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## Research Article

### A STUDY ON PHENOLOGY OF KALLAMALAI HILLS, SOUTHERN EASTERN GHATS, TAMIL NADU, INDIA

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#### ABSTRACT

The study was carried out at Kallamalai hills, Rasipuram Taluk, Namakkal district, Tamil Nadu, India. The vegetation analysis was enlisted 464 species and 251 genera of angiosperms belong to 75 families. During Post monsoon period Jan-Feb 24 species (5.19%) were in flowering and 133 species (28.79%) were in fruiting. In Pre monsoon period March-May 37 species (8.01%) were in flowering and 54 species (11.69%) were in fruiting. In south west monsoon period June-Sep 75 species (16.23%) were in flowering and 27 species (5.84%) were in fruiting. In North West monsoon period Oct-Dec 187 species (40.48%) were in flowering and 58 species (12.55%) were in fruiting. Flowering phenology largely take place during North West monsoon and fruiting phenology largely take place during Pre monsoon as evidenced by the study.

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#### INTRODUCTION

Phenology is an important study in understanding species interrelations and their interaction with the environment. A variety of factors have been involved to drive the phenology these include abiotic factors such as rainfall, day length irradiance, temperature and relative humidity (Wright and Van Schaik, 1994). Abiotic environmental conditions have been shown to play a significant role in the timing of various phenological events. Seasonal changes in abiotic and biotic factors can be expected to have consistent effects on phenology of tropical forests (Wright, 1996). Plant phenology is sensitive to climate and a key indicator of environmental change (Badeck *et al*, 2004; Estrella *et al*, 2007; Penuelas *et al*, 2009 and Yang and Rudolf, 2010). Phenological changes to be more rigorously used as early warning systems of potential climate impacts on species distributions (Menzel *et al*, 2006; Cleland *et al*, 2007 and Crimmins *et al*, 2009). Tropical plants with their high level of species diversity display phenological events such as leaf drop, leaf flushing, flowering and fruiting etc. in relation to time and space (Justiniano and Fredericksen, 2000; Singh and Singh, 1992). As plants reach the various developmental stages of their annual life cycle and the timing of a plant often

provides information for estimating geographic, climatic variation on a local scale (Kalb, 1962). No such phenological studies have been reported in Kallamalai hills; in this perspective, the study has been convened.

#### MATERIALS AND METHODS

##### Study area

The study was carried out at Kallamalai hills, Rasipuram Taluk, Namakkal district, Tamil Nadu India. The study area is situated between 11° 51' N latitude and 78° 12' E longitude and it is located in between Salem and Rasipuram towns. Kallamalai hills are considered a part of Boda hills of the Southern Eastern Ghats of the Eastern Ghats Gurveen Kaur *et al*, (2013). The average height of the hills is about 616m and covers an area of approximately 350 acres The average annual rainfall in this region is 76mm The Kallamalai hills are tropical dry deciduous thorny type of vegetation.

##### Seasonal periods

Kallamalai hills have experienced by four seasons in a year

- |                        |                  |
|------------------------|------------------|
| 1. Post monsoon season | January to March |
| 2. Pre monsoon season  | April to June    |

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3. South West monsoon season July to September
4. North West monsoon season October to December

### Field visits

The plant species were surveyed with flowering and fruiting phase and each species were noted season wise throughout the year in their natural habitats. Phenological data from the study area which is comprised of trees, shrubs, herbs, lianas, climber, twinner, parasite, etc. were recorded. The plant species were identified with the help of local floras, taxonomic revisions and monographs by using identification keys (Gamble and Fischer, 1935; Matthew 1995; Henry *et al.*, 1987; Chandrabose and Nair, 1988). The herbarium specimens prepared according to the standard instructions given by Jain and Rao, 1976. The collected plant species were cross checked for correct identification. The voucher specimens were deposited in the herbarium of PG & Research Department of Botany, Vivekanandha College of Arts and Science for Women Autonomous, Tiruchengode, Tamil Nadu.

## RESULTS

Floristic survey enlisted 464 species out of these 5 species belong to Pteridophyte and 1 species belong to Bryophyte. The angiosperm enlisted 458 species under 246 genera belongs to 75 families. Among angiosperm enumerated, 363 species belong to dicotyledons and 95 species belong to monocotyledons. Among dicotyledons, polypetalae and gamopetalae enumerated 175 species and 188 species respectively. In polypetalae, calyciflorae dominated with 98 species (21.39%) and in gamopetalae, bicarpellatae dominated with 106 species (23.14%).

Herbs dominated with 224 species (49.23%) followed by trees with 86 species (18.62%), Shrubs with 53 species (11.47%), Climbers with 29 species (6.28%), Prostrate Herb with 29 species (6.28%). Climbing shrub with 11 species (17.7%), Straggler, Twinner and Sub shrub each with 6 species (0.96%), Parasite with 5 species (0.80%), Climbing herb with 3 species (0.48%) and Creeper Diffuse herb and Lianas (0.96%) each.

### Flowering and Fruiting phases of plant species in Kallamalai hills

The reproduction of the species was analyzed and classified on the basis of a season or more than one season in a year. The plant species during the Post monsoon periods from January to March 24 species (51.9%), in the Pre monsoon period from April to June 37 species (80.1%), in the South West monsoon period from July to September 75 species (16.23%) and in the North West monsoon period from October to December 187 species (40.48%) were in flowering. About 95 species (20.56%) were in flowering throughout year.

The plant species during the Post monsoon periods from January to March 133 species (28.79%) and in the pre monsoon period from April to June 54 species (11.69%) were in fruiting. During the South West monsoon period from July to September 27 species (58.4%) and in the North West monsoon period 58 species (12.55%) were in fruiting. It is found that 48 species (10.39%) were in fruiting in both North West and Post monsoon periods 35 species (7.58%) were in fruiting in both Pre and Post monsoon periods About 103 species (22.29%) were in fruiting throughout the year.

### Phenology of Herbs

Flowering phase of herbs was observed the throughout the year, during the North West monsoon period 114 species (51.12%), in the South West monsoon period 28 species (12.56%), in the Post monsoon period 5 species (2.24%) and in the pre monsoon period 4 species (1.79%) were in flowering. Species flowered in both seasons are also recorded and the results revealed that in the North West and Post monsoon periods 10 species (4.48%), in the Post and Pre monsoon periods 2 species (0.89%), in the South West and North West monsoon period 1 species (0.45%) and in the North West Post and Pre monsoon periods 3 species (1.35%) were in flowering. About 56 species (25.11%) were in flowering throughout the year.

Fruiting phase of herbs was recorded and it is revealed that during Post monsoon periods 77 species (34.53%), in the North West monsoon period 25 species (11.21%), in the South West monsoon period 12 species (5.38%), in the Pre monsoon period 12 species (5.38%), in the North West and Post monsoon periods 24 species (10.76%) were in fruiting. In the Post and Pre monsoon periods 11 species (4.93%) in the South West and North West monsoon periods 1 species (0.45%) in the North West Post and Pre monsoon periods 2 species (0.89%) were in fruiting. About 59 species (26.46%) were in fruiting throughout the year.

### Phenology of Trees

During the Pre monsoon period 27 species (31.39%), in the South West monsoon period 20 species (23.26%) and in the North West monsoon period 17 species (19.77%) were in flowering. During Post monsoon period 10 species (11.63%) in the North West and Post monsoon periods 2 species (2.33%) in the South West North West and Post monsoon periods 2 species (2.33%) were in flowering and in the South West and North West monsoon periods 1 species (1.16%) were in flowering. About 3 species, 3.49% were in flowering throughout the year.

Fruiting phase of trees was observed and during Pre monsoon period 28 species (32.56%), in the Post monsoon period 22 species (25.58%), in the South West monsoon period 11 species (12.79%) and in the North West monsoon period 9 species (10.47%) were in fruiting. In the Post and Pre monsoon periods 5 species (5.81%), in the North West and Post monsoon periods 4 species (4.65%), in the South West and Pre monsoon periods 3 species (3.49%) and in the North West and Pre monsoon periods 1 species (1.16%) were in fruiting. About 3 species (3.49%) were in fruiting throughout the year.

### Phenology of Shrubs

Phenology phase of shrubs was monitored and it constitutes 11.47% of the flora During North West monsoon period 18 species (33.96%), in the South West monsoon period 9 species (16.98%), in the Post monsoon period 3 species (5.67%), in the North West and Post monsoon periods 2 species (3.77%) were in flowering. In the North West and Post monsoon periods 1 species (1.89%) in the Post and Pre monsoon periods 1 species (1.89%) are in flowering In the Pre and North West monsoon periods and South West monsoon periods 1 species (1.89%) are in flowering.

Fruiting phase of shrubs during the North West monsoon period 11 species (20.75%), in the Post monsoon period 9 species (16.98%) and in the Pre Monsoon period 4 species (7.55%) were in fruiting. In the South West monsoon 1 species (1.89%), in the North West and Post monsoon periods 6 species (11.32%), in the Post and Pre monsoon periods 4 species (7.55%) and 18 species (33.96%) were fruiting in throughout the year.

#### **Phenology of Prostrate Herbs**

Flowering phase of Prostrate herbs was observed and its constitutes 6.28 % of flora. During North West monsoon period 10 species (34.48 %), in the South West monsoon period 5 species (17.24%) were in flowering. In the North West and Post monsoon periods 5 species (17.24%) and in throughout the year 9 species (31.03%) were in flowering.

Fruiting phase of prostrate herbs was observed and resulted as below during the Post monsoon period 9 species (31.03%), in the North West monsoon period 2 species (6.89%) and in the South West monsoon period 1 species (3.45%) were in fruiting. In the North West and Post monsoon periods 4 species (13.79%), in the Post and Pre monsoon periods 3 species (10.34%) and in throughout the year 10 species (34.48%) were in fruiting.

#### **Phenology of Climbers**

The Flowering of Climbers was observed and it constitutes 6.28 % of flora. During the North West monsoon period 12 species (41.38%), in the South West monsoon period 7 species (24.14%) and in the Post monsoon period 2 species (6.89%) were in flowering. In the Pre monsoon period 1 species (3.45%), in the North West and Post monsoon periods 1 species (3.45%) and in throughout the year 6 species (20.69%) were in flowering.

The Fruiting phase of climbers was observed during the Post monsoon period 7 species (24.14%), in the North West monsoon period 5 species (17.24%) and in the Pre monsoon period 3 species (10.35%) were in fruiting. In the North West and Post monsoon periods 5 species (17.24%), in the Post and Pre monsoon periods 4 species each (13.79%) and throughout the year 5 species (17.24%) were in fruiting.

## **DISCUSSION**

In the study area, flowering was largely take place during the North West monsoon as evidenced by results. The flowering commences during the South West monsoon and peak of flowering occurs at the end of the North West monsoon. This observation of the study was similar to other studies such as (Lieberman 1982, Lott *et al*, 1990, De Lampe *et al*, 1992, Sun *et al*, 1996, Justiniano and Fredericksen, 2000). After the Post monsoon, high temperature with rising humidity favours flowering and this finding is similar to the reports of Croat, 1975, Murali and Sukumar, 1994, Stranghetti and Taroda, 1997. The flowering was least in the North West monsoon and Post monsoon and it is similar to the other studies mentioned above. The fruiting was largely takes place during the Post monsoon as evidenced by plant species in the study. The fruiting commences during the North West monsoon and peak of fruiting occurs at the end of Post monsoon. This observation of the study was similar to other studies like Lieberman, 1982,

Lott *et al*, 1990, De Lampe *et al*, 1992, Sun *et al*, 1996, Justiniano and Fredericksen, 2000. The fruiting was least in the South West monsoon, after the North West monsoon with rising humidity favours fruiting and this finding is similar to the reports of Croat, 1975, Murali and Sukumar, 1994, Stranghetti and Taroda, 1997.

In this present study leaf flushing and leaf fall happens before the onset of rains, however leaf flushing is in dry season agreed with other observation (Justiniano and Fredericksen, 2000). Trees initiated flowering during the beginning of the dry season at the time most of the trees were leafless or leaf flushing stage. Fruiting was initiated at the end of dry season and fruiting largely take place in the Pre monsoon and least in the North West monsoon. As flower initiation can advertise to pollinators as they get pollinated as seen in other tropical forest (Murali and Sukumar, 1994, Sundarapandian *et al*, 2005).

Herbs were initiated flowering during the end of rainy season and the beginning of the winter season. The flowering of herbs largely takes place during the North West monsoon and least in the Pre monsoon as evidenced by the result. The flowering commences during the South West monsoon and peak of flowering occurs at the end of the North West monsoon. The herbs initiated flowering during winter season and maximum fruiting was take place during the Post monsoon and least in the Pre monsoon period.

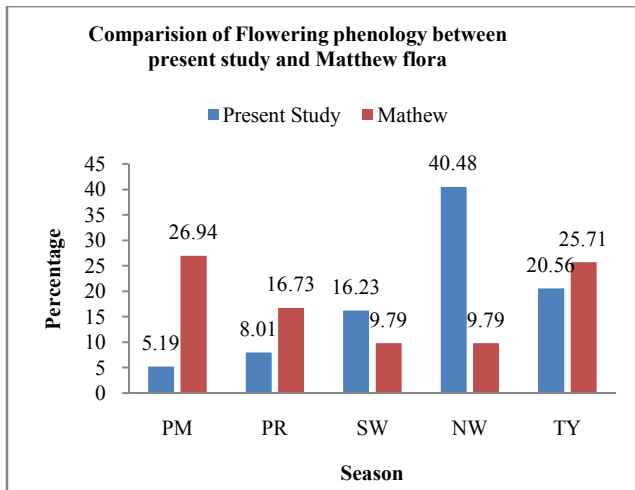
Shrubs were initiated flowering during the end of rainy season. The flowering of shrubs largely takes place during the North West monsoon and least in Post and Pre monsoon as evidenced by the result. The flowering commences during the South West monsoon and peak of flowering occurs at the end of North West monsoon. The fruiting of shrubs initiated during the beginning of the summer season and maximum fruiting takes place in the North West monsoon and least in the South West monsoon.

Climbers initiated flowering during the end of rainy season. The flowering of climbers largely takes place during the North West monsoon and least in Pre monsoon periods. The flowering commences during the South West monsoon and peak of flowering occurs at the end of the North West monsoon. The climbers initiated fruiting during the beginning of summer season and maximum fruiting take place in the Post monsoon and least in Pre monsoon.

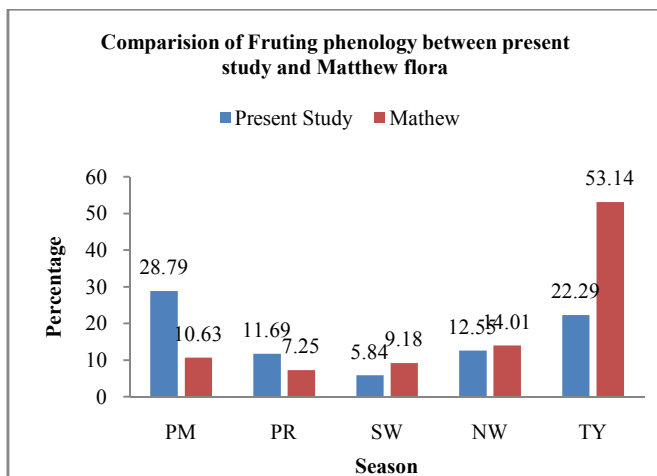
#### ***A comparison of Phenology of plant species of Kallamalai hills and An excursion flora central Tamil Nadu India by Matthew 1991***

An attempt has been made to compare the phenology of plant species of Kallamalai flora documented during 2015 with that of "An Excursion Flora of Central Tamil Nadu India" flora by Matthew 1991. The Matthew flora was documented during 1991 covering Pacchaimalai hills, Kolli hills, Bodamalai hills, Kalrayan hills, Servarayan hills and Melagiri hills of central Tamil Nadu. The present study area Kallamalai hills are a part of Bodamalai hills. The comparison was aimed to have knowledge of plant species phenology of Kallamalai hills studied in different periods. The phenology of plant species during the Post Monsoon period (Jan-Mar) 51.9% of species were in flowering and whereas 26.94% of species were flowering in Matthew study. In the Pre Monsoon period (Apr-

Jun) 8.01% of species were in flowering in the present study and whereas 16.73% of species were flowering in Matthew study. In the South West Monsoon period (Jul-Sep) 16.23% of species were in flowering and 9.79% of species were flowering in Matthew study. In the North West Monsoon period (Oct - Dec) 40.48% of species were in flowering in the present study and 9.79% of species were flowering in Matthew study. About 20.56% of species were in flowering throughout a year in the study area and 25.71% species were flowering in Matthew flora.



Graph 1 Comparison of flowering phenology between present study and An excursion flora of central Tamil Nadu India by Matthew 1991



Graph 2 Comparison of fruiting phenology between present study and An excursion flora of central Tamil Nadu India by Matthew 1991

During the Post Monsoon period (Jan-Mar) 28.79% of species were fruiting in the study area and 10.63% of species were fruiting in Matthew flora. In the Pre Monsoon period (Apr-Jun) 11.69% species were fruiting in the study area and 7.25% of species were fruiting in Matthew flora. During the South West Monsoon period (Jul-Sep) 5.84% of species were fruiting in the study area and 9.18% of species were fruiting in the Matthew flora. In the North West monsoon period (Oct-Dec) 12.55% of species were fruiting in the study area and 14.01% of species were fruiting in Matthew flora. About 22.29% of species were fruiting throughout a year in the study area and 53.14% of species were fruiting in Matthew flora.

In Matthew study the dominance of flowering was during the Post monsoon period, 26.94%, whereas in the present study the dominance of flowering is in during the North West monsoon

period 40.48%. Fruiting dominance in Matthew flora was throughout year 53.14% and in the present study fruiting of plant species was dominant in the Post monsoon period 28.79%. The study revealed the floristic composition and phenology of the study area and comparison revealed the variation in flowering and fruiting of plant species of different years of the study. Abiotic environmental conditions such as rainfall, changes in temperature might have shown to play a significant role in the timing of various phenological events, but the reasons for the variation to be studied and to be analyzed.

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### References

- Badeck F.W., Bondeau A., Bottcher K., Doktor D., Lucht W., Schaber J., and Sitch S.(2004). Responses of spring phenology to climate change. *New Phytologist*, 162: 295–309.
- Chandrabose M., and Nair N.C. Flora of Coimbatore. Bishen Singh and Mahendra Pal Singh, Dehra Dun. (1988).
- Cleland E., Chuine I., Menzel A., Mooney H., and Schwartz M. (2007). Shifting plant phenology in response to global change. *Trends in Ecology and Evolution*, 22: 357–365.
- Crimmins T.M., Crimmins M.A., and Bertelsen C.D. (2009). Flowering range changes across an elevation gradient in response to warming summer temperatures. *Global Change in Biology*, 15: 1141–1152.
- Croat T.B. (1975). Phenological behaviour of habit and habitat classes on Barro Colorado Island Panama Canal Zone. *Biotropica*, 7: 270-277.
- De Lampe M.G.Y., Bergeron R, Mcneil S., and Leduc A. (1992). Seasonal flowering and fruiting patterns in tropical semi-arid vegetation of Northeastern Venezuela. *Biotropica*, 24: 64-76.
- Estrella N., Sparks T.H., and Menzel A. (2007). Trends and temperature response in the phenology of crops in Germany. *Global Change Biology*, 13: 1737– 1747.
- Gamble J.S., and Fischer C.E.C. Flora of the Presidency Madras Adlard & Co London Reprinted 1957 Botanical Survey of India, Calcutta (1935).
- Gurveen kaur Bhupinder Pal Singh and Avinash kaur Nagpal (2013). Phenology of some phanerogams Trees and Shrubs of North Western Punjab India. *Journal of Botany*. 1–10
- Henry A.H., Kumari G.R. and Chithra V. Flora of Tamil Nadu India Series I Analysis 2 Botanical Survey of India, Coimbatore (1987).
- Jain S.K. and Rao R.R. A handbook of field and Herbarium method; Today & Tomorrow's Printers and publishers. New Delhi (1976).
- Justiniano M.J. and Fredericksen T.S. (2000). Phenology of timber tree species in a Bolivian Dry forest implication

- for forest management. *Journal of Tropical Forest Science*, 121:174-180.
- Justiniano M.J. and Fredericksen T.S. (2000). Phenology of tree species in Bolivian dry forests. *Biotropica*, 32: 276-281.
- Kalb M. (1962). Einige Beiträge zum Stadtklima von Köln. *Meteorologische Rundschau*, 15: 92-99.
- Liberman D. (1982). Seasonality and phenology in a dry tropical forest in Ghana. *Journal of Ecology*, 70: 791-806.
- Lott E.J., Bullock S.H. and Solis J.A. (1990). Phenology canopy trees of a tropical deciduous forest in Mexico. *Biotropica*, 22: 22-35.
- Matthew K.M. An Excursion flora of central Tamil Nadu India, Oxford & IBH Publishing Co Pvt Ltd. New Delhi, (1995).
- Menzel A. Sparks, T., Estrella, N., Koch, E., Aasa A. and Ahas R. (2006). European phenological response to climate change matches the warming pattern. *Global Change in Biology*, 12: 1969-1976.
- Murali K.S. and Sukumar R. (1994). Reproductive phenology of a tropical dry forest in Mudumalai Southern India. *Journal of Ecology*, 82: 759-767.
- Penuelas J., Rutishauser T. and Filella I. (2009). Phenology feedbacks on climate change, *Science*, 324: 887-888.
- Singh J.S., and Singh V.K. (1992). Phenology of seasonally dry tropical forest. *Current Science*, 6311: 684-689.
- Stranghetti V. and Renuka Taroda N. (1997). Phenological aspects of flowering and fruiting at the ecological station of Paulo de Foria-sp-Brazil. *Tropical Ecology*, 382: 137-142.
- Sun C., Kaplin B.A., Kristensen, K.A., Munyaligoga V., Mvukiyumwami, J., Kajondo K.K. and Moermond T.C. (1996). Tree phenology in a tropical montane forest in Rwanda. *Biotropica*, 28: 668-681.
- Wright S.J. and Van Schaik C.P. (1994). Light and the phenology of tropical trees *American Naturalist*, 143: 192-199.
- Yang L.H. and Rudolf V.H.W. (2010). Phenology ontogeny and the effects of climate change on the timing of species interactions. *Ecology Letters*, 13:1-10.

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