

Phenological studies of Angiosperms belongs to Purandar tehsil, Dist. Pune, M.S., India

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Abstract—Floristic assessments and documentation of change in floristic composition play a significant role in the economic development of the India. The seasonal variations and phenological properties influence the overall appearance and survival of various plants belonging to Purandar tehsil. The species association of herbaceous flora on the arrival of rainy season was typically short lived; and once the ephemerals flush recedes, the other seasonal invades the place and continues for a complete season.

Among 1110 flowering plant species, 98 species consist flowering and fruiting for the entire year. During August, September and October majority of the plant species were found in flowering and fruiting. (129, 206 and 217 respectively). Among 1012 seasonal plant species which shown flowering and fruiting during these three months were 547. While in the month of November to June (09 months) the total no. of seasonal flowering plant species found in flowering as well as fruiting were 563. So phenological trend was constant (with very few changes) during November to July. As the phenology is studied for all plant forms like herbs, shrubs, trees, climbers which were ephemerals annuals, biennials, perennials, phenological trend shows that flowering and fruiting is at its high during August to October.

Index Terms—Phenology, ephemerals, calendar, Fruiting.

I. INTRODUCTION

Vegetation phenology is highly sensitive to climate change, and the phenological responses of vegetation to climate factors vary over time and space. Research on the vegetation phenology in different climatic regimes will help to clarify the key factors affecting vegetation changes (Han H., and Bai J., et.al., 2020). Phenology is the study of seasonally recurring plant and animal life cycle stages, such as the leafing and flowering of plants, the maturation of agricultural crops, the emergence of insects, and the migration of

birds. Phenology is considered the pulse of our planet (www.usanpn.org). The International Biological Program (IBP) defined phenology as a recurring event that our ancestors used to guide agricultural production for thousands of years. Phenology can reflect the climate and environmental changes and is an important indicator of changes in the natural environment. Moreover, plants are crucial part of the ecosystem, providing the main portions of matter and energy. Phenology plays a significant role in the carbon balance of terrestrial ecosystems. Therefore, it is very important to study vegetation phenology.

A change in vegetation phenology has many consequences for ecological processes, agriculture, forestry, human health, and the world economy. Elucidating the trends of vegetation phenology can improve our understanding of the impacts of climate change on ecosystem productivity and carbon cycling and the associated feedback to the climate. (Han., H., Bai J., et.al., 2020).

The inherent variation within communities and ecosystems must be documented and used as base-line data to effectively predict the outcome of disturbances, such as regeneration and harvest methods on floristic diversity and richness (Sarkar A, 2015). Biodiversity is a comparative science. The investigator was typically interested in knowing and comparing one domain in various domains and are they more diverse than another or not? or whether diversity has changed over time due to processes such as succession or enrichment? But which entities should be compared, and over what scales can they be studied?

The community seems the natural unit (Harper J. & Hawks worth D., 1995). Vegetation has treasured ability nature has provided to meet the needed resources for the human in the form of food, fodder, fibre, fuel, and medicine, timber, resin, oil, dyes (Primary and secondary metabolites) etc. Plant

<i>Annona squamosa</i>	Annonaceae	Sitaphal	T	Mar.-Aug.	W.I.	E
<i>Bombax ceiba</i>	Bombacaceae	Shalmali	T	Feb.-June	Af. SE.	E
<i>Cassia fistula</i>	Caesalpinaceae	Bahava	T	Apl.-Oct.	Asia SE	N
<i>Cassia siamia</i>	Caesalpinaceae	Kashid	T	Aug.-June	Srilan.	E
<i>Dendrocalamus strictus</i>	Poaceae	Bamboo	H	Oct.-Mar.	Afr.	E
<i>Duranta repens</i>	Verbenaceae	Didoni	S	Jan.-Dec.	Am. S.	E
<i>Eucalyptus globosus</i>	Myrtaceae	Jambhul	T	Oct.-May	Aus.	E
<i>Ficus benghalensis</i>	Moraceae	Vad	T	Apl.-June	India	N
<i>Ficus microcarpa</i>	Moraceae	Nadruk	T	Mar.-June	Asia	N
<i>Gliricidia sepium</i>	Fabaceae	Giripushp	T	Feb.-Mar.	Am. S.	E
<i>Holoptelia integrifolia</i>	Ulmaceae	Vaval / Papdi	T	Jan.-June	Japan	E
<i>Jacaranda mimosifolia</i>	Bignoniaceae	Neelmohor	T	Jan.-June	Am. S.	E
<i>Jatropha curcus</i>	Euphorbiaceae	Chandjyoti	S	May-Aug.	Am. T.	E
<i>Lantana camara</i>	Verbenaceae	Ghaneri	S	Jan. -Dec.	Am. T.	E
<i>Leucaena leucacephala</i>	Mimosaceae	Subabul	T	Jan. -Dec.	Mexico	E
<i>Mangifera indica</i>	Anacardiaceae	Mango	T	Jan.-June	India	N
<i>Millingtonia hortensis</i>	Bignoniaceae	Singa. Cherry	T	Jan.-Dec.	Malesia	E
<i>Peltophorum pterocarpum</i>	Caesalpinaceae	Sonsavar	T	Jan.-June	Aus.	E
<i>Pongamia pinnata</i>	Fabaceae	Karanj	T	Feb.-May	IndoMal.	E
<i>Tamarindus indica</i>	Caesalpinaceae	Chinch	T	Feb.-May	India	N
<i>Tecoma stans</i>	Bignoniaceae	Ghanti	S	Jan.-Dec	W.I.	E
<i>Vitex negundo</i>	Verbenaceae	Nirgudi	S	Jan-Dec.	Asia T.	E
Name of the species	Family	Common name	Hab.	Flowering fruiting period	Origin	Nativity

Hab. =Habit, H = Herb, S =Shrub, T= Tree,

Observations: Among the 28 species studied, one species was the largest grass /herb, Bamboo plant (monocot) while remaining were dicot plants. Among 27 dicot plants, four were shrubs, *Jatropha curcus*, *Lantana camara*, *Tecoma stans* and *Vitex negundo*, while remaining were trees. Only six species were found to be native, Mahrukh, Bahava, Vad, Nandruk, Mango and Chinch (Table 1).

Table (2) showing Flowering calendar of one of the region of the tehsil:

Name of the species	Jn.	Fb.	Mr.	Al.	My.	Jn.	Jy.	Ag.	Sp.	Ot.	Nv.	Dc.
<i>Acacia catechu</i>	Through-out the year: January to December											
<i>Acacia leucophloea</i>								Aug. to Feb.				
<i>Acacia nilotica</i>								Aug. to Dec.				
<i>Agave sisalana</i>	Jan. to Mar.											
<i>Ailanthus excelsa</i>	Jan. to July											
<i>Albizia lebbeck</i>			Mar. to Dec.									
<i>Aloe vera</i>	Dec. to May											
<i>Anona squamosa</i>			Mar. to Aug.									

<i>Azadirachta indica</i>													June to Mar.
<i>Bauhinia acuminata</i>													Feb. to June
<i>Calotropis procera</i>													Through-out the year: January to December
<i>Cassia auriculata</i>													July to Jan.
<i>Cissus woodrowii</i>													June to Nov.
<i>C. multiflorum</i>													Nov. to Mar.
<i>Dalbergia sissoo</i>													Feb. to Oct.
<i>Delonix regia</i>													June to Dec.
<i>Eucalyptus globosus</i>													Oct. to May
Months:	Jn.	Fb.	Mr.	Al.	My	Jn.	Jy.	Ag.	Sp.	Ot.	Nv.	Dc.	
<i>Euphorbia tirucalli</i>													A to S
<i>Gliricidia sepium</i>													F to M
<i>Hardwickia binata</i>													Aug. to Jan.
<i>Jatropha curcus</i>													May to Aug.
<i>Jatropha gossypifolia</i>													Feb. to June
<i>Lantana camara</i>													Through-out the year: January to December
<i>L. leucocephala</i>													Through-out the year: January to December
<i>Marsdenia volubilis</i>													Apl. to July
<i>Tamarindus indica</i>													Feb. to May
<i>Tecoma stans</i>													Through-out the year: January to December
<i>Vitex negundo</i>													Through-out the year: January to December
<i>Zizyphus mauritiana</i>													Sept. to Mar.

Months: Jn.=January, Fb.=February, Mr. =March, Al.=April, My.=May, Jn. =June, Jy.=July, Ag. =August, Sp. =September, Ot. =October, Nv. =November, Dc. =December.

Observations: *Acacia catechu*, (Babul) Mimosaceae, *L. camara* (Ghaneri) Verbenaceae, *L. leucacephala*, (Subabul) Mimosaceae, *T. stans* (Ghanti) Bignoniaceae, *V. negundo* (Nirgudi) Verbenaceae are always found in flowering and fruiting (through-out the year) Table 2

Floristic Data Analysis:

To note the field observations and other details of the Purandar tehsil the geographical parameters, historical accounts, local names of the plants etc. were noted in a field diary. The inventory of all explored plant species within the tehsil is preserved. Plant list was then processed statistically by using Microsoft Excel software. Plants were categorised habit wise, and applying other assessment criteria. The accepted

botanical names were checked, confirmed through International Union for Conservation of Nature and Natural Resources (IUCN).

Determination of Indigenesness / Nativity

To find out the origin of the plant species, a biogeographic methodology was followed. All the plant species outside the political borders of the continent Asia, were considered as exotic plants, whose

indigenous ranges occur outside the boundaries of Indian territory. The indigenous assortment for each and every species was originally obtained from various references like Dictionary of Plants by George Usher, 1984 and it was confirmed with data from the internet sources. (Google, www.plantquarantineindia.org; etc.) and some other published research papers (Gattoo, 2012, Zennai et al., 2011).

The exotic plants grown in formal gardens, nurseries, parks have also been incorporated in the inventory. The intention behind doing so was to avoid deletion of any plant species. The domestic, non-domestic, cultivated, wild plants have been considered for the present revision. The taxa were well-thought-out at the taxonomic rank of species, subspecies and variety. The species name was updated with the help of taxonomic online data bases like <http://www.ipni.org> (International Plant Name Index).

III. RESULTS AND CONCLUSIONS

Field study provides valued materials; the ecological, economical and ethno-botanical data and it is beneficial and it is important for the various studies. The study of the diversity and plant distribution

patterns will further help in security, conservation and managing threatened plant species of the studied zone. The key assessment shows that, the forest pattern found in patches was deciduous and thorny scrub type, at distant locations due to variable climatic conditions. The floristic assessment for herbaceous and woody vegetation was also performed around the villages and various fields belonging to Purandar tehsil.

The endemic plants found in the Purandar tehsil were *Delphinium malbaricum*, *Impatiens dalzellii*, *Ceropegia media* and *Pinda concanensis*.

The Purandar tehsil is very close to Pune city, and now covered under PMRDA. Due to it, the given region is facing overall developmental challenges. It has resulted in habitat loss for many species. During the field surveys, 44 threatened plant species were reported.

The flowering- fruiting datum was documented for all the 1352 flowering species. Among 1110 species, 98 species bear flowers and fruits for the entire year. The flower or fruit formation occur in January and lasts for few months in 58 species among all species studied. The phenological trend from January to December was as follows. (Table 3)

Table (3) showing Phenological trend of Angiosperms of the Tehsil

Month	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Species Number	57	59	55	53	41	62	129	206	217	117	64	50

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Fig. 2: *Delphinium malbaricum* (Huth.) Munz.
Flowering and fruiting period: Aug. –Nov.



Fig.3 : *Ceropegia macenii* Ansari.

Flowering and fruiting period: July-Oct.

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