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# Seasonal dynamics of Pollinating insects in Majuli, Assam

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## ABSTRACT

Pollinating insects play a crucial role in maintaining biodiversity by facilitating plant reproduction. Their diversity and abundance differ considerably across various seasons. The objective of this study was to study the seasonal dynamics of pollinating insects. Direct observation and visual count methods were used monthly throughout the year at pre-monsoon (March to may), monsoon (June to September), post-monsoon (October-November), and winter (November to February). Quantitative data on flower density, diversity and phenology were recorded. The population of pollinating insects often follow a seasonal pattern. Their abundance increases during spring and early summer and directly proportional to floral abundance. Conditions such as heavy monsoon or dry winters also effect pollinator diversity. Phenology of flower also influence foraging behaviour. Seasonal dynamics of pollinating insects are closely linked to floral phenology and environmental conditions.

## Introduction:

Insects play a critical role in our ecosystems, serving as pollinators, decomposers, and food sources for a myriad of other organisms. Insect pollinators are composed mostly of the four most numerous insect orders, Coleoptera, Hymenoptera, Diptera, and Lepidoptera (Wardhaugh 2015). Pollinating insects provide essential ecosystem services for wild plants and crops.Their communities show strong seasonal dynamics driven by climate, floral phenology and land use. Their habitats are intricately tied to the seasons, with changes in temperature, precipitation, and vegetation profoundly impacting insect populations and their diversity. Seasonal temperature fluctuations trigger physiological responses that dictate breeding cycles, feeding habits, and even migration patterns. Seasonal temperature changes can also affect the geographical distribution of insect species.The population pollinating insects are prone to seasonal fluctuations in biotic and abiotic factors that are important drivers of insect biology and ecology (Islam et.al,2015)]. In Assam,the climate is tropical monsoon climate with high humidity, heavy rainfall and moderate to high temperature. North East India harbours a diversity of plants and animals including insect species. Recent regional surveys document diverse Hymenoptera and Lepidoptera in Jorhat and adjacent districts, and studies across Assam show marked seasonal and habitat-linked variation in pollinator communities. The objective of this study is to study the seasonal changes in pollinator abundance, diversity and compare diversity indices (Shannon) among habitats and seasons. Reduction in flowering plants and floral resources which are essential for survival and reproduction of flower-visiting insects would affect the reproductive output (Tscharntke et.al,2005) and population densities (Westphal et.al,2003) of these insects of economic importance. Plant species may be pollinated by a wide spectrum of various pollinator species (generalist plants), or only one or few pollinator species (specialist plant). In terms of coevolution, we can address these closely co-evolving species as modules (Jordano 1987, Olesen et al. 2007). The composition of pollination webs, and other ecological networks at a certain locality is not static, it changes with time, be it the time of day, the month or a year (Herrera 1988, Ricklefs 1987).

**Material and Methods:**

**Study area:** The study was conducted in Majuli district of Assam with coordinates 27°00' N, 94 °13'E.The climate of Assam is characterized by a humid subtropical climate with seasonal variations in temperature and heavy rainfall. Throughout the year Assam experiences a wide range of temperatures. The warmest months are from April to august while winter months can see temperature drop to around 8°C.The average annual temperature is approximately 24°C.

**Sampling design**

Monthly sampling for 12 months (Jan–Dec 2024) to capture pre-monsoon, monsoon, post-monsoon and winter. At least 3 sites per habitat were established, 3 transects (50 m × 2 m) Sample each site once per month between 0800–1100 h and 1500–1700 h (to cover peak activity). Record the weather at time of sampling (temp, humidity, wind, cloud cover).

**Collection methods:**

**Transect walk / timed observations** — slow walk along transect for 30 minutes; record all flower-visiting insects to species

**Sweep netting / active netting** — 20–30 minutes per sampling session to collect bees, butterflies and larger visitors.

**Hand collection & photography** — for behavioral notes and voucher specimens.

**Rainfall and temperature**: Monthly rainfall and temperature data obtain from nearest meteorological station to correlate with pollinating insect pattern.

**Statistical tests**

Compare abundance and H' (Shanon index) among seasons (pre-monsoon, monsoon, post-monsoon, winter).

**Result:** A total of 674 insect individuals, belonging to four orders (Hymenoptera, Coleoptera, Lepidoptera, and Diptera), were collected over the sampling period. 200 insect individuals were collected during the pre-monsoon and 300 insect individuals during the post-monsoon.106 insect individuals in the monsoon and 68 insect individuals in the winter. The seasonal variation showed a clear pattern, with pollinator abundance highest during the Post-monsoon season (October-november) followed by Monsoon (June-september). Temporal trends indicated peaks in pollinator activity, one during October-november and another during June-september, corresponding with major flowering phases. High diversity months were (October-november), moderate diversity months (march-september), and low diversity months (novemberr–February).

**Table 1: Diversity and abundance of Pollinating insects in different seasons:**

| **Season** | **Shannon index(H')** | **Abundance** | **Dominant species** |
|---|---|---|---|
| Pre-monsoon | -1.05 | 0.29 | Bees (*Apis dorsata, Apis cerana*), Moths (*Cephonodes hylas)* |
| Monsoon | -1.56 | 0.15 | Bees (*Apis dorsata, Apis cerana*), Butterflies (*Papilio polytes, Catopsilia Pomona*) |
| Post-monsoon | -2.42 | 0.44 | Bees (*Apis dorsata, Apis cerana, Trigona sp, Ceratina sp*), Butterflies (*Papilio polytes, Catopsilia Pomona, Danaus genutia, Eurema hecabe*), Diptera (*Musca domestica)* |
| Winter | -1.00 | 0.10 | Bees (*Apis cerana*), Butterflies (*Pieris canidia)* |

**Table 2: Number of individuals and number of species of pollinating insects in different seasons:**

| **Season** | **No of individuals of pollinating insects** | **No of species** |
|---|---|---|
| Pre-monsoon | 200 | 10 |
| Monsoon | 106 | 5 |
| Post monsoon | 300 | 13 |
| Winter | 68 | 3 |
| | Total-674 | |

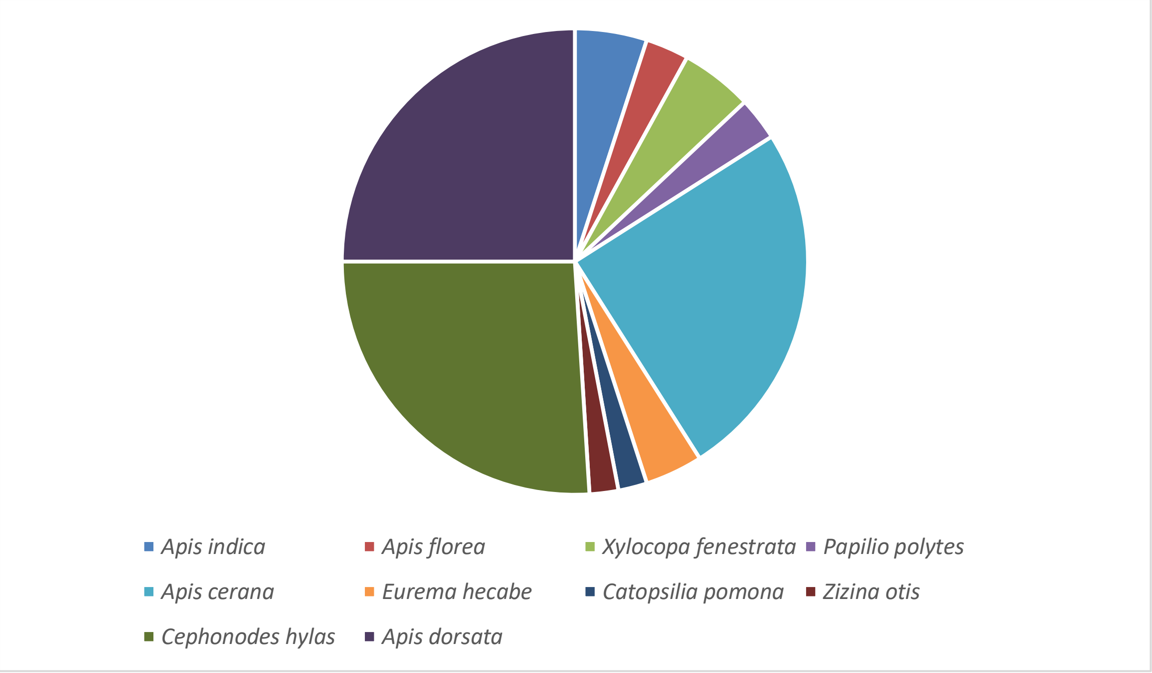


**Fig 1: Diversity insect species found in Pre-monsoon.**

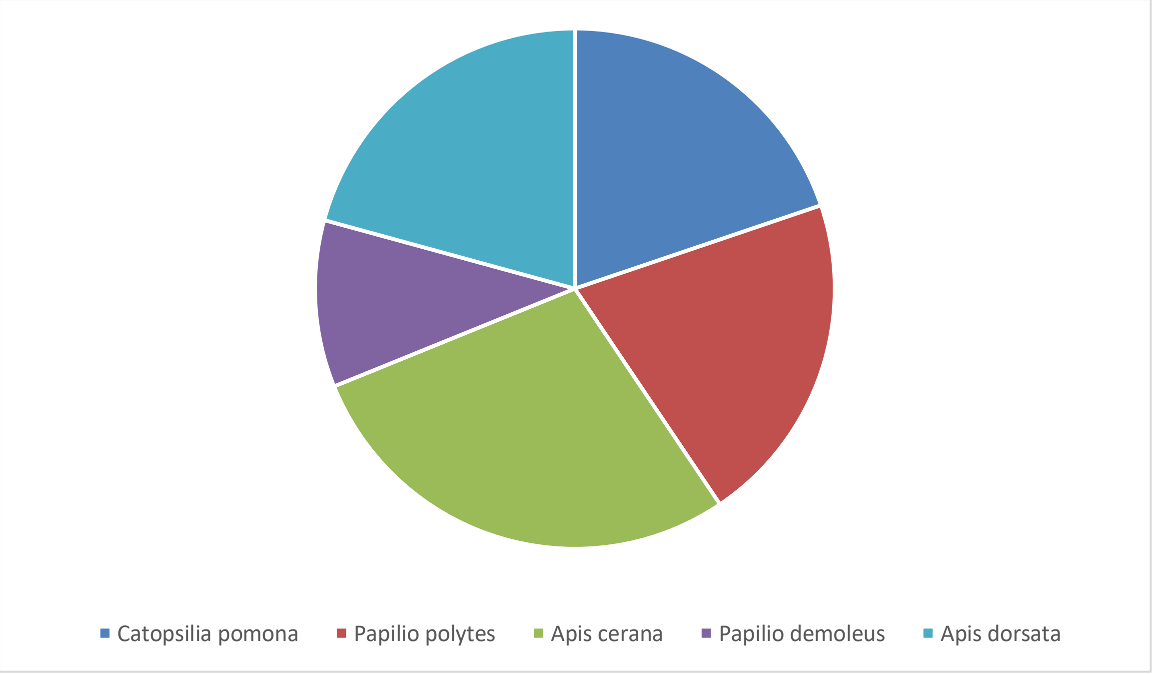


**Fig 1: Diversity of insect species found in Monsoon.**

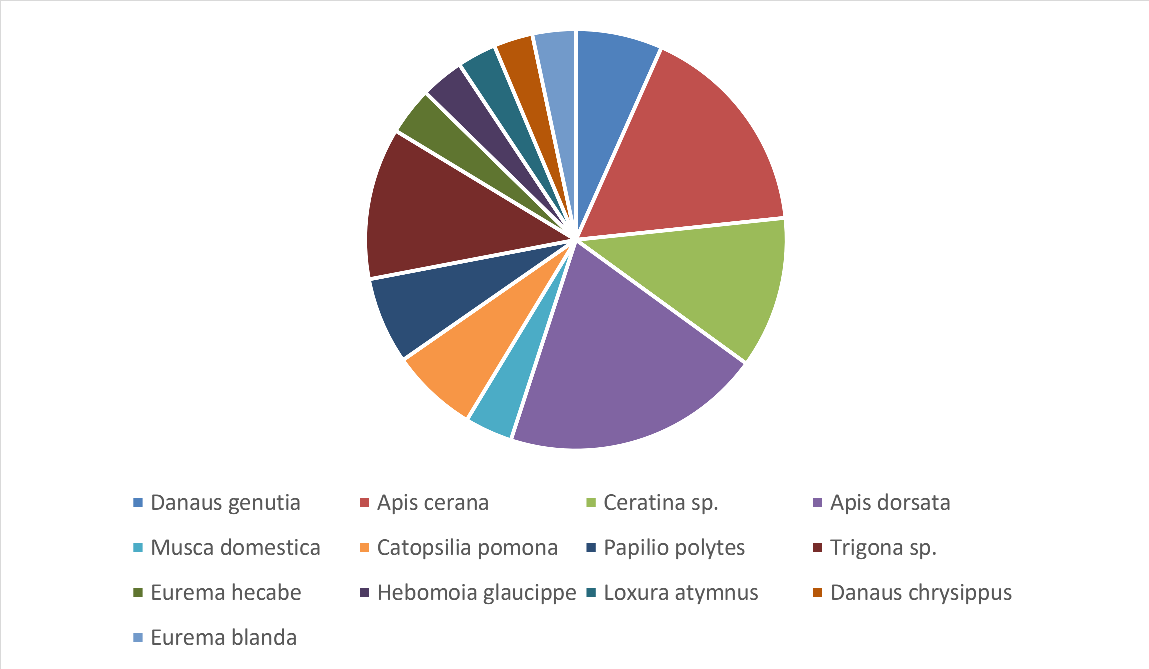


**Fig 1: Diversity of insect species found in Post-Monsoon.**

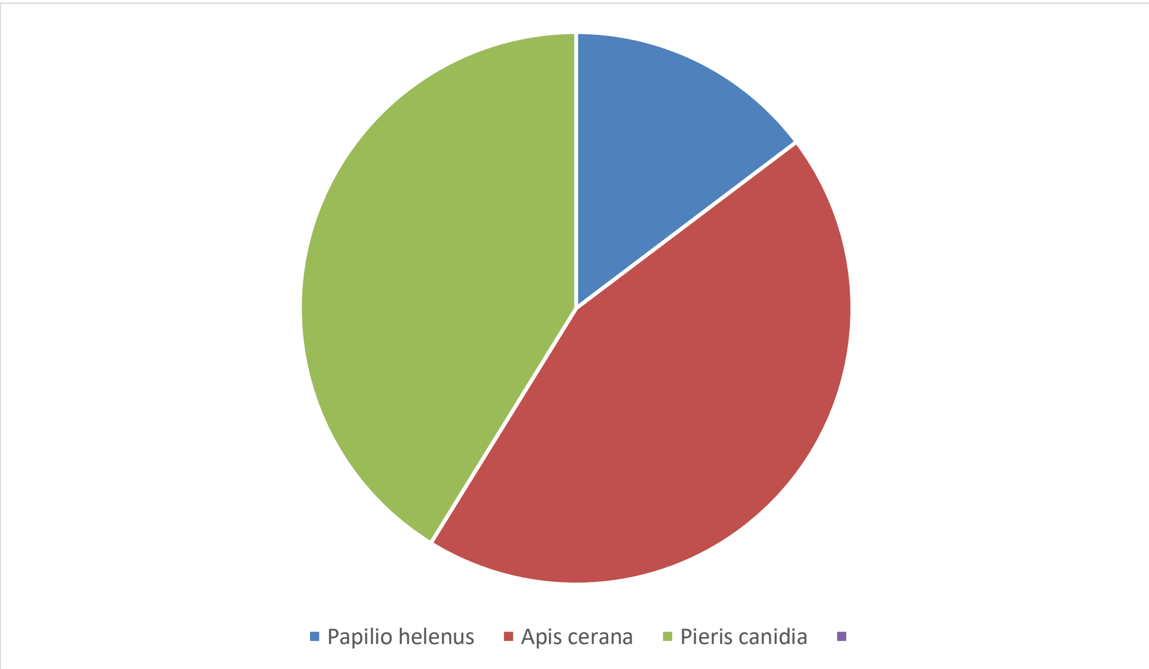


**Fig 1: Diversity of insect species found in Winter.**

**Hymenopteran Diversity**: Data showed that bees remained active throughout the year period, however their diversity and abundance varies with the change of temperature and humidity,maximum from September-November and the minimum in the month of January and December.

**Lepidopteran diversity:** The abundance of butterflies were higher in monsoon and post-monsoon.

**Dipteran Diversity:** Flies remained active throughout the year but their diversity and abundance varied with the change of seasons.

**Flies Abundance:** A fly species has been recorded during the post monsoon period.

**Correlation with Environmental factors:**

**Temperature:** Moderate temperatures increase insect activity, abundance and visitation rate

**Relative humidity:** High relative humidity reduces flight activity due to heavier air and reduced wing efficiency.Very low relative humidity also cause dessication stress limiting foraging activity.So,insects forage at an optimal relative humidity.

**Rainfall:** Heavy rain washes pollen and nectar from the flower thus reducing pollinator activity along with flower visitation.Bees, butterflies and wasps are negatively correlated to rainfall, however flies show positive correlation with rainfall and moist conditions.

**Light intensity:**Most diurnal insects show peak activity under moderate to high light intensity.Light induces flower opening,nectar secretion and affevts flower phenology **also.**

**Wind speed:**Low wind speed facilitate flight and flower handling but high wind speed reduces flight control.Bees and butterflies are highly sensitive to strong winds.

**Floral resources:**High flower density and floral cover attracts more pollinators.Higher species richness of flowering plants supports a wide range of pollinating insects.

**Discussion:** The study confirms that seasonal variation in temperature, rainfall, and floral phenology strongly influences pollinator activity . Post-monsoon and monsoon seasons supported greater diversity due to abundant flowering resources, while winter showed reduced activity. Our results were supported with the earlier study (Tepedino et.al 1981, Pearson et.al,1985) they resulted that pollinators populations vary widely in abundance and species composition within and between years Understanding how seasonal changes affect insect habitats is crucial for developing effective conservation strategies aimed at maintaining biodiversity within our ecosystems. Also, it has been reported that butterflies thrive more in areas where there are heterogeneous vegetations, which provide varied source of foods (Aguirre-Gutierrez et.al 2017) By recognizing the intricate connections between climate patterns and insect populations, we can better work towards sustaining healthy ecosystems that support both human well-being and wildlife longevity. Many insects rely on specific plants for food during certain seasons. These findings align with previous studies conducted in northeastern India and other tropical regions. Habitat heterogeneity played a key role in sustaining pollinator richness. The study highlights the importance of maintaining continuous floral resources across seasons to ensure pollinator conservation and ecosystem stability in Assam. Seasonal changes in abundance of polliantors depend on various variables. They can be affected by the climate (Devoto et al. 2009, González et al. 2009, Petanidou et al. 2018), or by the developmental cycle of the individual insect group or by the phenology of flowers (CaraDonna et al. 2017).

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