Journal of Environmental Impact and Management Policy
ISSN: 2799-113X
Vol: 04, No. 03, April-May 2024
http://journal.hmjournals.com/index.php/JEIMP
DOI: https://doi.org/10.55529/jeimp.43.1.7

Paleopalynological Analysis of Primulaceae Family Evolution during the New Holocene Period in Elbasan, Albania

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Received: 04 January 2024 **Accepted:** 19 March 2024 **Published:** 03 May 2024

Abstract: ***This paper presents pioneering paleopalynological data concerning the Primulaceae family during the New Holocene period in Elbasan, Albania. Fossil pollen data were extracted from soil deposits dating back to the last 20th centuries, shedding light on the evolutionary trajectory of Primulaceae Family plants in the region. Soil samples, primarily weighing approximately 0.5 kg and retrieved from depths ranging from 4 m to the surface, were collected at five stations in the Elbasan area using a dry rotary drilling probe between October and November 2023. The study aims to unveil the evolutionary dynamics of Primulaceae plants during the New Holocene, offering novel insights into their paleoenvironmental interactions. The Holocene epoch marks a critical period characterized by significant shifts in climate and ecological conditions. Understanding plant evolution during this era provides valuable insights into environmental dynamics and human impact on vegetation. A total of 485 Primulaceae palynomorphs were identified across all analysed soil samples, indicating consistent presence throughout the New Holocene period. The abundance and distribution of Primulaceae pollen suggests enduring resilience and adaptation within the local ecosystem. Furthermore, the study highlights a significant correlation between changes in vegetation patterns and human cultivation practices, underscoring anthropogenic influences on regional flora dynamics.***
The prevalence of Primulaceae palynomorphs across soil layers underscores the plants adaptability to varying environmental conditions. Human activities, particularly cultivation practices, emerge as key drivers shaping vegetation dynamics in the Elbasan region. The consistent presence of Primulaceae palynomorphs underscores their resilience amidst changing environmental dynamics. Human intervention emerges as a significant determinant of regional vegetation patterns, highlighting the intertwined relationship between human activities and plant evolution.

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Keywords: Paleopalynology, Primulaceae Family, New Holocene Period, Human Impact, Elbasan – Albania.

1. INTRODUCTION

The scientific work we conducted, which is summarised below, reveals the palynological Characteristics of the New Holocene deposits for Albania, with a focus on Elbasan City.
A subfield of paleopalynology, it is an interdisciplinary discipline with strong ties to geology and the biological sciences, particularly botany. Above all, this field of study examines pollen and spores that have been deposited in organic substrate and studies both living and extinct palynoforms [1], [2].
Because the exine, or outer wall, of pollen grains is so resilient, it has been demonstrated that pollen can be kept for years in subterranean layers [3], [4].
A significant contribution to the history of plant use and cultivation, the means of subsistence for our ancestors, and the development of agriculture can be made based on research on ancient pollen [5].
This work offers significant information that aids in the reconstruction of the Holocene stratigraphy, paleoclimate, and paleoflora, among other things [4], [6]- [9].
We have studied the distribution of vegetation during the New Holocene period in this scientific work, presenting the factors that have influenced the flora's transformation, with a constant focus on the evolution of the Primulaceae family [1]– [2], [6]– [10].

2. RELATED WORKS

We stress that no comparable studies have been conducted by domestic or international researchers on the information regarding the content of fossil spores and pollen for Primulaceae plants in the Holocene deposits in the study area; as a result, the microfossils of this family of plants have not been previously studied in the town of Elbasani [6]- [8].
The gathered paleopalynological data can significantly impact the evolution of Primulaceae plant use and agriculture, as well as the vegetation's genesis [6], [10], and [11].
Palynomorphs of the Primulaceae family were counted using light microscopy at a 1000x magnification. The main goal of this scientific study on evolution was to establish a relationship between the quantitative data of spores and fossil pollen and the changes that members of the Primulaceae family had undergone over time.

3. METHODOLGY

We can assess how the natural environment has changed and how humans have influenced this change by examining and analysing fossil pollen [12], [13].
Paleoclimate and palaeoecological studies of the Quaternary and, consequently, the Holocene periods are mostly conducted using paleopalynological tests, which have a high degree of accuracy [14], [15].
The pollen's physics-chemical makeup makes it possible to properly store and remove it from the soil sediments in which it is deposited. Almost all techniques are based on the physical

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and chemical processing of one gram of soil sediment, primarily for the processing of fossil pollen [1], [4], [6]-[8].
The fossil pollen that was removed from the soil sediments is then subjected to both qualitative and quantitative analysis.
In October and November of 2023, we collected 16 soil samples for this investigation in the field, spaced 0.25 metres apart and ranging in depth from 0.25 to 4 metres.
Every soil sample contained a sizable amount of organic matter, according to the results of the paleopalynological test that was conducted on each sample, indicating that the fossil pollen study could proceed.

3.1. The Erdtman Method of Acetolysis

The Erdtman approach is the foundation for soil sampling [16], [17]. To start, combine 1 cm^3 of soil with 10 millilitres of 10% KOH. The Erdtman acetolyze method involves treating the material in a 9:1 ratio using an acetolyze combination consisting of acetic anhydride $(CH3COO)_2$ and sulphuric acid (H_2SO_4).
After cleaning with distillate water, we combined it with acetolyze solution to create a neutral atmosphere. A centrifugal process (3000 rotation/minute) is applied for three minutes after the emasculation procedure.
Because it provides greater vision over the spores and pollen than other methods employed during the microscopic observation phase, the acetolyze method is extensively utilised in paleopalynology [6]-[8], [16]-[17].

3.2. Fixing the Prepared Compounds

The method of glue preparations using gel-glycerine, which was developed based on the Kisser method [18] by utilising 50 grams of gelatine, 175 millilitres of distillate water, 150 grams of glycerine, and 7 grams of phenol (crystals), was used to realise the fixture of the prepared composites.
After using spray or paraffin to isolate the composite to the edges of the microscope slide, it was ready for usage and storage after three days.

4. RESULTS AND DISCUSSIONS

The facts regarding the quantity of spores for the Primulaceae family according to depth and the total number of palynoforms for this family are provided in Table 1.

Table 1. Primulaceae palynoforms according to the depth.

Sample	Years after AD	Depth (meters)	Primulaceae Palynoforms
1	0	4	31
2	100	3.75	34
3	200	3.5	36
4	300	3.25	36
5	400	3	38
6	500	2.75	40
7	650	2.5	46

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8	800	2.25	47
9	950	2	52
10	1100	1.75	49
11	1250	1.5	49
12	1400	1.25	50
13	1550	1	58
14	1700	0.75	61
15	2850	0.5	59
16	2000	0.25	68
Total number of spores			754

The Primulaceae family's maximum number of spores (68 spores per sample) is obtained at a depth of 0.25 m, while the minimum number (31 spores) is taken at a depth of 4 m.
Except for samples 10 and 15, where a single, slight decrease in number (exactly at 1.75 and 0.5 m of depth) is observed, it is evident that the total number of representatives of the Primulaceae Family is increasing from the bottom near to the surface.
It is also evident that the number of spores for this family is increasing almost continuously throughout the depths. The amount of Primulaceae spores is immediately increasing in samples 7, 9, and 13.
Are 754 spores in Primulaceae family overall, according to the data in Table 1 (Fig. 1).

Figure 1. Primulaceae family Pollen *(Source: Jançe, 2023).*

Changes in climate can affect how land is used, and human societies can have intricate effects on the environment [19].
The data acquired indicates a discernible upward trend in Primulaceae plant growth from soil depth to the surface. This phenomenon suggests that the growing number of members of the Primulaceae family should be attributed to human involvement in the family's plant cultivation.
Furthermore, a higher quantity of fossil pollen has been found in the surface samples than in the deep samples. This finding can be explained by the fact that the most recent pollen types have a higher capacity for preservation than their older counterparts. It's interesting to note that samples 9 which equate to a depth of 2 meters, show an instantaneous increase in Primulaceae fossil pollen.
We have therefore relied on the mediaeval history of Albania [20], which claims that this period is related to the brutal exterminating wars of the Bulgarian and Serbian occupation, which resulted in a great decrease in population and the city lost the economic importance it had until then. This is because, after reviewing the literature, no data on significant climate

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factors were found in this period, the year 800-900 AD, which may have influenced the change of the vegetation.

Known by most as the primrose family, the Primulaceae are a family of herbaceous and woody flowering plants, primarily found in the high mountains of the northern temperate zone. They comprise over 1000 species and 22 genera, including numerous popular garden plants and wildflowers [21], [22].

Despite the paucity of fossil evidence for Primulaceae the age of the crown group has been estimated to be between 46 and 61 million years.[23], [24].

Many ornamentals that are grown for their aesthetic value are of economic significance, including *Androsace (rock jasmine), Cyclamen, Lysimachia (loosestrife),* and *Primula* (primrose) [25].

Due to their great ornamental value, many species in the primrose family, one of the top three taxa in the world for horticulture, have been widely grown for hundreds of years [24].

Important decorative plants, Primulaceae are grown extensively for their exquisite flowers. Cut flower floriculture is also practiced with these species [26].

Many Primulaceae genera are extensively grown as houseplants in both public and private areas; this is especially true in Elbasan, which is often referred to as the "City of Flowers" in Albania. The fact that Primulaceae palynoforms are present in every sample and show a growing tendency as they move from samples taken at depths to samples taken at the surface suggests that humans have had a significant influence on these plants, primarily because of the family's long history of cultivation in Elbasan city.

The fact that these plants have remained constant over the years serves to support this. Numerous species are extensively grown for their beautiful fruits, flowers, and foliage. Because of their eye-catching blooms and leaves, ornamental species of Primulaceae are grown in gardens.

Elbasan city is now home to a variety of plants, primarily olive plantations, commonly farmed fruit trees, and an extremely rich flora and vegetation. The influence of ecological and human factors on the dispersal of pollen grains is of particular and undeniable relevance.

The quantitative information provided on the fossil pollen of the Primulaceae family demonstrates the direction in which its plants have evolved throughout time.

5. CONCLUSION

- Primulaceae Family palynoforms exhibit a propensity to be more prevalent from depth to surface.
- All the examined samples contain members of the Primulaceae family.
- Since Elbasan has not experienced significant climate changes that could have influenced the flora change over time, it is believed that human influence is responsible for it.

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