Correlation between pollen spectra and modern vegetation of Anamalai Hills, Tamil Nadu

S.K. Bera & H.P. Gupta

Birbal Sahni Institute of Palaeobotany, 53 University Road, Lucknow 226 007, India

Bera, S.K. & Gupta, H.P. 1992. Correlation between pollen spectra and modern vegetation of Anamalai Hills, Tamil Nadu. *In* : Venkatachala, B. S., Jain, K. P. & Awasthi, N. (eds) – *Proc. 'Birbal Sahni Birth Centenary Palaeobotanical Conference'*, *Geophytology* **22** : 239 — 245.

Twenty eight surface samples from different forest zones in Anamalai Hills, ranging from within the woods to open land, were procured and investigated in order to obtain precision in the pollen rain and modern vegetation relationship. The study has revealed the occurrence of forest by virtue of being rich in tree pollen within the thickets of shola woods. But the tree pollen reduce proportionately in the samples collected from periphery and outskirt of the forest which are either absent or sporadic in the samples from about 1-4 km away from the forest.

This study has raised an alarm that the face value interpretation of pollen diagram is not relied upon for the reconstruction of palaeofloristics rather interpretation should be based on the signals comeforth from the modern pollen spectra.

Keywords–Pollen spectra, pollen rain, pollen/vegetation relationship, Anamalai Hills, Tamil Nadu (India).

INTRODUCTION

ANAMALAI in Tamil language implies literally for an abode to elephants or Elephant Hills. It lies (Lat. 10°32' E, Long. 76°43' N) at an elevation between 1000-1500 m a.s.l. and forms a vast range of mountains that run southward through the Travancore State. Anamalai ranges are cut off from Neliampatti Hills by the valley at Tekkadi River on the west and from Palni Hills by the Puchaiar Valley on the east. Its southern slope descends precipitously to the plains of central Coimbatore. To the north it connects the Silent Valley and Nilgiris following a break in the Western Ghats known as *"Palghat Gap"* which is about 20 km wide. The central mass of Anamalai is the highest range with an elevation of 3000 m and culminates with Travancore ranges.

The vegetation of Anamalai Hills is typically evergreen with an admixture of both tropical and temperate species. It is also ecologically interesting since evergreen shola forest and grassland co-exist in juxtaposition and have constant competition. The annual rainfall in these hill ranges varies from 375-500 cm. Depending upon the elevation and the quantum of precipitation, the vegetation is demarcated into three subtypes as follows:

a. *Lower Evergreen Subtype*—This covers an elevation between 500-1000 m a.s.l. and the annual rainfall is around 375 cm. The characteristic plants growing here are : *Hydnocarpus wightiana, Xanthophyllum flavescens, Ancistoicladus heyneana, Achronychia laurifolia, Geophila reniformes, Dimorphocalyx lawianus, Excoecaria robusta, Panicum pilipes*, etc.

b. *Medium Evergreen Subtype*—It occupies the hill ranges between 1000-2000 m a.s.l. and the annual rainfall varies between 500-625cm. This zone is determined by the occurrence of gigantic evergreen trees forming three tier system, such as; *Elaeocarpus tuberculatus, Canarium strictum, Cullenia excelsa*, etc.

– Top Storey

Unona pannosa, Goniothalamus wightii, Gracinia spp., Holigarna beddomei, Pithecolobium bigemmimum, Eugenia munronii, Isonandra lanceolata, Premna coriaceae, Macaranga tomentosa, etc.

– Second Storey

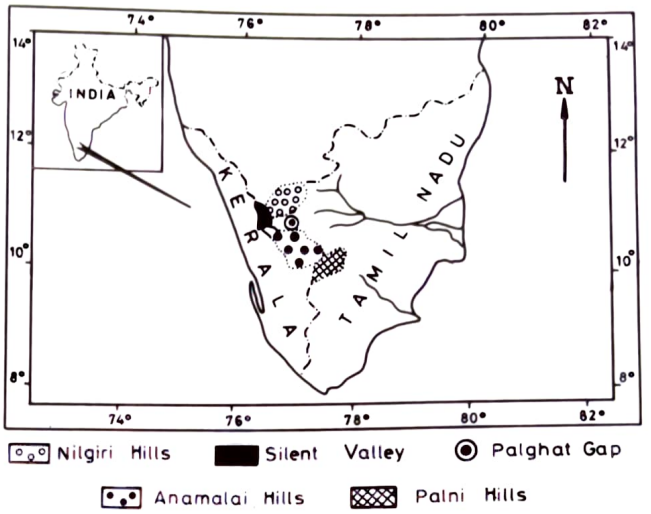
Paramignya armater, Turraea villosa, Ixora nigricans, Saprosma indicum, Strobilanthes spp., etc.

– Under Storey

c. *Upper Evergreen Subtype*–This occupies hill ranges above 2000m and enjoys annual rainfall above 750 cm. The characteristic plants of this zone are *Michelia nilagirica, Mahonia leschenaultii, Eurya Japonica, Elaeocarpus ferrugineus, Euonymus in*

dicus, *Ilex* spp., *Microtropis* spp., *Turpinia pomifera*, *Eugenia* sp., *Rhododendron arboreum*, *Symplocos anamallayana*, *Cinnamomum wightii*, etc.

Beside the forest types, the grassland vegetation is equally important and is present in a good variety. On the basis of composition variations, the lower and upper grasslands have been identified having clear cut demarcation at 2000 m a.s.l. The object of undertaking this study is two fold: (i) to ascertain the representation of tree pollen taxa in sediments which are generally absent and/or sporadic in the pollen diagram reconstructed earlier from Nilgiris and (ii) to have precise information of pollen deposition/modern vegetation relationship in the area. This, in turn, would help to reconstruct the palaeofloristics of Anamalai Hills through time.



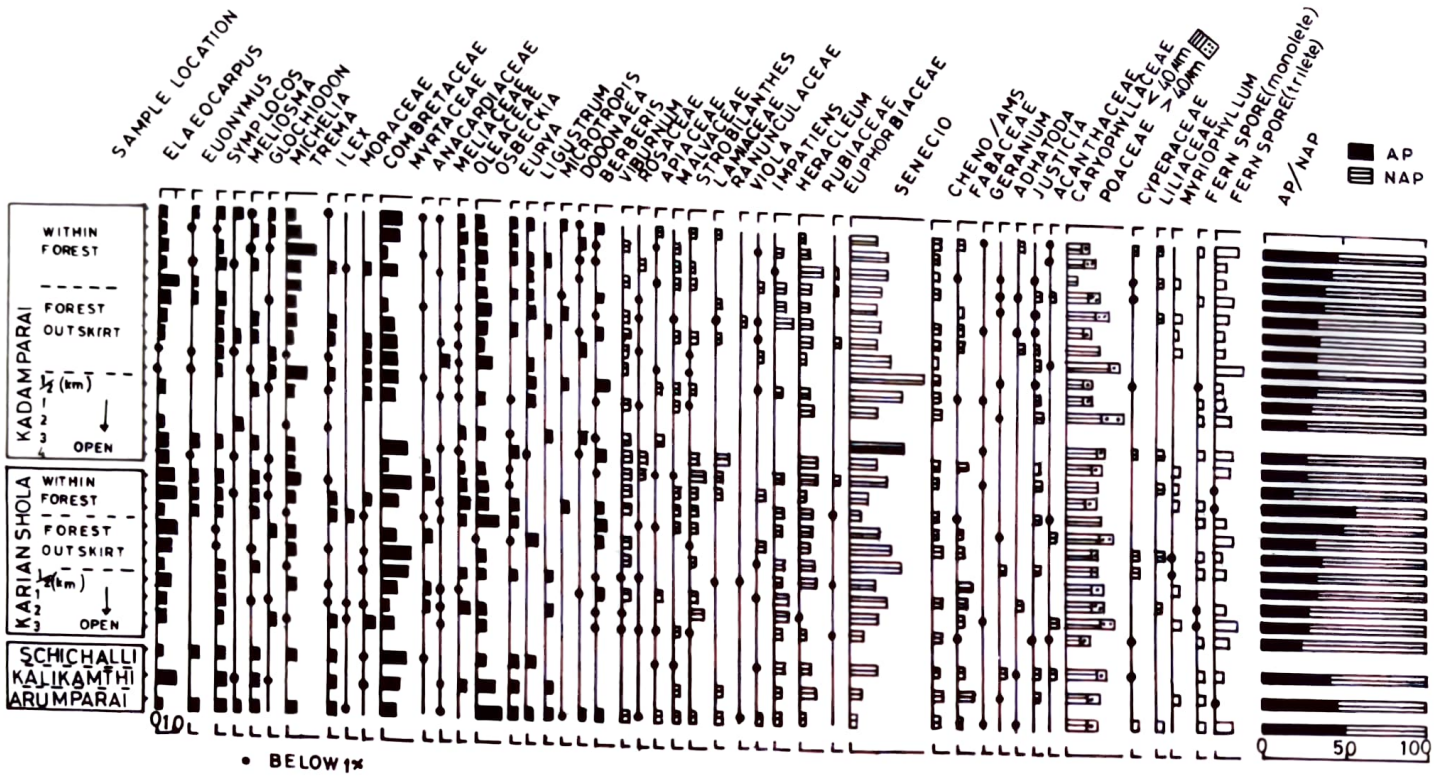
Map 1. Showing shola localities in south Indian montanes.

MODERN POLLEN/VEGETATION RELATIONSHIP

Surface samples for pollen analytical investigaion were procured from forested as well as unforested zones covering an area of about 4 km in Anamalai Hills. The areas under investigation are Kadamparai, Karian shola,

Table 1

Area under investigation	Sample location	Details of samples
KADAMPARAI	Within forest	1. Moss cushion from forest floor beneath *Cinnamomum* tree
"	"	2. Moss cushion from forest floor
"	"	3. Moss cushion from a dead stump of *Elaeocarpus* tree
"	"	4. Moss cushion from a rock surface near an elephant resting camp
"	"	5. Moss cushion from the bark of *Cinnamomum* tree
"	Forest outskirt	6. Soil from near a bamboo stake
"	"	7. Soil from the edge of a cultivated land
"	"	8. Soil from a road cutting
"	"	9. Moss cushion from a dead pine log
"	"	10. Moss cushion from a boulder surface
"	1/2 km away from the forest edge	11. Soil from near a nala
"	1 km away from the forest edge	12. Mud from near a bamboo stake
"	2 km away from the forest edge	13. Mud from near a small stream
"	3 km away from the forest edge	14. Soil from an open land
"	4 km away from the forest edge	15. Mud from near a nala
KARIAN SHOLA	Within forest	16. Moss cushion from near an elephant resting camp site
"	"	17. Moss cushion from a boulder near an *Elaeocarpus* tree
"	"	18. Soil from forest floor
"	Forest outskirt	19. Moss cushion from a dead log
"	"	20. Soil from near an elephant camp site
"	"	21. Soil from near petit stream
"	1/2 km away from the forest edge	22. Soil from dry nala
"	1 km away from the forest edge	23. Soil from dry swamp
"	2 km away from the forest edge	24. Moss cushion from a dead pine log
"	3 km away from the forest edge	25. Soil from near cultivated land
SCHICHALLI	Within forest	26. Mud sample from swamp
KALIKAMTHI	Forest outskirt	27. Soil from near bamboo stake
ARUMPARAI	Within forest	28. Mud from dry swamp



Text-fig. 1. Recent pollen spectra from Anamalai Hills, south India (Percentage calculated in terms of total land plants pollen excluding ferns).

Schichalli, Kalikamthi and Arumparai, etc. (Table 1). The pollen details of each area is given below separately so as to obtain precise information of modern vegetation/pollen relationship.

Kadamparai : It is situated about 43 km south of Pollachi at an elevation of 1000 m a.s.l. and fifteen samples were investigated covering a part of forest and extending to the open land. Out of total lot, five samples numbering 1-5 are from within the thickets of forest and five numbering 6-10 are from forest periphery, and five numbering 11-15 are from open land covering a distance of 4 km from the edge of the forest.

Sample 1-5– Pollen assemblage of these samples has revealed that arboreals and non-arboreals are present in almost equal ratio signifying the factual relationship between pollen and modern vegetation set up. Amongst arboreals, the prominent taxa such as *Elaeocarpus, Trema, Osbeckia*, Myrtaceae and *Symplocos* are present in good values whereas other taxa, such as, *Ilex*, Oleaceae, etc. are either poor or sporadic. Amongst non-arboreals, Poaceae, Asteraceae, Rubiaceae record high values. Taxa like *Strobilanthes, Impatiens*, Malvaceae and *Heracleum* are either poor or sporadic. The sporadic display of these taxa is largely held owing to the prevalent entomophily. Trilete fern spores are present in good frequencies as compared to monoletes.

Sample 6-10– The pollen spectra obtained from these samples reflect an overall dominance of non-arboreals. Arboreals are present to the tune of 40 per cent of the total vegetation and amongst them *Elaeocarpus, Trema*, Myrtaceae, *Symplocos* and *Osbeckia* are present in moderately good values whereas *Ilex, Euonymus, Eurya*, etc. are either poor or sporadic. Non-arboreals have proportionately increased as compared to the preceding set of samples and could be counted to about 60%. Poaceae and Asteraceae are the predominant taxa while Rubiaceae, *Strobilanthes, Impatiens*, Lamiaceae, etc. are less represented. Ferns are known through trilete spores only having moderately high values in all samples.

Sample 11-15– The pollen spectra so obtained have revealed that efficiency in non-arboreals is directly proportionate to the distance covered from the forest to open land. The arboreals are reduced to 30% of the total vegetation. The prominent arboreals such as Myrtaceae, *Elaecarpus, Trema*, etc. attain moderate values and taxa like *Symplocos, Osbeckia*, Oleaceae, etc. are sporadic. The ground vegetation is represented by Poaceae and Asteraceae at highest values while the taxa like Rosaceae, Malvaceae and Ranunculaceae are recorded in low values. *Strobilanthes* as well as *Impatiens* disappear from these samples. Trilete and monolete spores have reduced as compared to the preceding samples.

Karian shola: This area possesses shola belt, situated near the Top Slip, extending upto 1700 m covering several kilometers in Kerala State. The forest is very dense but the ground vegetation is poor.

Ten samples are investigated covering a part of forest and open land. Out of them, samples (16-18) are from within the forest thickets, three samples (19-21) are from forest periphery and four samples (22-25) are from the open land covering about 3 km of distance from the edge of the forest and above all sample no. 25 is devoid of sufficient pollen for percentage calculation.

Samples 16-18–The pollen spectra obtained from these samples reflect an overall dominance of arboreal pollen attaining 60% values of the total vegetation. The tree taxa such as *Elaeocarpus*, Myrtaceae, *Osbeckia* and *Trema*, etc. are present in good values and other tree taxa like *Glochidion*, Oleaceae, Anacardiaceae, *Eurya* and *Euonymus* are present in low values. The ground vegetation is proportionately reduced as compared to the arboreal components. The dominant non-arboreals are Poaceae, Asteraceae, Rubiaceae whereas other taxa like *Strobilanthes*, Rosaceae, *Impatiens*, etc. are present in low values. Trilete fern spores attain upto 10% and monoletes are under 2-3%.

Samples 19-21–These sample depict relatively higher values for non-arboreals as compared to the preceding samples. The arboreals are present to the tune of 40% and predominant amongst them are Myrtaceae, *Elaeocarpus*, *Trema*, etc. but *Symplocos*, *Michelia*, *Eurya*, etc. remain low. Combretaceae and *Glochidion* are sporadically present. The ground vegetation is represented by Poaceae, Asteraceae, Rubiaceae, etc. in good values and Cheno/Ams., Rosaceae, *Heracleum*, *Impatiens*, etc. in low values. Lamiaceae and Apiaceae are sporadic. Trilete fern spores attain upto 6% and monolete remain under 3%.

Samples 22-25–The pollen spectra obtained display further reduction in arboreals and uprise in non-arboreals. The arboreals are reduced to 25% of the total vegetation. *Elaeocarpus*, *Symplocos*, Myrtaceae, etc. are some of the arboreal taxa present in low values. Non-arboreals are frequent and represented by Poaceae, Asteraceae, *Heracleum*, Fabaceae, Lamiaceae, etc. *Impatiens* is sporadic in the samples. Amongst fern spores, triletes improve and maintain 12-15% whereas monoletes become sporadic.

Schichalli: It is situated about 15-16 km south of Anamalai Top Slip and is devoid of any natural lake rather deep gorges within the forest are quite common.

The pollen spectrum obtained from one sample numbering 26 has depicted the overall dominance of non-arboreals. Arboreals are present under 40% of the total vegetation. Amongst arboreals, Myrtaceae *Euonymus*, *Trema*, *Symplocos*, *Eurya*, *Osbeckia*, etc are present in moderate values and *Glochidion*, *Ligustrum*, *Ilex*, *etc* are present in low values. Amongst non-arboreals, the highest values are maintained by Poaceae and Asteraceae but Rubiaceae, *Heracleum*, etc. are present in low profile. Other associates like Cheno/Ams., *Strobilanthes*, Acanthaceae, Caryophyllaceae, etc. are sporadic. Ferns are in low values.

Kalikamthi: It is situated one and half kilometer further south of Schichalli under Ullandi forest range. Owing to the extensive scheme of teak plantation the shola forest is endangered.

The pollen spectrum obtained from sample number ing 27 reflects the overall dominance for non-arboreals. The arboreals attain upto 40% of the total vegetation. The dominating tree taxa encountered are Myrtaceae, *Elaeocarpus*, *Osbeckia*, *Symplocos*, followed by *Ilex*, *Eurya* and *Microtropis*. The other associates like *Michelia*, *Meliosma*, Meliaceae, Combretaceae, etc. are either poor or sporadic. Amongst non-arboreals, high values are attained by Poaceae followed by Asteraceae, Rubiaceae and Fabaceae. *Strobilanthes*, Ranunculaceae, *Heracleum* and Cheno/Ams. are the other taxa enumerated in low values. Monolete ferns are low and trilete ferns become sporadic.

Arumparai: It is situated about 2 km south of Kalikamthi and mostly abounds in swamps and degraded form of tea plantation all around. The pollen spectrum obtained from one sample numbering 28, depicts the dominance of non-arboreals. The arboreals attain upto 46% of the total vegetation composition. Tree taxa such as *Osbeckia*, Myrtaceae, *Elaeocarpus*, *Euonymus* and *Trema* are present in moderately good values whereas *Eurya*, *Microtropis*, *Viburnum*, etc. are present in low frequencies. The ground vegetation is largely represented by Poaceae. However, Asteraceae, *Heracleum*, Rubiaceae, Euphorbiaceae, *Impatiens*, *Strobilanthes*, etc. are present in low frequencies. Trilete fern spores enjoy high values whereas monoletes are lowly present.

DISCUSSION AND CONCLUSION

The information permeated from the pollen analytical investigation of surface samples has envisaged that existence of shola forest constituents is faithfully acknowledged as long as the study is confined within the woods and forest outskirts but their frequency proportionately declines in the samples away from the forest. This aspect is to be judiciously considered while interpreting the pollen data in a pollen diagram. Thus, a pollen diagram constructed from the south Indian montanes having little or no tree taxa should not be viewed as forestless zone. Instead, in the absence or sporadicity of shola trees, certain herbaceous elements closely associated to the woods be taken into consideration for defining the various developmental phases of the shola forest.

Pollen rain within the forest–Palynological investigation have been conducted on eleven surface samples procured from different areas within shola forest. Pollen

rain has revealed the existence of factual forest composition of tree taxa such as *Elaeocarpus*, *Euonymus*, *Symplocos*, *Trema*, Myrtaceae, *Osbeckia*, *Ilex*, *Michelia*, *Glochidion*, *Eurya*, etc. Shrubs and other associated herb elements like *Ligustrum*, *Heracleum*, *Strobilanthes*, *Impatiens* and Rubiaceae are also recorded moderately and *Senecio* is consistently present in all samples in good values. Grass pollen are also represented in good frequencies. Fern spores specially trilete spores show their regular representation in all samples in good values. This set up of pollen distribution has enabled us to deduce that the pollen vegetation relationship is in order.

Pollen rain in forest outskirt–The study was conducted on eight surface samples from outskirts of shola forest. Here the study shows relative reduction in tree pollen present in pollen rain composition as compared to preceding samples. However, *Senecio* as well as grass pollen show their higher frequencies than those of the forest but *Impatiens* and *Strobilanthes* dwindle. Fern representation continues without recording any evident variation between within and outskirt of the forest.

Pollen rain away from the forest.–The study of nine surface samples procured from forest outskirt to open land covering a distance of 4 km has revealed the dominance of non-arboreals as compared to arboreals. The common feature of the study is the reduction of tree pollen taxa which is directly proportional to the distance covered from the forest margin to the open land. In ultimate case of samples collected further off the forest the tree pollen are either absent or sporadic. However, there is no evident change in the frequency of Asteraceae in pollen rain.

The reasons for tree pollen not being represented are many-fold but we are of the view that there are two main reasons, (i) The entomophilous pollination mechanism amongst the forest trees and (ii) Bushy fencing of the shola which precludes the exit of tree pollen from the forest.

Nevertheless, these combinations and permutations in the pollen distribution are to be taken into consideration for interpretation of pollen diagrams from south Indian montanes and to record various developmental phases of shola forest in time and space.

REFERENCES

Champion, H.G. & Seth, S.K. 1968. *A Revised Survey of the Forest Types of India*. Govt. of India Publications, Delhi.

Erdtman, G. 1943. *An Introduction to Pollen Analysis*. Chronica Botanica Co., Waltham, M.A.

Fischer, C.E.S. 1920. A survey of the flora of the Anamalai Hills in the Coimbatoor District, Madras Presidency. *Rec. bot. Surv. India* **9** (1): 1-218.

Meher-Homji, V.M. 1965. Phytogeography of the south Indian hill stations. *Bull Toreey bot. Club* **94** (4): 230-242.

Meher-Homji, V.M. 1972. Himalayan plants on the south Indian Hills. Role of Pleistocene glaciation Vs long distance dispersal. *Sci. Cult.* **38** (1): 8-12.

Gupta, H.P. & Prasad, K. 1985. The vegetational development during 30,000 years B.P. at Colgrain, Ootacamund, Nilgiris, S. India. *Jour. Palynol.* **21** : 174-187.