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Melissopalynological analysis to investigate the importance of the bee as a pollinator in the Deepor beel area of Kamrup, Assam, India

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Abstract

The practical branch of palynology is melissopalynogical investigation. A melissopalynological examination was performed on 16 honey samples taken from the Deepor beel area between December 2018 and November 2019. Following the research, 46 plant species belonging to 32 families were discovered. In terms of habit and habitat, 24 species were herbs, 5 were shrubs, and 17 were trees, with 37 species being terrestrial and 9 being aquatic.

The importance of bees in pollination can be determined via melissopalynological study.

Key words: Melissopalynology, hoey, palynology, Deepor beel, Assam.

INTRODUCTION

Pollination is the transport of male gamete-containing pollen from the anther to the stigma of the gynoecium, the female component of the same or another plant of the same species. The plants are fertilised as a result of this process, and seeds are produced as a result of it. As a result, pollination is the foundation of a complex ecological system (Heithus 1974). External agents, often known as pollinators, play an important part in cross pollination. The interdependence system developed as a result of the link between flowering plants and their pollinators, which is an important step in organic evolution (Martin EC, 1992).

Bees are the world's major pollinators, and they play an important role in the pollination of both wild and domesticated plants (Winfree R, 2010). They not only produce honey and beeswax, but they also play an essential role in pollination, assisting us in increasing crop productivity through cross pollination, improving seed and fruit quality, and utilising heterosis (Moniruzzamann M, Rahmann MS, 2009). Melissopalynology is a branch of palynology that focuses on the study of honey pollen grains that bees collect both intentionally and unintentionally. Melissopalynology is a method for determining the purity, geographical origin, and floral origin of honey (Water R, 1915; Song XY, Yao Y-F, Yang W-D, 2012). The process of determining the floral origin of honey samples entails identifying the plant species that assisted in pollination.

STUDY AREA

Deepor beel is situated between 91°35′ and 91°43′ E. and 26°05′ and 26°11′ N., at an elevation of 165-186 feet above mean sea level (Saikia and Bhattacharjee, 1987). The village Maj Jalukbari, Pachim Jalukbari, Dharapur, and National Highway No.37 are on the north; Dakhin Jalukbari, Tetelia, and Pachim Baragoan are on the east; Gorbhanga Reserve Forest, Chakardew Hill, and Chilla Hill are on the south west; and Village Azara and Kahikuchi are on the west. The beel, which is thought to be of riverine origin, is located on the southwestern outskirts of Guwahati City and covers an area of roughly 40 km.

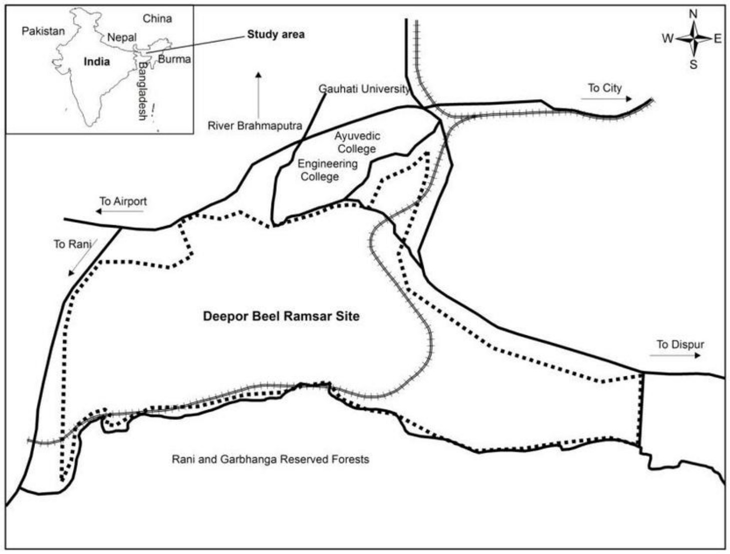

Fig1: Location of Deepor Beel

Deepor beel is one of the most biologically diverse regions in Assam's wetland environment. The presence of high land, as well as partially deep and partially shallow water, sustain a great number of plant and animal species. Phytoplankton is one of the most important components of the Deepor beel's lowest level of producers. Eicchornia crassipes, Azolla pinnate, Pistia stratiotes, Lemna minor, Lemna major, and Spirodela polkyrrhiza are free-floating plants that exist all year and grow more abundant in the summer. Trapa bispinosa, Utricularia flexuosa, Eleocharis pantaginea, Nelumbo nucifera, N. lotus, Nymphaea alba, N. rubra, Sagitaria sagitifolia, and others are among the emergent vegetation. Alium cepa, Pisum sativum, Brassica juncia, B. rugusa, Beta vulgaris, Momordia charantia, Ducus carrota, and Triticum aestivum are some of the other cultivated and non-cultivated plant species available in the beel area. The weeds which are prevalent in the cropped area *are Amaranthus spinosus, A. Viridis, Cyperus rutundus, Cortoria strata, Agaratum conyzoid, Solanum khasianum, Cassia tora, Cassia occidentalis, Solanum torvum, Lucus aspera, Michania scandenses, Cynodon dactylon, Xanthium strumarium, Polygonum hydropiper, P. plebum, P. occidentalis, P. barbahim, Hydrocoliu japonica, Cyperus esculentus, Cyperus flavidus, Elusin indica, Cyperus silletensis, Cyperus flavidus, Elusin indica, Cyperus silletensis.*

AIM

Honey bees acquire nectar from a variety of flowers, and pollen grains are accidentally collected along with the nectar. Those pollen grains were kept in mature honey, revealing the abundance of a certain plant in the location where the honey samples were taken. The pollen grains' identification will reveal information regarding honey bees' pollination involvement.

The aim of the study was to use melissopalynology to deterime the foraging preference of bees and their role in pollination.

Material and Methods:

Seasonally, 16 honey samples were taken from an Apis cerana indica bee hive from December 2018 to November 2019. To investigate the seasonal fluctuation of pollen grains and their relevance in pollination, four samples were collected for each season: Winter (Dec-Feb), Premonsoon (Mar-May), Monsoon (Jun-Aug), and Postmonsoon (Sept-Nov).

To extract sugars and water soluble components, 10 gm honey was dissolved in warm distilled water and centrifuged. The supernatant was carefully eliminated to avoid pollen particle loss during the procedure. After that, the residue was treated using the conventional acetolysis procedure (G. Erdman,1960). The collected residue including pollen grains was mounted in glycerin medium and viewed with x450 magnification using a light optical microscope after the acetolysis technique (LABOMED). The identification of pollen kinds was based on the morphological properties of the outer wall of pollen grains.

Honeywasdissolvedinwarm,distilledwatertoremovesugars

Pollen identification was done using prepared reference slides created from live materials gathered from the sample location, as well as Erdtman (1954), Nair (1970), and Gupta and Sharma's published literature (1986). The average number of pollen grains in 450 fields of view, the area of a field view, the volume dispersion, and the quantity of honey used (1gm, 10gm, etc.) were used to calculate the absolute numbers of pollen grains (Louveaux et al.1970). The Louveaux(1978) approach was used to determine Frequency classes and Frequency of Distribution. The words "dominant pollen" (D) and "secondary pollen" (S) were used to describe the frequency classes: "dominant pollen" (D) occurs in excess of 45 percent, "secondary pollen" (S) occurs between 16 and 45 percent, and "important minor pollen" (M) occurs between 3 and 15 percent. Below 3%, "minor pollen" (T) was discovered.

Results and Discussion:

The data obtained after melissopalynological studies have been summarized in Table 1, Table 2, Fig 2 and Fig 3.

Table 1: Identified Angiospermic plants from honey samples in different frequency classes

[Abbreviation used: D=Dominant (>45% of total pollen grains); S=Secondary (16-45% of total pollen grains); M=Important Minor (3-15 %of total pollen grains); T=Minor (<3% of total pollen grains)]

Season	Dominant (D)	Secondary(S)	Important Minor(M)	Minor (T)
Winter	Nil	*Brassica* sp. *Moringa oleifera* **Lam.** *Neolamarckia cadamba* (Roxb.) Bosser	*Argemone mexicana* **L.**,*Bombax ceiba* **L,** *Coriandrum sativum* **L.**, *Eichhornia crassipes* **(Mart.),** *Ludwigia adscendens* **(L.**	*Butea monosperma* (Lam.) Taub. *Dalbergia sissoo* **DC.** ,*Eclipta prostrata* **(L.) L.**,*Erythrina stricta* **Roxb.**,*Hibiscus rosa-sinensis* **L.**, *Impatiens*

			) H.Hara ***Polygonum* sp.,***Saccharum spontaneum* **L.**	sp.,*Leonurus sibiricus* **L.** *Macrosolen cochinchinensis* , **(Lour.) Tiegh.** ***Oxalis* sp.,***Balakata baccata* **(Roxb.) Esser.**
Premonsoon	*Syzygium cumini* **(L.) Skeels**	*Mimosa pudica* L. *Moringa oleifera* **Lam.*Neolamarckia cadamba* (Roxb.) Bosser**	*Acacia auriculiformis* **Benth.,***Azadirachta indica* **A.Juss.,** *Bombax ceiba* **L.,** *Gmelina arborea* Roxb. , *Helianthus annuus* L., *Ludwigia adscendens* (L.) H.Hara *Leonurus sibiricus* **L.,*Polygonum* sp.**	*Argemone mexicana* **L.***Butea monosperma* **(Lam.) Taub.,***Dalbergia sissoo* **DC.** , *Dillenia indica* L.,*Drypetes assamica* (Hook.f.) Pax & K.Hoffm. ,***Impatiens* sp.,** Ipomoea sp.,*Nasturtium officinale* R.Br . *Nelumbo nucifera* Gaertn.,*Saccharum spontaneum* **L.,** ***Solanum* sp.,***Tectona grandis* **L.f.**
Monsoon	Nil	*Lagerstroemia speciosa* (L.) Pers. *Mimosa pudica* L.	*Commelina benghalensis* **L.** *Gmelina arborea* Roxb. *Ludwigia adscendens* (L.) H.Hara *Peltophorum pterocarpum* (DC.) K.Heyne *Tectona grandis* **L.f.**	***Senna* sp.,***Eclipta prostrata* **(L.) L,** *Hedychium coronarium* J.Koenig, *Hibiscus rosa-sinensis* **L.,** *Nasturtium officinale* R.Br.,*Nelumbo nucifera* Gaertn. *Nymphaea alba* L.,*Nymphaea rubra* Roxb. ex Andrews.,*Nymphoides cordata* (Elliott) Fernald.
Postmonsoon	Nil	*Mimosa pudica* L. *Ziziphus jujuba* **Mill.**	*Andrographis paniculata* **(Burm.f.) Nees** *Gmelina arborea* Roxb. *Justicia adhatoda* **L.** *Ludwigia adscendens* (L.) H.Hara	*Amaranthus spinosus* **L.,***Commelina benghalensis* **L.,** *Eclipta prostrata* **(L.) L.,***Hedychium coronarium* J.Koenig, *Hibiscus rosa-sinensis* **L.**

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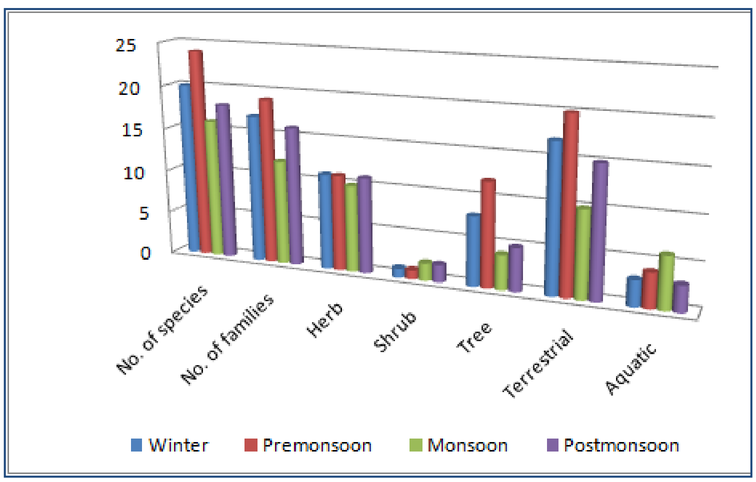
			Nasturtium officinale R. Br. *Neolamarckia cadamba* (Roxb.) Bosser	*Impatiens* sp.,*Nymphoides cordata* (Elliott) Fernald,*Panicum khasianum* Munro ex Hook.f. *Peltophorum pterocarpum* (DC.) K.Heyne ***Senna* sp.**

Table 2: Showing absolute number of pollen grains, distribution of plant species in habit , habitat, no. of identified plant species and no. of families

Season	Absolute no. of pollen grains	Habit	Habitat	No. of identifies species	**No. of families**
Winter	53241	Herb:11 Shrub:1 Tree:8	Terrestrial: 17 Aquatic:3	20	17
Premonsoon	34190	Herb:11 Shrub:1 Tree:12	Terrestrial: 20 Aquatic:4	24	19
Monsoon	27843	Herb:10 Shrub:2 Tree:4	Terrestrial: 10 Aquatic:6	16	12
Postmonsoon	47234	Herb:11 Shrub:2 Tree:5	Terrestrial: 15 Aquatic:3	18	16



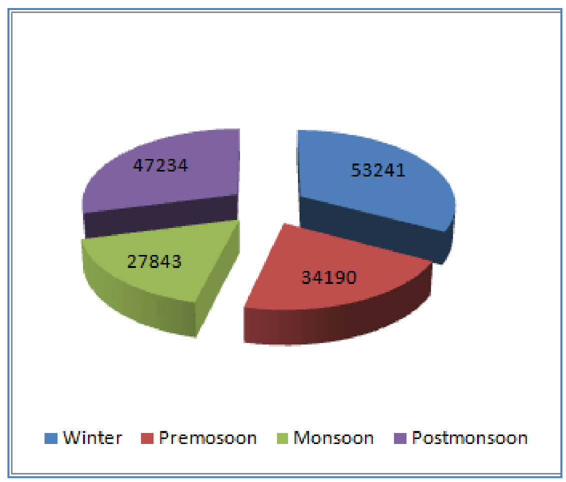


Fig 2: No. of identified plant species, no. of families, and pollen

Distribution of plant species in habit and habitat.

Fig 3: Absolute number of

grains in each season.

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After melissopalynological analysis of 16 no. of honey samples 46 plant species were identified belonging to 32 families.The family Leguminosae was recorded as the highest species representative family with 7 identified plant species which was followed by Lamiaceae with 3 species. Other important families were Brassicaceae, Malvaceae, Asteraceae, Nymphaceae and Poaceae (2 species of each family). Out of 46 species 24 species wererecorded as herbs, 5 shrubs and 17 as trees. Habitat analysis revealed that 37 species were terrestrial and 9 were aquatic.

Following a seasonal investigation, it was discovered that samples obtained throughout the winter, monsoon, and postmonsoon seasons were multifloral, whereas samples collected during the premonsoon season were unifloral. Syzygium cumini (L.) Skeels was the most common pollen species in those samples (>45 percent of total pollen count) (Table1). Winter honey contains 20 plant species from 17 different groups. Leguminosae was the most species-representative family, with three species, followed by Malvaceae, which had two species. According to habitat and habitat study, 11 species are herbs, 1 species is a shrub, 8 species are trees, 17 species are terrestrial, and three species are aquatic (Table2, Fig2).

There were 24 plant species identified from premonsoon samples, divided into 19 families, with Leguminosae (4 species) and Lamiaceae (3 species) being the most species representative groups. Out of the 24 species, 11 were herbs, 1 was a shrub, and 12 were trees, with 20 being terrestrial and 4 being aquatic (Table2, Fig2).

There were 16 of the 12 families of plant species found in Monsoon samples. Leguminosae, Lamiaceae, and Nymphaceae, each with three species, were identified as major families. Ten of the 16 families were herbs, two were shrubs, and four were trees, with ten being terrestrial and six being aquatic (Table2, Fig2).

There were 18 plant species in postmonsoon samples from 16 families, including two species each from the Acanthaceae and Leguminosae families. According to habitat and habitat analyses, 11 species were herbs, 2 were shrubs, and 5 were trees, with 15 being terrestrial and 3 being aquatic (Table2, Fig2).

Because honey samples with 20,000- 100,000/10gm pollen grains are created from a typical floral source (Jones and Bryant, 1996), all of the samples were pure (Table2, Fig3).

Honey bees are great pollinators because they take nectar from a variety of plant species, including herbs, shrubs, and trees, as well as single species. Their collection is not just limited to terrestrial species, but also includes aquatic plants. Pollination is the primary survival and evolutionary process of plants, and these collections aid in pollination. Pesticide usage in agricultural and urban areas has increased over the previous century, resulting in a decline in both wild and managed bee populations. We have a responsibility to create policies that will safeguard their community, preserve their relationship, and balance the ecology and vegetation pattern of a certain location.

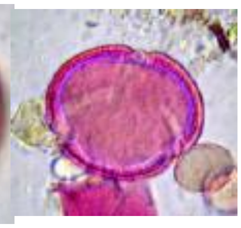
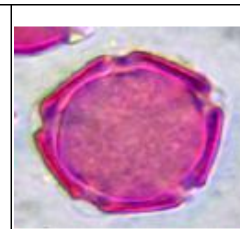
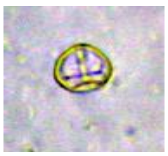
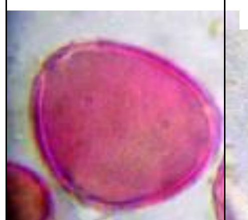
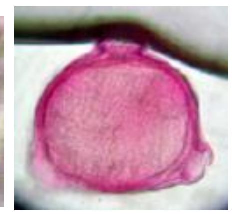
 *Nymphaea alba* Linn.(450X)	 *Nelumbo nucifera* Gaertn. (450X)	 *Bombax ceiba* Linn. (450X)	 *Impatiens sp.* (450X)	 *Azadiracta indica*A.Juss.(450X)
 *Mimosa pudica* Linn.(450X)	 *Acacia auriculiformis* Benth .(450X)	 *Moringa oleif era* Lam. (450X)	 *Syzygium cumini* Skeels. (450X)	 *Ludwigia adscenden s* (L.) H.Hara(450X)

Plate1: Microphotograph showing some identified pollen grains.

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