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MODERN POLLEN REPRESENTATION FROM THE MARSHY AREA OF THE PALA WETLAND RESERVE FOREST, MIZORAM, INDIA

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ABSTRACT: The present paper deals with the pollen analysis of ten mud samples collected from the marshy area on the bank of the Pala Lake which is under the Pala Wetland Reserve Forest, Siaha district, Mizoram. The overall palyno-assemblage revealed the dominance of non-arboreal pollen (57.6%) over arboreal pollen taxa (23.9%). The study indicates the wetland reserve forest as mixed vegetation with its widespread occurrence of semi-evergreen forest elements consisting of *Lagerstroemia, Mesua* and *Xerospermum* along with patches of deciduous forest taxa including *Diptereocarpus*, *Terminalia* and *Salmalia* which are frequently encountered. Pterodophyte are also present in the assemblage in fair frequency. We also record a good number of extra-regional pollen taxa such as *Pinus, Betula, Alnus* and *Corylus* (7.1%) suggesting the influence of wind activity in and around the deposition site. The continuous presence of cereals and other non-cereal pollen are suggestive of the area's close proximity to agricultural land, thus partly influencing the modern pollen deposition scenario. The pollen deposition took place in a favorable climatic condition as there is no sign of any deterioration of pollen spores as inferred from pollen assemblage.

KEYWORDS: Pollen analysis, Modern pollen rain, Marshy region, Pala/Palak Lake, Mizoram, Northeast India.

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1.INTRODUCTION

Study of modern pollen rain and its relationship with the present vegetation is a prerequisite for the reconstruction and interpretation of past vegetation and climatic changes [1, 2, 3, 4, 5, 6, 7]. The modern pollen rain not only serves as a monologue in interpreting the past vegetation and climate but also helps in understanding the behavior of a single species in relation to their reproduction and dispersal nature [8, 9] which widely varies in different species of plants. These factors tend to cause major discrepancies in pollen representation often either over-representing or under-representing the plant taxa [10]. Other factors are climatic [11], fire, insect infestation, plant succession changes and anthropogenic activities [12].Various pollen substrates and traps such as lake sediments, moss cushions or air samplers are commonly used to assist with the interpretation of fossil lake sediment sequences. As lake basins often derive their pollen and spores (palynomorphs) from both aerial deposition and rain water run offs, it is a must to study soil palynomorphs [13]. The Pala Lake is the biggest natural lake in the State of Mizoram and it is located inside the Pala Wetland Reserve Forest in the remote corner of the state bordering Myanmar (Plate 1). It lies between 22°11"-22°12" N and 93°53'29" E, covering roughly 18.5 sq. kms including its catchment area and is also listed among endangered wetlands to be protected by the Indian Govt. The rainfall season is directly influenced by the south-west monsoon with an average rainfall of 1700mm – 3900mm ppm. The soil in this region are mostly acidic, dark brown to yellowish brown in the forest region, clay loam surface and clay sub-surface soil along with peat in the region surrounding the lake which are well- drained. The Pala Lake is an enclosed basin which receives only the rainwater run-offs from the surrounding hills depositing top layer sediments along with pollen on the shores. The narrow shore is composed mainly of peat soil and could potentially be a sink for off- loading pollen before the rain water enters the lake, although further studies need to validate this. Changes in the annual deposition rates of pollen must be consistent with vegetation changes interpreted from percentage pollen analysis and that the influx rates to the enclosed basin are consistent with measurements of contemporary pollen deposition from air to lake [14]. Although analysis of modern pollen deposition are well documented from reserve forest and wetlands of different states of northeast India [15, 16, 17, 18, 19, 20, 21,22,23], there is no database found from this wetland reserve forest let alone the state of Mizoram in regards to the study of modern pollen vegetation relationship. Studying the present deposition trend from the marshy region near the lake could help in assessing the actual relationship between the modern pollen and its extant vegetation and basing this to interpolate the future vegetation cover scenarios of the Pala wetland reserve forest.

Plate 1. Overview of the Pala Lake.

1). Lake view. 2,3) Marshy area around the lake. 4) Soil sample

2. MATERIALS AND METHODS

A total of 10 mud samples (MS1-10) were collected from the marshy region on the bank of the Pala/Palak Lake. A Trimble Juno 3B GPS was used to mark the co-ordinates of each sample location. All samples were carefully packed and labeled in a tight plastic bag. Dead plants, stones and leaves were first removed from the sample before undergoing the chemical process. For the chemical process, 10gms of soil samples are first boiled with 10% KOH and on cooling, it was made to go through a 150 micron sieve to separate the particulates from the sediment. After this 40% Hydrofluoric acid was added and kept undisturbed for 3-5 days. After decanting the supernatants, the samples are then acetolysed using the Erdtman's Acetolysis technique which is a mixture of acetic anhydride and conc. Sulphuric acid at a ratio of 9:1 respectively [24]. This was followed by two rounds of washing and centrifuging the samples with glacial acetic acid (GAA). After decanting, 50% glycerin and a drop of phenol were added to the samples and were kept in a vial for quantitative analysis and taxon identification.

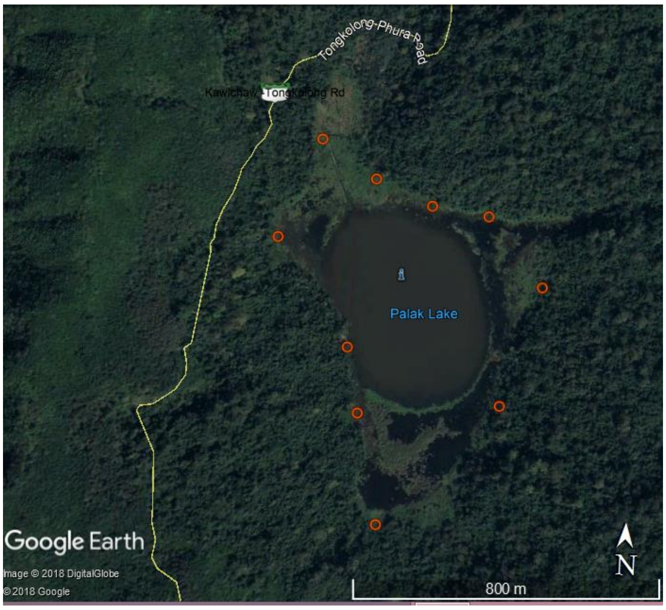

Plate 2: Map showing the sampling locations

Photo-documentation of palynomorphs were made using Olympus BX 50 Microscope and the pollen were identified using the reference slides from the Birbal Sahni Institute of Palaeosciences, Lucknow and also from published literature [25, 26]. Pollen frequency is calculated based on the total pollen sum. Grasses are grouped under Poaceae pollen <60 µm as non-cereals and Cereals with pollen>60 µm. The diverse plant taxa in the spectra have been categorized into arboreal (trees and shrubs), non-arboreal (terrestrial herbs and marshy/aquatics), ferns and extra-regional taxa (Fig. 1). The sample location map is made using ArcGis (Plate.2).

3. RESULTS AND DISCUSSION

The pollen spectra shows the dominance of non-arboreal taxa (57.6%) over arboreal taxa (23.9%). Tree taxa such as *Lagerstroemia, Salmalia, Garcinia, Terminalia, Dysoxylum, Xerospermum, Grewia, Artocarpus, Dipterocarpus, Mesua, Ficus* and *Drimycarpus* are frequently encountered within the values of 0.5-1.6% in the palynoassemblage. However, *Lepisanthes, Adhatoda, Glycosmis*, *Melastoma* and Oleaceae are the shrubby taxa contributing to the arboreal pollen with each contributing between 1.6- 1.9% of the total pollen rain. Among the non-arboreals, non-cereal Poaceae is the most dominant taxa at 8.6% of the total palynoflora. Other associates such as *Impatiens*, Acanthaceae, *Xanthium, Oscimum,* Cerealia, *Mimosa* and Malvaceae are represented between 1.1-3.5%. Caryophyllaceae, Chenopodiaceae. Tubiliflorae, Asteraceae, *Ricinus* and Amaranthaceae are also present in varying abundances (1.4-2.1%). Species of *Peltandra, Ludwigia, Polygonum, Cyperaceae, Equisetum, Ligustrum* and *Hygrophilla* are the marshy associates and are quiet dominant within 0.8- 2.7% in the palynoflora. Aquatic taxa such as *Myriophyllum, Trapa, Typha, Nymphaea* and *Lemna* are also present within the values of 1.4-1.9%. Among ferns both monolete and triletes are represented and major taxa are *Davallia*, *Polypodium*, *Osmunda, Lycopodium* and *Cyathea* are observed within the value of 2.1-3.9%. Extra-regional pollens such as

Pinus, Betula, Corylus and *Alnus* also contribute between 1.4-1.9% in the palynoassemblage. Fungal spores mainly of *Glomus, Diplodia, Cookeina, Tetraploa, Nigrospora* and *Meliola* are also present in the assemblage.

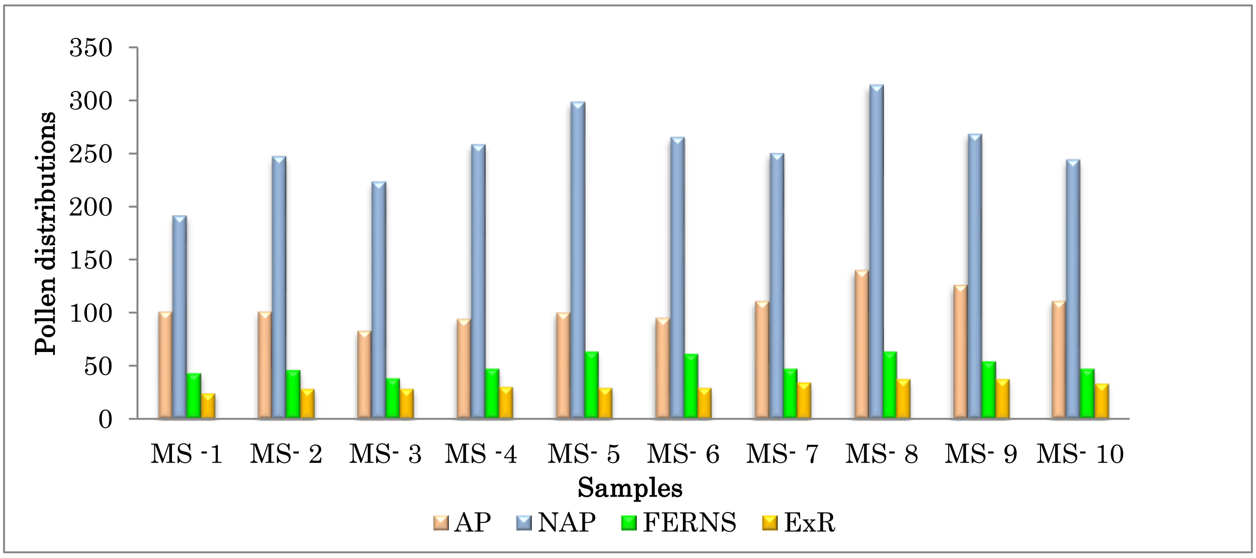

Figure 1: Composite diagram showing the distribution pattern of pollen (AP: Arboreal, NAP: Non-arboreal, F: Ferns and ExR: Extra regional pollen)

This study is aimed to understand the pollen deposition influx by rain water run-off and aerial deposition from the marshy region on the banks of the Pala Lake located inside the Pala Wetland Reserve Forest, Mizoram. The palynoassemblage shows the dominance of non-arboreal taxa (57.6%) over arboreal taxa (23.9%). Among the arboreal taxa, *Salmalia* has the highest representation, contributing at 1.6% of the total palynoflora. This was followed by *Ficus, Lagerstroemia, Dysoxylum, Xerospermum, Dipterocarpus* and *Artocarpus* all contributing above 1% to the total palyflora. Taxa such as *Garcinia, Mesua, Drimycarpus, Grewia* and *Terminalia* also contribute to the assemblage in varying frequencies. The frequent presence of arboreal taxa in the assemblage shows the influence of the wetland forest on the pollen spectra [27] and its proximity to the sampling site. Taxa such as *Mesua* and *Grewia* although abundant in the reserve forest are greatly under-represented in the spectra. Their low representation could possibly be due to their low pollen productivity owing to insect pollination [28, 29, 30], low dispersal efficiency as well as poor preservation in the sediments [31]. Another possible factor could be their sampling period, which could give a better representation in the case of anemophilous species [32]. Non-cereal Poaceae has the highest representation, contributing 8.6% to the total palynoflora which could be due to the sampling location as it is situated along the transition zone between the forest margin and the open land. Terrestrial herbs along with weed associates such as *Impatiens, Ranunculus, Artemisia, Xanthium, Mimosa*, Acanthaceae, Asteraceae, Chenopodiaceae, Tubiliflorae and Amaranthaceae are frequently encountered and are well represented in the assemblage. Their dominance and abundance indicates the presence of the nearby open land allowing the free flow of pollen transfer and deposition in the sediments. Another factor would be the location of the lake and the marshy area which is situated in a low lying region, facilitating and harboring the transport and depositions of any aerobiological remnants along with rainwater run-off from the surrounding hillocks. This is supported by the continuous presence of Cerealia which could have been transferred from the nearby Jhum lands. The presence of marshy taxa such as *Peltandra, Equisetum, Ligustrum, Cyperaceae, Acrostichum, Polygonum, Ludwigia* and *Chrozophora* are highly indicative of a continuous moist condition and the sampling site habitat. Aquatic taxa such as species of *Myriophyllum, Typha, Trapa, Lemna* and *Nymphaea* are suggestive of the sampling site proximity to the lake. However, taxa such as *Eichhornia, Canna* and *Nelumbo* are not represented in the assemblage in spite of their prevalence and abundance. This could be due to the soil pH which is found to affect the preservation of pollen if it exceeds the normal range 5-7 [33, 34]. Continuous presence of fern taxa both monolete and trilete, such as *Osmunda* and *Lycopodium, Cyathea* are indicative of a damp and shady environ [35]. Species of *Pinus*, *Corylus*, *Betula* and *Alnus* which are not found in the study area are frequently encountered in the assemblage indicating their influence by wind transfer as these taxa are highly anemophilous. The abundance of fungal spores such as *Diplodia, Tetraploa, Meliola, Nigrospora* and *Cookeina* are indicative of the humid and damp climatic conditions of the sampling site. The continuous presence of *Glomus* also indicates the frequent sedimentation of forest soil thereby transferring many palynomorphs into the Lake basin and the marshy area due to rainwater runoffs.

4. CONCLUSION

The overall pollen assemblage shows a partial correlation with that of the extant surrounding vegetation around the lake vicinity. Species of *Xerospermum, Dysoxylum, Grewia* and *Lagerstroemia* which are abundant around the lake vicinity are well represented in the assemblage. Arboreal pollen exhibit an overall moderate representation, however, taxa such as *Shorea robusta* (Dipterocarpaceae) and species of Sterculiaceae are not present in the palynoflora in spite of their luxuriant growth in the forest vicinity. This could be due to the entomophillous nature of the plant in the case of *Shorea robusta* [25]. Other factors include timing of the sample procurement [11], soil pH [33], Sporopollenin content [36] and anthropogenic incursion. The presence of Cerealia and extra-regional taxa shows the influence and impact of wind and rainwater run-off in the deposition of pollen grains in the sediment. However, their continuous presence in the assemblage gives us an insight into their pollen deposition behavior and does not annihilate the understanding of the extant vegetation cover, as this study shows the close relationship between the surrounding vegetation and the modern pollen rain. Though the sample size in not that much large, the available pollen data is significant towards the contribution for interpretation of fossil data to reconstruct climate-vegetation history of the Pala Wetland Reserve Forest from such a remote corner of the country.

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CONFLICT OF INTEREST

The authors have declared there is no conflict of interest.

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