

Late Pleistocene/Holocene vegetation and environment in and around Marian shola, Palni Hills, Tamil Nadu

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This paper highlights the results obtained from fine resolution palynostratigraphy and chronostratigraphy of 1.7 m deep sediment profile from Marian shola in Palni Hills. Palynological reports have unravelled a two-fold vegetation development, viz., shrub savanna-grassland-shrub savanna reflecting two-fold climatic oscillations such as warm and moist-cold and dry-warm and moist under tropical surroundings. Radiocarbon dates have revealed 30,000 years age for the total deposits. The sediments are mostly lacustrine and laid down under reducing environment indicating slow rate of deposition, i.e., top 1 m deposits were accumulated at the rate of 1 cm per 107.50 years while bottom 70 cm deposits were laid down at the rate of 1 cm per 275.70 years.

Key-words — Palaeoenvironment, Marian Shola, Pleistocene/Holocene, India.

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सारांश

तमिलनाडु में पलनी पहाड़ियों में मारियन शोला और इसके आस-पास अनंतिम प्लिस्टोसीन/होलोसीन कालीन वनस्पति एवं पर्यावरण

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प्रस्तुत शोध-पत्र में पलनी पहाड़ियों में मारियन शोला से 1.7 मीटर गहरी परिच्छेदिका के परागाणुस्तरीय एवं कालानुस्तरीय अध्ययन से प्राप्त परिणाम प्रस्तुत किये गये हैं। उपलब्ध परिणामों से झाड़ी-सवाना-घासभूमि से झाड़ी-सवाना प्रकार की वनस्पति होने के संकेत मिले हैं जिसके आधार पर उष्णकटिबन्धीय जलवायु में उतार-चढ़ाव प्रदर्शित होते हैं। इन निक्षेपों की 30,000 वर्ष रेडियोकार्बन आयु आँकी गई है। ये अवसाद सरोवरी हैं तथा कम निक्षेपण दर से इनका निक्षेपण हुआ है। ऊपरी एक मीटर निक्षेप एक सेन्टीमीटर प्रति 107.50 वर्ष की दर से निक्षेपित हुआ है जबकि नीचे तली के अवसाद एक सेन्टीमीटर प्रति 275.70 वर्ष की दर से निक्षेपित हुए हैं।

MARIAN shola forest is situated in Palni Hill ranges, Tamil Nadu at an elevation of 2360 m asl between Lat. 10° 12' to 10° 18' north and Long. 77° 26' to 77° 34' east. The present study has been undertaken as an effort to build up the local picture of palaeovegetation and palaeoenvironment enabling to reconstruct the history of shola forest and causes of its degradation. The object of undertaking this area for palynological study is to tune with the data obtained from Nilgiris, Palni Hills and Anamalai Hills concerning the status of grassland vs. shola forest to ascertain climatic cycles involving various controlling factors (Bera & Gupta, in press; Blasco & Thanikaimoni, 1974; Gupta, 1973; Gupta & Prasad, 1985; Gupta & Bera, in press; Menon, 1968; Vasanthy, 1988; Vishnu-Mittre & Gupta, 1970).

The geological formation is largely metamorphic, rocks being granitic gneiss. The soil is often poor in

areas subjected to erosion and outwash but in moist swampy depressions peat and clay are also found. Laterite is another significant feature which denotes a wet environment. The soil profile largely comprises fibrous organic mud and silty clay.

Upland savanna above 2000 m cover more than two third of the plateau in Palni. It is often found that the hilly regions are occupied by evergreen shola forests which are characterised by short-boled trees. Premier tree components, such as, *Eurya japonica*, *Gordonia obtusa*, *Sideroxylon tomentosum*, *Elaeocarpus ferrugineus*, *Euonymus crenulatus* and *Symplocos foliosa* occur in the mid forest while *Rhododendron nilagiricum* occupies periphery of the forest. The ephemerals, e.g., *Andropogon foulkerti*, *Cymbopogon polyneuros*, *Fimbristylis* sp., *Anaphalis lawii*, *Cyanotis* sp., *Leucas subfruticosa*, *Heracleum tingens*, *Cassia mimtoides*, *Cnicus wallichtii*, *Viola*

patrini, *Impatiens floribunda*, etc. occupy the areas in near vicinity of the forest.

MATERIAL AND METHOD

Five surface samples were collected in a transect from within the forest thicket across the open land in and around Marian shola, Palni Hills. Three samples (1-3) were collected from the forested area and two samples (4-5) from open land at an interval of 100 m each. One sediment profile was sampled up to 1.7 meter at 10 cm interval employing Hiller's manual peat-auger. Samples were packed separately in polythene bags adding a few drops of phenol to prevent fungal growth. Samples for radiometric dating were collected from 50 cm, 100 cm and 130 cm depths.

The sediments are blackish-brown to black in colour from the surface down to 150 cm depth and look doughy when moist but crack when dried. The sediments are mostly lacustrine and were laid under reducing environment. Radiocarbon dates have revealed an age of 30,000 years for the total deposits. Pollen analysis was done following conventional maceration technique (Erdtman, 1943).

MODERN POLLEN/VEGETATION RELATIONSHIP

Modern surface samples (moss cushions) from Marian shola have been pollen analysed to find the modern vegetation relationship and interplay of pollen in order to precisely interpret the pollen records from the sediment profile. The pollen records are given below.

Sample 1 — The pollen assemblage of this sample has 35 per cent representation of arboreals. Alien taxa, such as, *Pinus* are 4 per cent of the total pollen assemblage. Among the core-shola arboreals, *Symplocos*, *Ilex*, *Osbeckia* and Myrtaceae are dominant whereas, *Eurya*, *Glochidion*, *Euonymus*, *Palaquatum*, *Dodonaea*, Oleaceae, *Rhododendron* and *Ligustrum* are either poor or sporadic in distribution. Among nonarboreals, *Ranunculus*, *Senectio* and Lamiaceae are represented in low curve whereas *Artemisia*, *Peperomia*, etc. are sporadically present. Poaceae represents the ground vegetation at the value of 22 per cent. Both monolete and trilete spores attain 15 per cent each.

Sample 2 — This sample was collected from margin of the forest. The pollen spectrum of this sample has revealed relatively higher values for arboreals (45%). Alien taxa, such as, *Acacia* and *Pinus* are 10 per cent each. The prominent shola taxa represented are *Ilex*, Myrtaceae, *Symplocos*, *Eurya*, Meliaceae, *Pavetta* and Oleaceae; *Elaeocarpus*, *Celastrus*, *Glochidion*, *Palaquatum*, *Mallotus* are recorded sporadically. Among nonarboreals, Poaceae is 20 per cent, followed by other ephemerals like *Ranunculus*, *Peperomia*, *Senectio*, Lamiaceae and Chenopodiaceae either in low or sporadic values. Monolete fern spores are 15 per cent and trilete spores are 8 per cent.

Sample 3 — This sample is from the outskirts of the forest. The pollen spectrum has revealed predominance of nonarboreals over arboreals. The significant feature of this sample is sudden disappearance of most of the prominent shola taxa recorded in previous two samples. The arboreals represented by *Eurya*, *Ilex*, *Symplocos*, *Pavetta* and Oleaceae are 27 per cent. *Pinus*, the only alien taxon recorded, has low values. Among nonarboreals Poaceae show significant increase to 39 per cent. Other ephemerals, such as, *Ranunculus*, *Senectio*, Lamiaceae and Rubiaceae also show increased frequency. Trilete fern spores are 10 per cent and monoletes 5 per cent.

Sample 4 — This sample was collected at a distance of 100 m from the periphery of the forest. The pollen spectrum depicts preponderance of nonarboreals over arboreals. The dominant taxa such as *Euonymus*, *Symplocos*, *Ilex*, *Rhododendron*, *Osbeckia* and *Viburnum*, etc. collectively add up to 27 per cent. *Celastrus*, *Valertiana* and Anacardiaceae are sporadically recorded. Frequency of *Pinus* is comparatively less. The ground vegetation is dominated by Poaceae (42%) followed by *Ranunculus*, *Senectio* and Lamiaceae in improved values as compared to the preceding sample. *Cnicus*, *Peperomia*, Lamiaceae and Chenopodiaceae are recorded either in low values or only sporadically. The fern spores are represented in low values.

Sample 5 — This sample was procured from a distance of 200 m from the periphery of the forest. The pollen spectrum shows a drastic fall in the frequency of arboreals (5%). Only stray occurrence of *Ilex*, *Rhododendron* and Oleaceae is observed.

Poaceae attained highest value (78%) followed by other ephemerals like *Impatiens*, *Senecio*, *Ranunculus*, *Heracleum*, *Artemista*, etc. Rubiaceae and Chenopodiaceae are recorded either sporadically or in low values. Fern spores are also recorded in low values.

After making a careful analysis of the pollen spectra, it is visualised that the shola constituents (27-45%) are quite faithfully represented in the samples collected from within the forested areas. Nonetheless, their occurrence in the samples from open area is either negligible or scanty. Thus the interplay of the pollen of shola components is restricted to the forested area only and therefore, this observation has been taken into consideration while reconstructing the palaeovegetation.

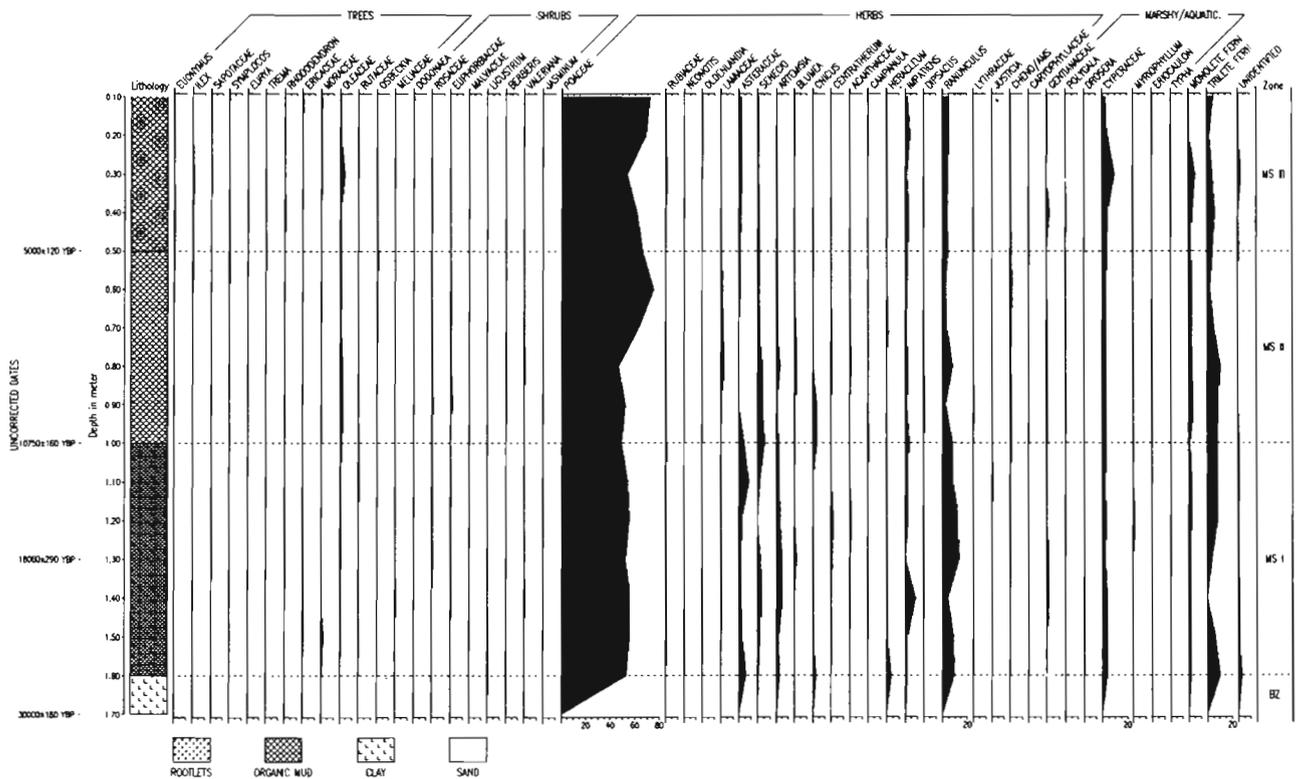
POLLEN DIAGRAM AND ITS COMPOSITION

One pollen diagram from 1.7 meter deep sediment profile has been constructed and three pollen zones were recognised. The lowermost part of the profile between 30,000-25,000 BP has not yielded any palynodebris and thereby it has been designated as BZ (barren zone). This span indicates the prevalence

of oxidising depositional environments. The remaining profile is classified into three pollen zones prefixed with site initials MS I, II and III (Text-figure 1).

Pollen zone MS I (25,000-10,000 BP)

This zone is marked by the presence of low to stray occurrence of typical shola constituents followed by predominance of graminoid pollen attaining up to 52 per cent of the total pollen content. Sapotaceae, Oleaceae and Moraceae are recorded in low values. *Osbeckia*, *Ligustrum*, Ericaceae and Rosaceae are represented sporadically. The shola forest associated ephemerals, such as, *Senecio*, *Artemista*, Acanthaceae, *Impatiens* and *Ranunculus* are also recorded. Lamiaceae, *Cnicus*, Gentianaceae and Chenopodiaceae are present in relatively low values. Marshy and aquatic taxa, e.g., Cyperaceae, *Myrtophyllum* and *Ertocaulon* are meagrely represented. Among ferns, trilete spores attain high value as compared to monoete spores. The climatic condition in which the vegetation of this zone developed could be interpreted as increasing warm-humid and decreasing cold-dry, reflecting an open shrub savanna.



Text-figure 1—Pollen diagram from Marian Shola, Palni Hills, south India.

Pollen zone MS II (10,000-5000 BP)

This zone is marked by the rise in the value of Poaceae forming two summits of about 50 per cent and 80 per cent in the lower and upper parts of the zone. Most of the shola constituents, except Oleaceae, Euphorbiaceae and *Berberis*, disappeared from the scene. Rosaceae and Moraceae have reduced. Among nonarboreals, *Ranunculus*, *Impatiens*, *Senectio*, *Artemisia*, *Blumea* and Lamiaceae are the dominant taxa recorded in this zone. *Centratherum*, *Heracleum*, Rubiaceae, Lythraceae and Chenop/Ams are represented either sporadically or in low values. *Campanula*, *Neonotis* and *Polygala* appear for the first time in the scenario. Among marshy and aquatic taxa, Cyperaceae remained same as before whereas, *Myrtophyllum*, *Eriocaulon* and *Typha* are sporadic. Trilete fern spores are recorded in consistently high values as compared to monolete spores. Thus, this vegetation complex suggests the existence of vast stretches of grasslands, and onset of cold and dry climate.

Pollen zone MS III (5000 BP to Present)

This zone is marked by significant invasion of shola woods into the grassland. *Ilex*, *Euonymus*, *Symplocos*, *Eurya*, *Rhododendron* and *Trema*, etc. emerged right in the beginning and continued throughout the zone. Simultaneously some close associate of shola forest, such as, *Ranunculus*, *Impatiens*, *Heracleum* and Asteraceae, also improved than before but *Senectio*, *Artemisia*, *Blumea*, Lamiaceae, etc. relatively reduced. The grasses show consistent improvement. Among marshy and aquatic taxa Cyperaceae gained slight improvement whereas, *Eriocaulon* occurred only sporadically. Trilete fern spores are recorded comparatively in low values. whereas, monolete spores show slight improvement in the middle zone. Thus, the vegetation scenario could be interpreted as showing the co-existence of shola forest and grassland which may be due to warm and humid climate.

HISTORY OF VEGETATION AND CLIMATE

Quaternary vegetational history has been reconstructed for various areas in south Indian montanes, namely, Nilgiris, Palnis, and Anamalai Hills. The pollen assemblage from Pykara region, characterised by paucity of arboreal species, is

indicative of two phases of drier climate separated by a moist interval (Menon, 1968). Blasco and Thanikaimoni (1974) recorded dominance of pollen of savanna species over that of shola trees in the Pykara and Parson' Valley swamps. Vishnu-Mittre and Gupta (1970) and Gupta (1973) proposed that at Kakathope, grass cover was formed following the destruction of shola forest. Gupta and Prasad (1985) recorded three phases of vegetational development during 30,000 BP at Colgrain, Ootacamund, Nilgiris. Vasanthy (1988) observed that montane grasslands persisted in Sandynallah of Nilgiri Hills since ca. 30,000 BP. Gupta and Bera (in Press) have recovered a pollen assemblage dating back to >40,000 BP from Bombay shola forest in Palni Hills indicating three phases of vegetation development, i.e., degeneration of shola forest, grassland, re-establishment of shola forest, reflecting on three fold climatic oscillations such as increasing cold and decreasing moist, cold and dry, and warm and moist climatic regimes. The pollen assemblage from Anamalai Hills indicates that the area during 1500 BP was without trees on the landscape and that some of the nonarboreal taxa, e.g., *Senectio*, *Heracleum*, *Impatiens*, *Peperomia*, etc., are closely associated with the forest in south India and are the positive indicators of the existence of shola woods (Bera & Gupta, in Press).

The findings of the present study in and around Marian shola have an important bearing upon the theories regarding the origin and ecological status of upland savanna of Nilgiris, Palnis and Anamalai. The existence of montane grassland and evergreen shola forest have posed an enigmatic problem as to which plant community be considered as climatic climax plant community.

The face value picture of pollen spectra obtained from surface samples does not portray factual composition of modern vegetation; the study has rather revealed that the nonarboreal taxa are preponderant and the trees are either absent or under-represented. Three successional phases of vegetation development have been recovered out of the palynological study of 1.7 m deep profile from Marian shola. The first phase covering a time span between 25,000-10,000 BP is marked by the occurrence of open shrub savanna denoting warm-humid and decreasing cold-dry climatic regime. The second phase covering time span between 10,000-5000 BP has witnessed a shift in vegetation suggesting the existence of far and wide grassland under cold and

dry climatic condition. Thereafter, the third phase of vegetation development, ranging from 5000 years to present has registered overall improved values of shola forest constituents showing the co-existence of forest and grassland under warm and humid climatic regime.

Furthermore, pollen evidence suggests that the savanna represent the climatic climax of the forest zone during 30,000 BP and was not formed by degradation of forest on one hand and the sholas represent a second climatic climax, i.e., the forest zone on the other hand. Further, it is to mention that today the study area is totally devoid of natural forest and not subjected to grazing and periodic burning. This clue has definitely supported the view that the persistence of the present savanna especially around swampy areas in Marian shola should have been governed largely by abiotic factor such as frost and other soil condition (clayish, rich in organic content and poor drainage).

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