IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

Phenology of dominant tree species in Sanjay-Dubri Range of Sanjay National Park, Sidhi, Madhya Pradesh, India (M.P.)

Research Scholar
Ankita Singh

Research Supervisor
Prof Skand Mishra

Abstract:

The phenological traits of 19 dominant tree species have been examined within the forest ecosystems of the Sanjay-Dubri Range, located in Sanjay National Park, Sidhi. This investigation focused on leaf fall, new leaf emergence, flowering, and fruiting patterns from July 2024 to June 2025. The findings indicated that the prevalence of evergreen tree species exceeded that of deciduous species across all forest sites. Most species demonstrated a peak in leaf fall during the cool dry season (January-February). They initiated a new leaf at the onset of the warm dry season (March-April), with an additional peak observed during the rainy season (August). Both overstorey and understorey species exhibited a pronounced flowering peak in April, while the fruit maturation phase peaked in September-October. Notably, leaf flushing and flowering occurred concurrently in both strata, although the fruiting period for understorey species preceded that of overstorey species by one month.

Keywords: Phenology, Dominant tree species, Sanjay-Dubri Range, Sanjay National Park, Sidhi.

Introduction:

Phenology refers to the examination of the timing of biological events such as bud development, leaf emergence, flowering, fruiting, and leaf drop in relation to seasonal and annual climatic variations. Research in phenology is crucial for the conservation of tree genetic resources and effective forestry management, as well as for enhancing our understanding of the ecological adaptations of plant species and their interactions at the community level. The interactions between plants and animals within these communities are informed by the seasonal availability of various plant parts. While the general phenological characteristics of leafing, flowering, and fruiting in tropical tree species are relatively well-documented (Borchert 1983; Daubenmire 1972; Frankie et al. 1974; Opler et al. 1980; Putz 1979; Singh & Singh 1992; Sun et al. 1996), there is a scarcity of studies focusing on phenology in the forest ecosystems of the Central

Himalaya (Ralhan et al. 1985a,b; Sundriyal 1990) and northeastern India (Boojh & Ramakrishnan 1981; Shukla & Ramakrishnan 1982). The phenological patterns of tree species within the forests of the Sanjay Dubri Range in Sanjay National Park, Sidhi, Madhya Pradesh, India, have not been extensively investigated. Consequently, this study seeks to analyse the phenological patterns of tree species in subtropical forests along a disturbance gradient to better understand their responses to climatic factors and seasonal periodicity.

In India, the study of plant phenology, which examines the timing of seasonal life cycle events such as bud break, leafing, flowering, and fruiting, is essential for comprehending plant growth and their responses to environmental changes, particularly climate change. This field of study enhances agricultural practices, elucidates ecosystem processes, and monitors the impacts of climate change on plant life. The diverse flora and varying climatic conditions of Indian forests provide a rich context for phenological research.

Plant phenology in India:

Impact of climate: The significant influence of climate on phenological events, especially monsoon patterns and temperature fluctuations.

Diverse phenological patterns: The diverse phenological patterns exhibited by different regions and forest types due to variations in climate and soil conditions, such as the rich flora of the Eastern Ghats compared to the unique patterns found in the Western Ghats

Importance of agriculture: The critical importance of understanding crop phenology for optimizing agricultural practices like pruning, irrigation, and pest management.

Monitoring climate change: The utility of phenology studies in tracking climate change effects on plant life, including alterations in flowering times.

Use of remote sensing: The application of remote sensing data alongside ground-based observations to monitor phenological changes in Indian forests and agricultural areas.

Impact on ecosystem services: The impact of phenological patterns on ecosystem services, including pollination, seed dispersal, and carbon cycling.

Phenological Events in India:

Leaf flushing: New leaves pop up, usually in spring or during the monsoon, and this can differ by plant type and location.

Flowering: When flowers bloom depends on things like temperature and daylight, and it changes with different plant species.

Fruiting: After flowers bloom, fruits start to develop and ripen, with their timing and duration also varying.

Leaf fall: Leaves detach as a reaction to changes in the seasons, and both the timing and duration of this phenomenon can vary as well.

In conclusion, examining plant phenology in India is essential for understanding the relationships between plants, climate, and ecosystems, which have significant implications for agriculture, forestry, and conservation efforts.

Research conducted in Madhya Pradesh has uncovered notable patterns in the phenology of woody plants, highlighting distinct periods of flowering and fruiting. According to the International Science Community Association, two primary fruit fall periods are observed: one in winter and another in summer. Additionally, investigations into the region's forests have

indicated that different forest types, including Sal, mixed broadleaf, and pine forests, exhibit varying timings for bud break and leafing. Specifically, Sal forests experience bud break and leafing from April to September, with peak activity occurring in June.

Phenological Events and Trends in Madhya Pradesh:

Flowering and Fruiting: A total of six distinct flowering and fruiting behaviours have been identified among woody plant species.

Fruit Fall: The phenomenon of fruit fall is predominantly observed during two key seasons, winter and summer, although instances of fruit drop can also be noted during the rainy season.

Sal Forests: In Sal forests, the processes of bud break and leaf emergence generally commence in April and persist until September, with a peak occurrence in June.

Mixed Broadleaf Forests: Mixed broadleaf forests exhibit two primary phases of bud break, occurring in July and September, respectively. Leaf abscission is a continuous process throughout the year, with significant peaks in November and July.

Pine Forests: In pine forests, notable bud break episodes are recorded from April to July, while leaf drop is also a year-round event, with pronounced peaks in November and July.

Medicinal Plants: Research has additionally concentrated on the phenological characteristics of medicinal flora in Madhya Pradesh, including species such as Mucuna prurita and Gloriosa superba, which thrive in the tropical dry deciduous forests of Damoh District.

Influence of Climate: The impact of climate on phenological events is significant, as seasonal variations in temperature and precipitation patterns play a crucial role. For instance, the onset of the rainy season fosters vibrant green plant life, whereas the summer months typically result in a more arid environment.

The Sanjay-Dubri Tiger Reserve, located in Sidhi, Madhya Pradesh, showcases a rich diversity in plant phenology, shaped by its heterogeneous landscape and climatic variations. This region's abundant biodiversity, featuring Sal, Bamboo, and mixed forests, sustains a wide array of both flowering and non-flowering plant species, many of which are well-adapted to the monsoon climate.

Detailed Analysis:

Sal Forests: The reserve predominantly consists of Sal forests, which may vary from dense to sparse.

Bamboo Forests: Bamboo is frequently encountered, often coexisting with Sal forests.

Additional Plant Species: A variety of other plant species, such as Saj, Dhaora, Tendu, Baheda, Arjun, Amla, Palas, Salai, Bhirra, Gamar, Dhaman, Mango, and Jamun, are also found within the reserve.

Non-Flowering Plants: Certain species, including Eriocaulon equaticum, which bears resemblance to pipeworts, emerge during the monsoon period.

Insectivorous Plants: The presence of Drosera burmannii, Drosera indica, and Utricularia Aurea further emphasizes the ecological diversity present in the reserve.

Phenological Variations: The flora within the Sanjay-Dubri Tiger Reserve demonstrates distinct phenological variations, as various species bloom and bear fruit at different intervals throughout the year, indicative of the influence of seasonal shifts and climatic conditions.

Impact of Microclimates: The reserve's varied topography and microclimatic zones play a significant role in fostering a rich diversity of plant species and their corresponding phenological behaviours.

Dominant Forest Types: The reserve is characterized by the presence of both moist and dry deciduous forests, prominently featuring the Sal tree (Shorea robu
sta) as a significant species.

Materials and methods/ *Study site*

The current investigation was conducted in the Sanjay Dubri Range, located within the Sanjay National Park in Sidhi, Madhya Pradesh, India. This area encompasses various ecological zones, including hill bottoms, marshy regions, rivulet sides, extensive grazing lands, dense forests, and hill slope grasslands. The climate is defined by three distinct seasons: a warm and wet rainy season from mid-June to September, a cool and dry winter from November to February, and a hot and dry summer from April to June. March and October serve as transitional months, with their climatic conditions leaning more towards the subsequent season. Daytime temperatures can reach a maximum of 42°C in June, while the minimum nighttime temperatures range from 10°C in January to 30°C in May. Approximately 85% of the annual precipitation, totalling around 1035 mm, occurs during the rainy season, with 7 to 8 months characterized by dry conditions throughout the year. The vegetation in the Sanjay-Dubri Range is classified as Tropical Dry Deciduous Forest. The upper canopy is formed by trees reaching heights of 15 to 20 meters, supported by a discontinuous lower layer of trees, a sparse shrub layer, and a seasonal herbaceous layer that includes various grasses. The predominant tree species accounts for 75% of the total tree density at the research site. During the rainy season, the forest exhibits a vibrant green appearance due to the fully developed leaves of trees and shrubs, along with a dense herbaceous layer. In contrast, the summer landscape appears dry and desolate, marked by leafless trees and shrubs, as well as a withered herb layer.

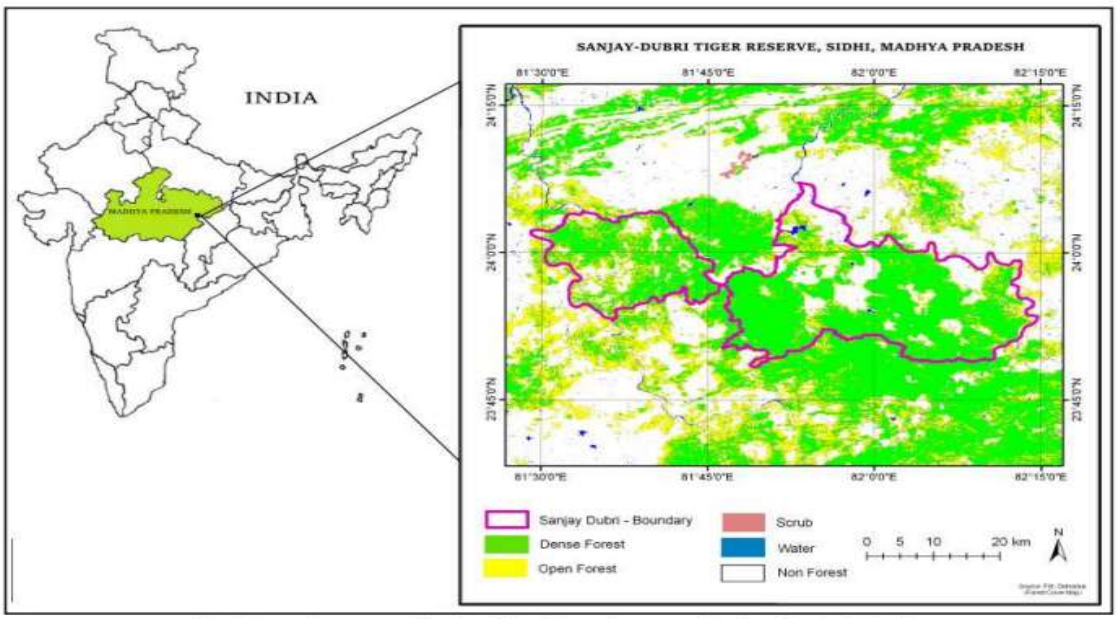

Fig. 1: Location map of Sanjay-Dubri Tiger Reserve, Madhya Pradesh, India.

Phenological studies were conducted on 19 predominant tree species across five distinct forest locations. Each of the 19 species was marked and tagged for identification. Comprehensive observations were performed at monthly intervals over one year, spanning from July 2024 to June 2025. For every tagged tree, data were collected regarding leaf drop, leaf flushing, flowering, and

fruiting events. The phenological activity of each tree species was assessed by aggregating the number of species exhibiting various phenological stages every month. The duration of activity and the phenological patterns of the tree species were analysed by the method established by Opler et al. (1980).

Table 1. Phenological patterns of dominant tree species

	Species Name		Months Name											
S.N.	Scientific Name	Common Name	J	A	S	O	N	D	J	F	M	A	M	J
1.	*Shorea robusta*	Sal					Lf	Lf	Lf	Lf Nl	Nl Fl	Fl	Fl Fr	Fr
2.	*Terminalia tomentosa*	Saj	Fr	Fr	Fr	Fr	Lf Fr	Lf Fr	Lf Nl Fr	Lf Nl Fl	Lf Nl Fl	Fr	Fr	Fr
3.	*Anogeissus latifolia*	Dhaora	Fl	Fl	Fl	Fr	Fr	Fr		Lf	Lf Nl	Nl	Nl	Fl
4.	*Madhuca longifolia*	Mahua	Fr							Lf	Lf Nl Fl	Lf Nl Fl	Nl Fl Fr	Fr
5.	*Tectona grandis*	Teak	Fl	Fl	Fr	Fr	Lf	Lf	Lf			Nl	Nl	Nl Fl
6.	*Boswellia serrata*	Salai	Fr	Fr						Nl Fl	Lf Nl Fl Fr	Lf Fl Fr	Lf Fl Fr	Lf Fr
7.	*Chloroxylon sweitenia*	Bhirra	Fr								Lf	Lf Nl Fl	Nl Fl Fr	Fr
8.	*Pterocarpus marsupium*	Bija	Fl Fr	Fl Fr	Fr	Fr	Fr	Fr	Fr	Fr	Lf Fr	Lf	Nl	Nl Fl
9.	*Gmelina arborea*	Gamar	Fr	Fr					Lf	Lf	Lf	Nl	Nl Fl	Fl Fr
10.	*Buchanania lanzan*	Chironji					Lf	Lf	Lf Fl	Lf Fl	Fl Fr	Nl Fr	Nl Fr	
11.	*Diospyros melanoxylon*	Tendu	Fl	Fl	Fr	Fr	Fr	Lf Fr	Lf Fr	Lf Fr	Nl Fr	Nl	Nl	Fl
12.	*Terminalia bellerica*	Beheda	Fr	Fr	Lf Fr	Lf Fr	Lf Fr	Lf	Lf	Nl Fl	Nl Fl	Fl	Fl	Fr
13.	*Terminalia arjun*	Arjun	Fr	Fr	Fr	Fr	Fr		Lf	Lf Nl	Lf Nl	Nl Fl	Fl	Fr

14.	*Emblica officinalis*	Amla	Fr	Fr	Fr	Fr	Lf Fr	Lf	Lf	Lf Nl	Nl Fl	Nl Fl Fr	Nl Fr	Fr
15.	*Butea monosperma*	Palas						Lf	Lf	Lf	Nl Fl	Nl Fl	Nl Fl	Fl
16.	*Mangifera indica*	Mango					Lf	Lf	Lf Nl Fl	Lf Nl Fl	Nl Fl Fr	Fr	Fr	Fr
17.	*Dalbergia latifolia*	Shisham					Lf	Lf		Nl	Nl Fl	Fl Fr	Fr	Fr
18.	*Syzygium cumini*	Jamun	Fr	Fr				Lf	Lf Nl	Lf Nl	Nl	Fl	Fl	Fl Fr
19.	*Tamarindus indica*	Imali	Fr	Fr	Fr Lf	Fr Lf			Nl	Nl Fl	Fl	Fl	Fl	Fr

Leaf fall (Lf), New Leaf (Nl), Flowering (Fl), Fruiting (Fr)

Table 2. Seasonal phenological behaviours of some important tree species

S.N.	**Species Scientific Name**	**Species Common Name**	**Leaf fall**	**New leaf**	**Flowering**	**Fruiting**
1.	*Shorea robusta*	Sal	Nov - Feb	Feb - Mar	Mar - May	May - Jun
2.	*Terminalia tomentosa*	Saj	Nov - Mar	Jan - Mar	Feb - Mar	Aug - Jan
3.	*Anogeissus latifolia*	Dhaora	Feb - Mar	Mar - May	Jun - Sept	Sept - Dec
4.	*Madhuca longifolia*	Mahua	Feb - Apr	Mar - May	Mar - May	May - July
5.	*Tectona grandis*	Teak	Nov - Jan	Apr - Jun	Jun - Aug	Sept - Oct
6.	*Boswellia serrata*	Salai	Mar - Jun	Feb - Mar	Feb - May	Mar - Aug
7.	*Chloroxylon sweitenia*	Bhirra	Mar - Apr	Apr - May	Apr - May	May - July
8.	*Pterocarpus marsupium*	Bija	Mar - Apr	May - Jun	Jun - Aug	July - Mar
9.	*Gmelina arborea*	Gamar	**Jan - Mar**	Apr- May	**May - Jun**	**Jun - Aug**
10.	*Buchanania lanzan*	Chironji	Nov - Feb	Mar - Apr	Jan- Mar	Mar - May

11.	*Diospyros melanoxylon*	Tendu	Dec - Feb	Mar - May	Jun - Aug	Sep - Mar
12.	*Terminalia bellerica*	Beheda	Sep - Jan	Feb - Mar	Feb - May	Jun - Nov
13.	*Terminalia arjun*	Arjun	Jan - Mar	Feb - Apr	Apr - May	Jun - Nov
14.	*Emblica officinalis*	Amla	Nov - Feb	Feb - May	Mar - Apr	Sep - Nov
15.	*Butea monosperma*	Palas	Dec - Feb	Mar - May	Mar - Jun	Aug - Oct
16.	*Mangifera indica*	Mango	Nov - Feb	Jan - Mar	Jan - Mar	Mar - Jun
17.	*Dalbergia latifolia*	Shisham	Nov - Dec	Feb - Mar	Mar - Apr	Apr - Jun
18.	*Syzygium cumini*	Jamun	Dec - Feb	Jan - Mar	Apr - Jun	Jun - Aug
19.	***Tamarindus indica***	Imali	Sep - Oct	Jan - Feb	Feb - May	Jun -Oct

Results and discussion

A total of 19 tree species were selected for this study. The forest maintains its green appearance throughout the year as the majority of the species are evergreen in this forest. However, in the drier and cool months of November to February evergreen aspect of the forest is not so conspicuous due to marked leaf fall. The general phenological stages of all species have been presented based on the number of species (Table 1). The seasonal phenological behaviours in some important tree species have been discussed under leaf fall, new leaf, flowering, and fruiting activities (Table 2).

Conclusion

The findings of this research indicate a pronounced seasonality in the phenological patterns of tree species within sub-tropical forest ecosystems. Leaf emergence and flowering typically occur concurrently in the majority of species, with a significant peak observed in March and April, and a lesser peak noted in August and September. Fruiting, on the other hand, takes place during the cooler and drier winter months. The phenological timing for most species appears to be aligned with the transition between winter and spring, allowing summer rainfall to promote plant recruitment through germination. Seasonal fluctuations in environmental conditions, along with the dispersal of propagules by avian and terrestrial animals, play a crucial role in shaping the phenological patterns of tree species in these ecosystems. The spatial and temporal dynamics of tree species phenology contribute to the maintenance of a highly dynamic and productive forest ecosystem.

References :

Kikim A. & Yadava P.S. 2001**.** Phenology of tree species in subtropical forests of Manipur in north eastern India. ***Tropical Ecology 42(2): 269-276.***

Murali, K.S. & R. Sukumar. 1994. Reproductive phenology of a tropical dry forest in Mudumalai, Southern India***. Journal of Ecology 82: 759-767.***

Reich, P.B. 1995. Phenology of tropical forests: Patterns, causes and consequences***. Canadian Journal of Botany 73: 164-174.***

Rivera G, Elliott H, Caldas LS, Nicolossi G, Coradin VTR, Borchert R. 2002. Increasing day length induces spring flushing of tropical dry forest trees in the absence of rain***. Trees 16: 445–456.***

Rotzer T, Grote R, Pretzsch H. 2004. The timing of bud burst and its effect on tree growth**.** ***International Journal of Biometeorology 48: 109–118.***

Sundriyal, R.C. 1990. Phenology of some temperate woody species of the Garhwal Himalaya. ***International Journal of Ecology and Environmental Sciences 6: 107-117.***

Singh KP, Kushwaha CP. 2005a. Paradox of leaf phenology: Shorea robusta is a semi-evergreen species in tropical dry deciduous forests in India. ***Current Science 88:1820–1824.***

Singh KP, Kushwaha CP. 2005b. Emerging paradigms of tree phenology in dry tropics. ***Current Science 89: 964–975.***

Singh KP, Kushwaha CP. 2006. Diversity of Flowering and Fruiting Phenology of Trees in a Tropical Deciduous Forest in India. ***Annals of Botany 97: 265–276.***