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Study of Herbaceous Biomass and Productivity of Sahatradhara Forest Region under Garhwal Himalaya

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Abstract

The structure of vegetation of an area is based on the quantity and quality of floristic elements. The quality, quantity and the organic behavior in an ecosystem are all manifestation of energy, which vary with the season, species composition and plant parts. Present study is conducted to verify the actual biomass production of the herbaceous plant species in the Molu forest of Sahastradhara region along Baldiriver under Garhwal Himalaya. The area under investigation is divided into three major study sites viz; site A, Site B and Site C. The estimation of biomass is done by harvest method. Rate of production is calculated by dividing the production by the number of days in the month concerned. The maximum biomass (0.56 gm/m^2) was reported in the month of January and minimum (0.22 gm/m^2) in the month of April from site 1. Average standing dead biomass was found maximum (7.69 gm/m^2) was reported in the month of January and minimum (0.18 gm/m^2) in the month of April from site 1. The average litter biomass was foundmaximum (4.51 gm/m^2) was reported in the month of November and minimum (0.52 gm/m^2) in the month of February from site 1. During the study we able to know that in December, January we found the maximum biomass productivity. The minimum biomass we found in the month of April and May. The variation in the biomass is due to seasonal changes and thesemonths have got the suitable climatic conditions such as water availability, humidity, temperature etc. for the growth of the vegetation. This study could be useful to the researcher and scientist to know the idea of biomass productivity in the region.

Key words

Biomass productivity,Molu forest, Species composition, herbaceous plants, Garhwal Himalaya

1. Introduction

The Himalaya represents one of the youngest mountain systems of the world and is known for its beautiful landscapes, rich flora and fauna, vast river systems, snow-clad peaks, a varied topography and climatic conditions (Putz and Redford, 2010). The herbaceous community of treeless grasslands and forest grazing land vegetation in the Himalayan region are described by Singh and Saxena (1980). The favorable climate for the development of grazing land as a climax unit would be frequent rainfall evens a small amount and sufficient warmth and moisture during the growing season. The grazing land vegetation changes to one or the other type of forest under natural conditions (Gilliam, 2007). The biotic and edaphic factors help in the development of grazing land over extensive areas. Ones the woody vegetation takes hold of the area, grasses begin to decrease and the composition of the ground flora changes considerably (Chandra *et al.*, 2010).

The structure of vegetation of an area is based on the quantity and quality of floristic elements. The phytosociology includes mainly the description of the vegetation of that area in terms of various analytic and synthetic characters. The basic concepts regarding the phytosociology and the plant community have been proposed by Schultz and Mooney (1993). The dominating plant species determine the structure of a community (Hanson and Churchill, 1961). The species that exert major controlling influencing by their number, size, distribution pattern, IVI or other activities are described as dominants (Odum, 1971). The major topographic features such as elevation, aspect and slope inclination are known to play a significant role in determining structural characteristics of vegetation (Smith,1974). Each constituent species has not only its own ecological amplitude but also its particular relationship to the environment and to the associate species (Bliss, 1963).

The community is influenced not only by physical or Abiotic conditions, but also by biological conditions. Biologically controlled communities are often influenced by a single species or by a group of species that modify the environment. These organisms are called dominants (Smith, 1974). The dominant species in a community possess the highest biomass occupy, the most space and make the largest contribution to energy flow and mineral cycling or by any other means to control or influence the rest of the community. The degree of dominance expressed by any one species appears to depend in part on the position it occupies on a physical or chemical gradient (Sharma et al., 2009).

Estimation of the Biomass and productivityis a pre-requisite for understanding of ecosystem properties and functions (Singh and Singh, 1992). Biomass is the total organic matter of vegetation produced in a given time for a unit area. The indices of the amount of Phytomass and dead organic matter give a static picture of the potential reserve of matter and energy that have been accumulated by the community over a certain time interval (Bazilevic and Rodin, 1971). The biomass and productivity of different ecosystems have been much emphasized by the ecologists to understand their functioning. Lindeman (1942) in his pioneering study has explained the energy transfer occurring through different trophic levels in an aquatic ecosystem.

The path of flow of energy, which is related with the dry matter production and structural component of primary production in a food chain, is an important aspect of the study of ecosystem function. The quality, quantity and the organic behavior in an ecosystem are all manifestation of energy, which vary with the season, species composition and plant parts (Singh and Yadava, 1974).In this context, present study is conducted to verify the actual biomass production of the herbaceous plant species in the Sahatradhara region.

2. Material and Methods

2.1. Study Site

The present study area (Molu forest of Sahastradhara) is located along Baldiriver in Doon, valley at the foot hills of Garhwal Himalaya. 'Sahastradhara' Litterally means "the thousand fold springs" situated at a distance of 11 kms towards North-East of Dehradun between 600-1000 m asl. Geographically, it is located in and around latitude 30^0 23' N and longitude 78^0 07' E. Saratradhara is surrounded by hills on three sides and broad river lead on 4^{rth} side. The climate of the present study area having temperate rainfall and followed three well defined seasons viz., rainy, winter and summer are distinctly marked.

Bauhinia species **(***Bauhinia variegate* L., *Bauhinia vahlii*Wight&Arn), is a dominant species of this region. Besides it many plant species viz. *Rhamnusvirgatus*Roxb.,*Berberisasiatica*Roxb.ex DC., *Berberisasiatica*Roxb.ex DC., Murrayakoenigii, Opuntia, *Acacia catechu* (L.F) Willd., *Woodfordiafruticosa* (L.) Kurz, *Partheniumhysterophorus* L.,*Bidenspilosa* L., *Eupatorium adenophorum*Sprengel., Lantana camara, *Ageratum conyzoides* L., *Carissa opaca*Stapf ex Haines,*Adhatodazeylanica*Medikus., *Chenopodium ambrosioides* L., *Rumexhastatus*D.Don, *Urticadioica* L., *Ficusauriculata*Lour., *Cynodondactylon* etc., contribute a very important role in biomass productivity and are found approximately in all the month during the period of study.

2.2. Data collection and sampling

The Area under investigation along Baldi river is divided into three major study sitesviz; site A, Site B and Site C. Each major study site is further divided into two sub-sites i.e.siteA1 and A2; Site B1 and B2; and site C1 and C2.

From each sub-site, two samples have to be collected. Thus from major study site, total number of samples to be collected are six.The estimation of biomass is done by harvest method (Curtis and McIntosh, 1951).For the estimation of biomass in present study, from each sub-sites three quadrates of the size 15cm x 15cm x 30cm (l x b x d) are randomly selected. The samples of plant material are collected from the experimental field at monthly intervals by harvesting the plants. Samples are collected in the first week of the month. The samples to be collected are divided into two main components such as above ground sample and below ground sample. Further these samples were collected as green (live), standing dead (SD) and litter while the below ground sample is represented by the roots.

The roots are collected with the help of digger. The separated samples are packed in the bags. Each bags having the label to avoid any problem in handling the samplescontaining the name of the study site, sub-site, type of samples and the collection of date and month. The packed bags having samples are bought to the laboratory and washed thoroughly with the running water.The collected above ground and below ground samples are oven dried at 60°C for 24 hours. The monthly data so obtained is used to calculate the biomass value for the different sites under investigation.The collected samples are weighed and the biomass is expressed in gm/m^2.Aboveground live, standing dead, litter and belowground samples are weighed separately.

Clearly total primary production or gross production exceeds that which can be measured. The relationship can be summarized most simply by the formula:NPP = GPP – [Ra + Rh]

Where,NPP = Net Primary Production; GPP = Gross Primary Production.

Rate of production is calculated by dividing the production by the number of days in the month concerned(Singh and Yadav, 1974).Total Net Production (TNP) is calculated by adding the Aboveground Net Production (ANP) and Belowground Net Production (BNP).

3. Results

3.1. The average live biomass

During the present study the maximum biomass (0.56 gm/m^2) was reported in the month of January and minimum (0.22gm/m^2) in the month of April from Site 1. Similarly, maximum biomass (0.45 gm/m^2) was reported during the month of December and minimum (0.21 gm/m^2) in March from site 2. At the same time maximum biomass (0.57 gm/m^2) was reported during the month of January and minimum (0.11 gm/m^2) in April from site 3 (Fig 1).

3.2. The average standing dead biomass

During the present study the average standing dead biomass was found maximum (7.69 gm/m^2) was reported in the month of January and minimum (0.18 gm/m^2) in the month of April from Site 1. Similarly, maximum biomass (1.25 gm/m^2) was reported during the month of November and minimum (0.20 gm/m^2) in January from site 2. Maximum biomass (0.68 gm/m^2) was reported during the month of December and minimum (0.27 gm/m^2) in May from site 3 (Fig 2).

3.3. The average litter biomass

During the present study the average litter biomass was foundmaximum (4.51 gm/m^2) was reported in the month of November and minimum (0.52 gm/m^2) in the month of February from Site 1. Similarly, maximum litter biomass (3.31 gm/m^2) was reported during the month of December and minimum (1.04 gm/m^2) in May from site 2. Maximum litter biomass (2.73 gm/m^2) was reported during the month of March and minimum (0.82 gm/m^2) in May from site 3 (Fig 3).

3.4. Total aboveground biomass

The present study revealed that the higher total aboveground biomass (10.98 gm/m^2) was reportedduring the month of December while minimum (1.19gm/m^2) in the month of February from Site 1. Similarly, maximum total aboveground biomass (4.65gm/m^2) was reported during the month of December and minimum (1.63gm/m^2) in May from site 2. Maximum total aboveground biomass (3.37gm/m^2) was reported during the month of November while minimum (1.32 gm/m^2) in May from site 3 (Fig 4).

3.5. Total aboveground biomass

The present study reported that the higher total below ground biomass (0.44 gm/m^2) was reportedduring the month of November while minimum (0.11 gm/m^2) in the month of April from Site 1. Maximum total below ground biomass (0.40 gm/m^2) was reported during the month of November and minimum (0.09 gm/m^2) in April from site 2. Similarly, maximum total below ground biomass (0.26 gm/m^2) was reported during the month of November while minimum (0.12 gm/m^2) in May from site 3 (Fig 5).

4. Discussion

The importance of productivity in the functioning of ecosystem cannot be overemphasized. While many workers have investigated primary productivity of plant species in several ecosystems (Ram, 1988) most studies deal with the terrestrial ecosystems. Previously very less study has been done in this particular area at Molu forest. Thus this study become very important as it is focused mainly on biomass productivity of this area because this area having very important plant species and plays a vital role in affecting the forests around it. Molu forest shows variation in the biomass productivity. All the study sites shows the variations in the biomass productivity which is influenced by the biotic and abiotic factors.Abiotic factors like moisture contents, air soil, temperature, human interference, cattle grazing, destruction of vegetation layer for commercial purpose etc. has big impact on biomass product.

In this study we come to know that only those plants are able to grow or live in this ecosystem which is adapted well to the situation of less or no water supply. During rainy season plants receives sufficient water supply and growth rate become fast due to this productivity becomes high. During summer, plants shed their leaves and other parts due to this productivity are affected.

5. Conclusions

During the study period we come to know that this fragile ecosystem is influenced by some human activity such as to cut plants for logging, grass cutting for their cattle and other many purposes. Cattle grazing along ecosystem side also affect the plants vegetation. During the study we able to know that in December, January we found the maximum biomass productivity. The minimum biomass we found in the month of April and May. The variation in the biomass is due to seasonal changes. December and January has got the suitable climatic conditions such as water availability, humidity, temperature etc. for the growth of the vegetation. April and May shows less production in the biomass which is due to the rise in the temperature. Due to increase in the temperature, the moisture content of the soil, water availability from soil becomes less, thus affecting the normal life cycle of the plants.

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Conflict of interest

Authors declare that they have no conflicts of interest.

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Figures

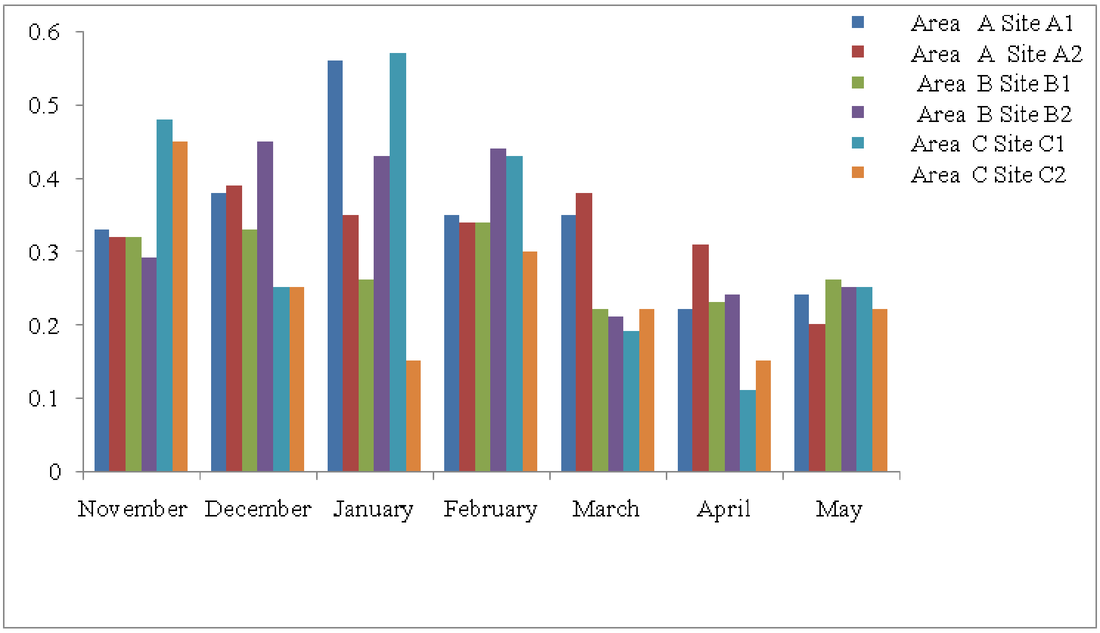

Fig.1: Live biomass of herbaceous at various sites

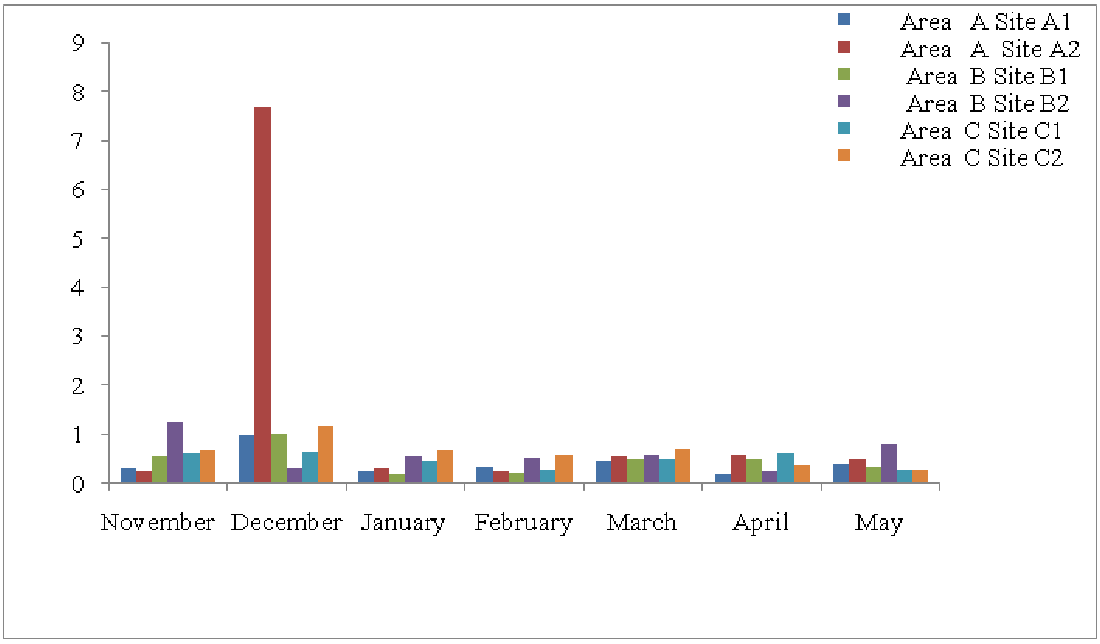

Fig.2: Standing dead biomass of herbaceous at various sites

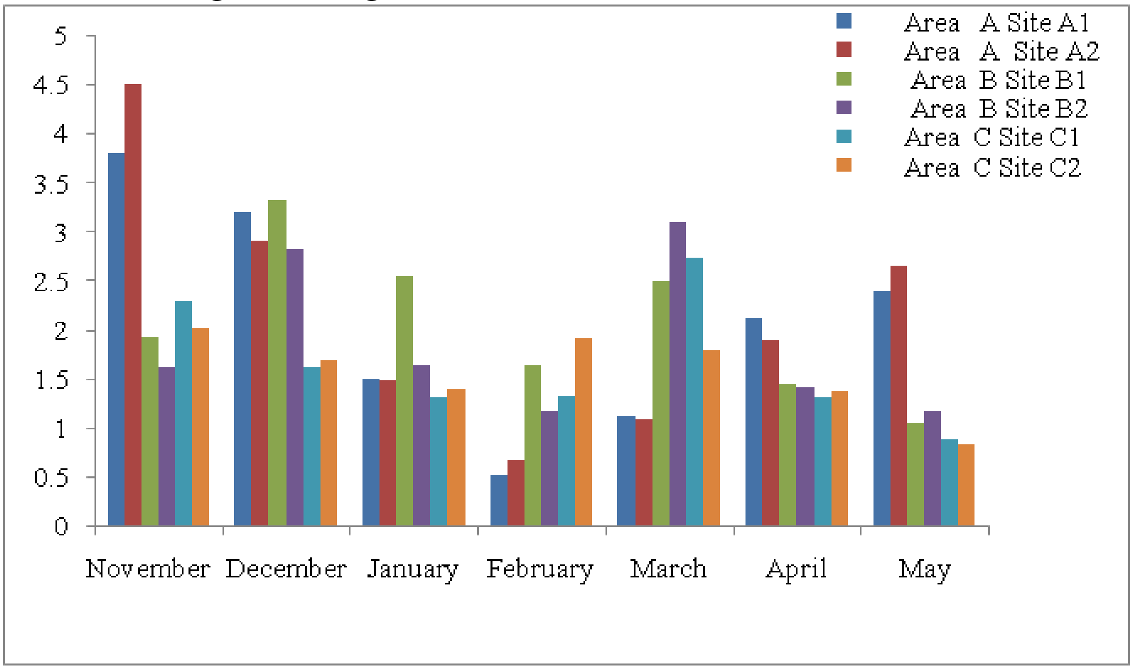

Fig.3: Litter biomass of herbaceous at various sites

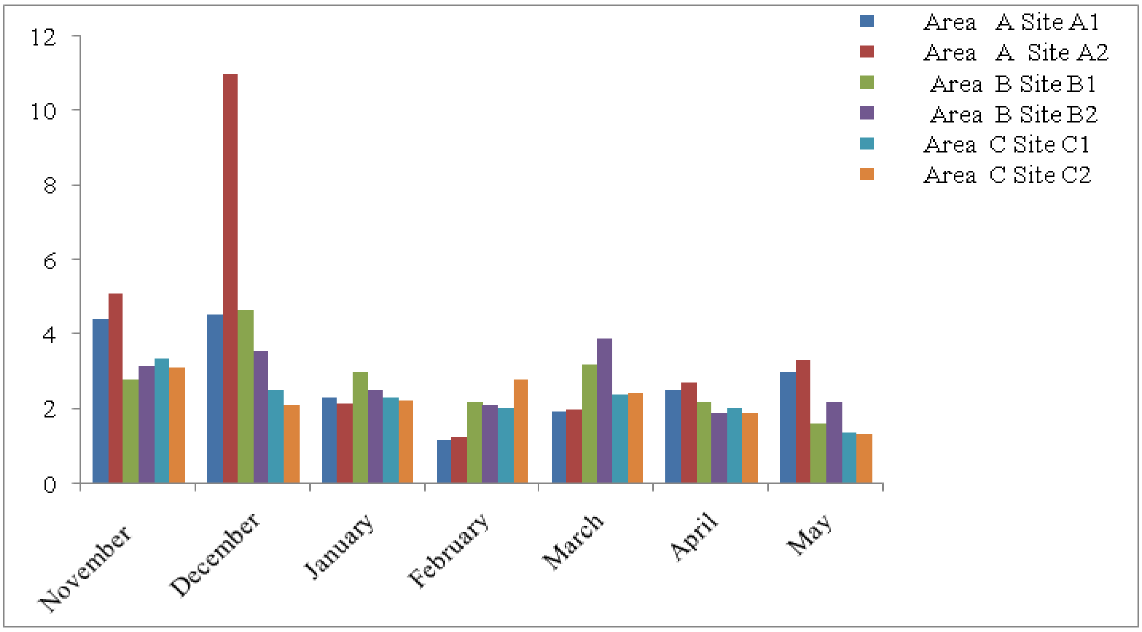

Fig.4: Total aboveground biomass of herbaceous at various sites

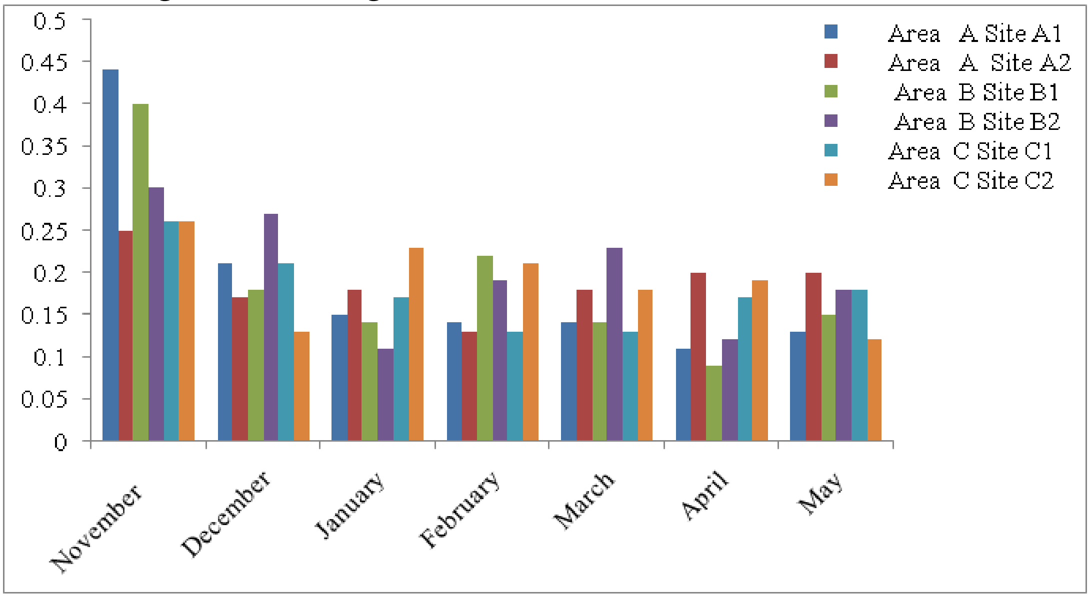

Fig.5: Total belowground biomass of herbaceous at various sites