjoys a wide range of climatic conditions very much influenced by the Western Ghats and also by south-west and north-east monsoon. The rainfall varies according to the seasons, south-west monsoon, north-east monsoon, post-monsoon and summer (Anami and Jeeva, 2013; Domettila and Jeeva, 2013a,b). The biomass also varies according to the season. Live shoot biomass showed negative correlation with rainfall. Dead shoot biomass is maximum in summer. Litter production is maximum in summer and the below ground biomass showed significant negative correlation with air temperature.

Biomass is an important parameter to assess the atmospheric carbon that is harvested by plants. In recent times, biomass related studies have become significant due to growing awareness of carbon credit system throughout the world. In India as much as 86% of the forest area is under tropical forest, of which 53% is dry deciduous, 37% moist deciduous and the rest wet evergreen (Kaul *et al*., 1971). Terrestrial ecosystems of India are extensively studied for biomass and productivity estimation using ecological methods (Chaturvedi *et al*., 1987; Rawat *et al*., 1988; Singh *et al*., 1989). Biomass is the primary source of energy in any ecosystem. The biomass varies considerably not only among different types of ecosystems, but also among similar ecosystems from season to season. Biomass production is influenced by factors such as nutrient availability, moisture especially precipitation, temperature, duration of growing season, animal utilization and fire (Brigges and Knapp, 1995). Biomass estimation methods have been reviewed by Kale *et al*., (2002). Plants allocate net production to leaves, twigs, stem, bark, roots,

flowers and seeds. The root/shoot ratio varies from season to season. Plants with large root biomass are more effective competitors for water and nutrients and can survive more successfully in harsh environment because of active below ground biomass. Plants with more above ground biomass assimilate more light energy, resulting in high productivity. The main aim of this study is to show how the root, shoot (live and dead), litter biomass varies in different seasons.

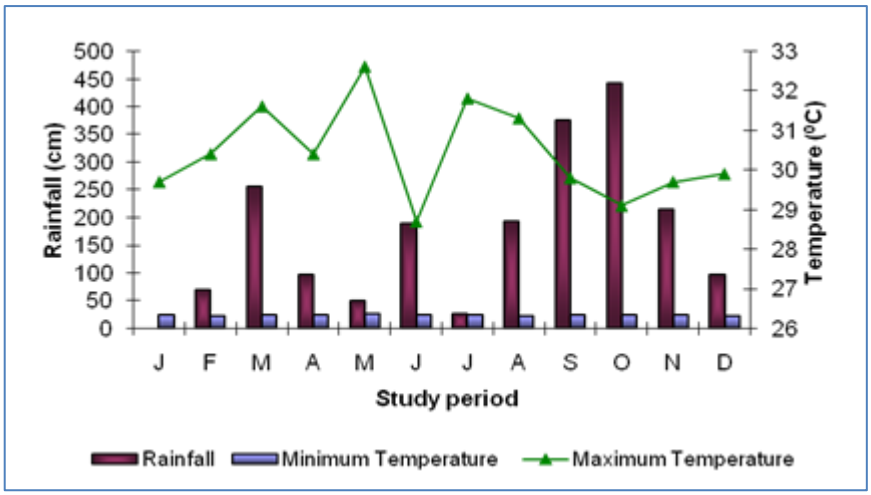
MATERIALS AND METHODS

Study Area The present study was carried out in Lower Kodayar, located in the western part of Kanyakumari district in Tamilnadu between 77°0′ and 77°0′ east longitude and 8°0′ to 9°0′ north latitude. This area comprises of low lands, plains, artificial plantations (mainly *Hevea braziliensis* and *Tectona grandis*) and natural forest. Maximum rainfall was recorded during North-East monsoon season and lesser rainfall during South-West monsoon season. Maximum temperature was recorded during summer and minimum during winter (Figure 1).

Methods

Biomass was estimated by harvest method (Milne, Huges 1968). Above ground and below ground biomass was collected at monthly intervals through randomly laid 50 cm × 50 cm quadrats for two years. The above ground mass was separated into live shoot, dead shoot and litter.

Figure 1: Rainfall and temperature pattern of the study area



The below ground biomass was estimated by escavating 25 × 25 × 30 cm monolith from each quadrat. The depth was sufficient to include more than 90% of root mass were separated from the soil particles by washing. After recording the fresh weight of the root, live shoot, dead shoot and litter were dried in hot air oven at 80°C for 48 hours and dry weight was recorded. The dried samples were weighed again and again until the concordant values was obtained (Sah *et al*., 1994).

Biomass of unit area= $(b_2-b_1)/ D$ Dry wt/gm/m^2

Where

b_1 = biomass at time t_1

b_2 = biomass at time t_2

D = Day interval between t_1 and t_2

Results and Discussion

Western Ghats in Kodayar enjoys a wide range of climatic conditions very much influenced by south-west monsoon and north-east monsoon. They are Post-monsoon (Winter)-January and February, Hot season (Summer)- March to May, South-west monsoon season- June to September and North-east monsoon season- October to December. The monthly rainfall varied from 0 mm to 682mm during the study period. Maximum rainfall was recorded during north-west monsoon season (682 mm).

Live shoot biomass varies from 12.88g/m^2 to 53.64 g/m^2 . The maximum live shoot biomass was recorded during south-west monsoon season (September). During winter season the live shoot biomass ranges between 17.62 to 35.46 g/m^2, whereas in summer it ranges from 13.34 to 43.48g/m^2. During north-west monsoon season it ranges from 13.62 to 41.64 g/m^2. The live shoot biomass is comparatively lesser during winter

season, because winter adversely affects the growth survival of herbaceous plants. But during south-west and noth-east monsoon season the herbs exhibit luxuriant growth. Similar effect has been reported by Joshi *et al*., (1980) in tropical deciduous forest in Orissa. Live shoot biomass showed negative correlation with rainfall. The regression equation for the live shoot biomass was Y= 29.30-0.22 x (P<0.05).

The standing dead biomass ranged from 0.00 to 40.56 g/m^2. The standing dead biomass was maximum during summer and no standing dead was recorded during certain months of post-monsoon season. During post-monsoon season it ranges from 0.00 to 32.36 g/m^2. During summer it ranges from 2.02 to 40.56 g/m^2. The standing dead ranges from 0.24 to 29.22 g/m^2 during south-west monsoon season and 2.30 to 6.48 g/m^2 during north-east monsoon season. The reduction in standing dead biomass during summer months is mainly due to less canopy cover and less rainfall as a result the herbaceous layer is directly exposed to extremes of temperature and light. This leads to the formation of more standing dead biomass. Senescence of plants also increases standing dead biomass during dry months (Sundaravalli and Paliwal, 1997).

The biomass of litter also fluctuated throughout the study period. It ranges from 32.74 to 276.58 g/m^2. During post-monsoon season the litter biomass ranges from 100.62 to 209.00 g/m^2. Litter biomass is maximum during summer and minimum during monsoon season. During summer it varies from 55.20 to 276.58g/m^2. During monsoon season it ranges from 32.74 to 158.46g/m^2.

Table 1: Table showing the seasonal variation biomass for a period of two years

Month	Live shoot gm/m^2	Standing Dead shoot gm/m^2	Litter gm/m^2	Root gm/m^2	Total Biomass gm/m^2
September	27.00	7.74	122.84	22.54	180.12
October	37.58	2.30	126.28	94.54	260.70
November	32.86	5.44	49.64	58.08	146.02
December	13.62	3.16	128.22	3.00	148.00
January	17.62	10.66	100.62	6.90	135.80
February	35.46	7.28	209.00	5.20	256.94
March	40.90	6.48	170.80	29.86	248.04
April	30.14	7.40	276.58	20.48	334.60
May	43.48	3.68	225.42	26.84	299.42
June	36.38	2.40	184.28	33.80	256.86
July	43.98	0.24	64.50	45.74	154.46
August	12.88	12.90	158.46	42.38	226.62
September	53.64	29.22	83.20	36.18	202.24
October	41.64	6.48	104.28	27.44	179.84
November	23.08	3.04	32.74	2.92	61.78
December	15.00	27.60	73.56	11.68	127.84
January	19.58	32.36	114.94	18.82	185.70
February	18.72	0.00	171.18	37.22	227.12
March	18.84	2.02	102.42	16.42	139.70
April	13.34	40.56	99.32	25.02	178.24
May	18.03	2.75	55.20	26.04	102.02
June	29.49	7.84	145.34	12.28	194.95
July	42.21	5.84	34.25	18.43	100.73
August	37.80	7.50	53.96	7.50	106.76

Litter fall quantification provides a reasonable indication of the phenology of a forest. The litter production is maximum during summer. This is mainly due to less canopy cover and addition of leaf litter from the trees and lianas. During winter and monsoon season the litter biomass is comparatively lesser due to closed canopy condition, which helps in moisture retention in tropical rainforest.

The below ground biomass ranges from 2.92 to 94.54 g/m^2. During post-monsoon season it varies from 5.20 to 37.22 g/m^2, whereas in summer it ranges from 16.42 to 29.86 g/m^2. During rainy season the below ground biomass varies from 2.92 to 94.54 g/m^2. The below ground biomass showed negative correlation with air temperature. The regression equation for below ground biomass was

$Y = 26.22 - 0.98 \times (P<0.1)$

Variation in below ground biomass is influenced by species composition and species diversity. The increased root biomass may be attributed to more nutrient availability and rate of rainfall. The total biomass varies from 61.78 to 334.60 g/m^2. The total biomass is maximum during summer and minimum during rainy season. Light availability and soil moisture had a significant effect on total biomass. Several studies have shown that, as light availability decreases, plants allocate more biomass to above ground components relative to below ground component (Lieffers, 2001).

From the above study of seasonal variation in biomass it can be suggested that the biomass varies within the same forest ecosystem during different seasons. The biomass is influenced by factors such as light intensity, nutrient availability and precipitation. The biomass is also influenced by human disturbance and extensive biomass removal causes stress in the ecosystem (Rajeev *et al*., 1998). The live shoot biomass and root biomass shows negative correlation with rainfall and temperature respectively. Therefore the present study revealed that the fluctuation in biomass is due to light, temperature, nutrient availability and moisture content of the surrounding environment.

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