Mangrove development at Nalabana Island, Chilka Lake: a palynological interpretation

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Gupta, H.P. & Khandelwal, Asha 1992. Mangrove development at Nalabana Island, Chilka lake: a palynological interpretation. *In* : Venkatachala, B. S., Jain, K. P. & Awasthi, N. (eds) – *Proc. 'Birbal Sahni Birth Centenary Palaeobotanical Conference'. Geophytology* **22** : 235 — 238.

Pollen analytical investigation of a 3.75 m deep soil profile from Nalabana Island within Chilka lake has exhibited poor occurrence of both core and peripheral mangroves. Throughout its development the island was inhabited with scrubby vegetation dominated by Poaceae, Chenopodiaceae and Cyperaceae. The overall vegetational mosaic has revealed that the Nalabana Island was an oasis of salt marshes within the mangrove throve.

Key-words—Palynology, mangrove, Nalabana, Chilka lake, Orissa (India).

INTRODUCTION

NALABANA (Lat.29° 5′, Long. 85° 6′) is a muddy island and is situated almost in the centre of Chilka Lake, about 22 km south-east of Barkul Panth Niwas. It is estimated that Nalabana is a spread of mud flat, measuring about 10 sq km and is considered to be an abode to the migratory birds. In the rainy months Nalabana is submerged with fresh water but as dry summer approaches the fresh water influx abates and island gradually surfaces. The inflow of sea water and evaporation of lake water under bright hot sun increases the salinity around Nalabana and turns it brackish. This character of the Chilka Lake in general and Nalabana in particular, abounds a wealth of aquatic life that the birds relish and come to feed upon. The island is sheathed with thin layer of salt. The plants growing there are highly salt-resistant. Nalabana Island is devoid of any arboreal vegetation. It is inhabited by reeds, sedges, chenopods, etc. Bushes of *Acanthus ilicifolius* are also found bordering the eastern flank of the island.

MATERIAL AND METHOD

The authors visited Nalabana Island in March/April, 1988 when it was completely surfaced and was higher by about half a meter from the water level all around. The island was looking like an emerged mud-flat. After a thorough survey, several trial borings were conducted and a 3.75 m deep soil profile was obtained. The samples were collected at an interval of ten centimeter each.

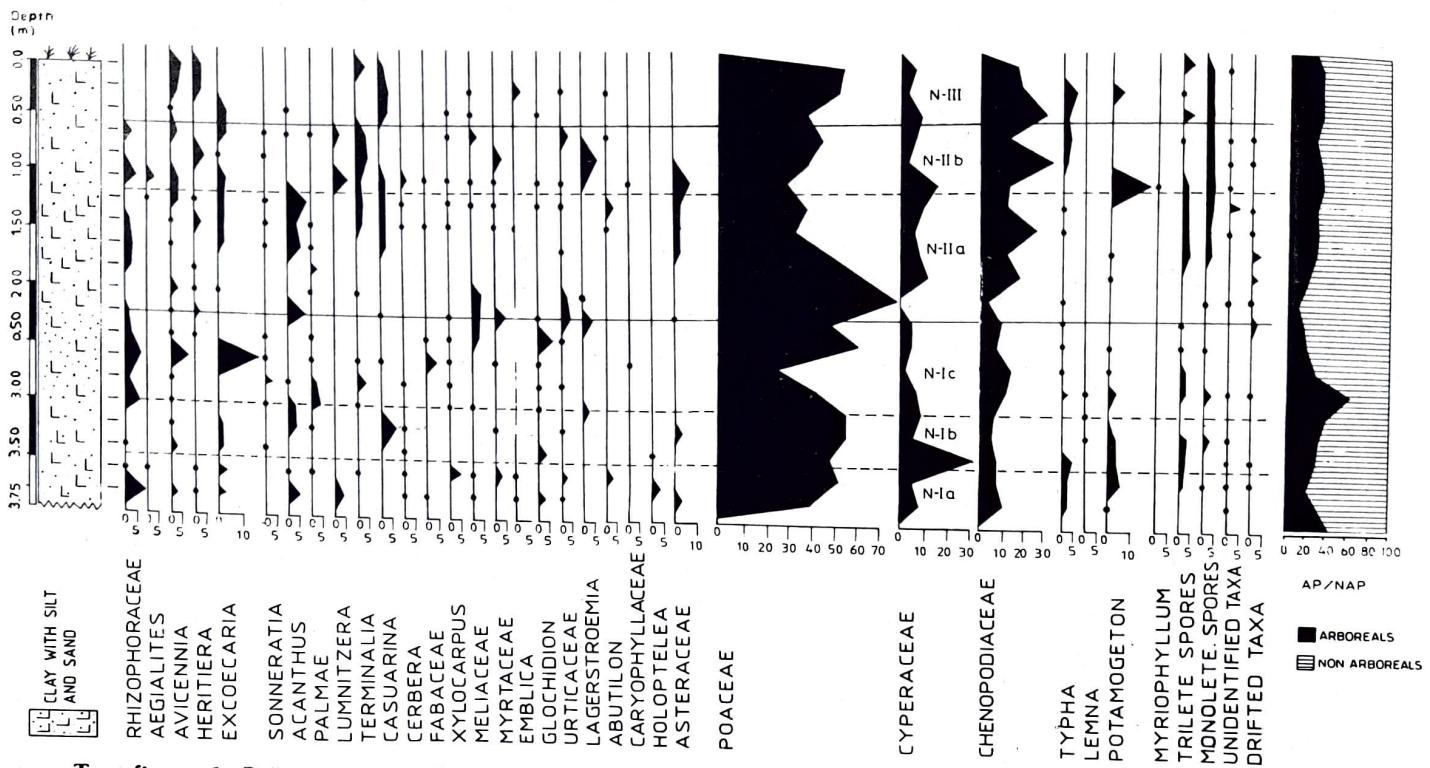
The sediments laid down in the profile are more or less same type and are identified as clayey sand in general. Organic matter, however, is present in considerably low quantity and therefore, no rediocarbon dates could be obtained for this profile. The lithological details are as follows:

0.0-1.25 m –	Grey sandy clay, organic matter negligible.
1.25-2.25 m –	Grey clayey sand, organic matter negligible.
2.25-3.25 m –	Grey sandy clay, organic matter absent.
3.25-3.75 m –	Grey clayey sand, organic matter absent.

POLLEN DIAGRAM AND PALAEOMANGROVES

A pollen diagram (Text-fig. 1) has been prepared from Nalabana Island and relative frequencies of taxa have been plotted alongwith the lithocolumn. The pollen diagram, based on certain changes in the vegatation development, has been ingeniously graded into three zones in stratigraphic sequence and prefixed with site initials, e.g., N-I to N-III and the zones N-I and N-II are subdivided into three and two zonules, respectively. This has been done primarily to express biostratigraphic units in terms of palaeovegetation and secondly to translate significant bio-and climatic events since the time of deposition of sediments. Each zone has been discussed and interpreted separately.

Based on vegetational development and its correlation with other well dated pollen diagrams from Chilka



Text-figure 1. Pollen diagram from Nalabana Island, Chilka Lake, Orissa. (Percentages calculated in terms of total land plant pollen).

Lake, it is assumed that the total accumulation of 3.75 m deep sediments at Nalabana would have been completed in a time span of about 2,000 years B.P. and the age calculated for each zone is approximative.

Zone N-I (3.75 to 2.20 m)—The overall picture permeated out of this zone reveals that the core mangrove and peripheral mangrove taxa are recorded albeit in degraded pattern. Instead, salt marsh vegetation, mostly comprised of Poaceae, Cyperaceae, Chenopodiaceae, etc., is consistently present. Furthermore, the vegetation set-up seems to be fast changing due to erraticity in salinity. Therefore, this zone has been subdivided into three zonules, viz., a, b, c. This zone provides the information on vegetation development roughly between 2,000-1,200 years B.P.

Zonule N-Ia (3.75 to 3.50 m)—It encompasses a time span of about 200 years. During this period most of the core mangroves and peripheral mangroves are found in degraded form and are in discontinuous low values. Poaceae is present in high values whereas Cyperaceae and Chenopodiaceae are moderate. Aquatic taxa are feebly present and mark their presence in the upper half of this zonule.

Zonule N-Ib (3.50 to 3.0 m)—It also covers a time period of 200 years and is marked by further reduction in the mangrove components in general and improvement in the herbaceous elements.

Rhizophoraceae disappears and other mangrove taxa experience set-back but *Casuarina* emerges. Poaceae continue in high values but Chenopodiaceae shows a slight depression. Cyperaceae increases tremendously in the beginning and later declines upwards. Amongst aquatic taxa, *Potamogeton* forms continuous pollen curve. Ferns are represented mostly by monolete spores.

Zonule N-Ic (3.00 to 2.20 m)—It covers a time span of about 400 years and marks the reappearance of Rhizophoraceae and general improvement in all other core-mangrove taxa. For instance Rhizophoraceae forms a continuous low curve throughout the period whereas *Excoecaria* and *Avicennia* spurt in the middle. This feature records corresponding decline in Poaceae and Cyperaceae but Chenopodiaceae improves slightly. Aquatic taxa and ferns decline during this phase.

Zone N-II (2.20 to 0.60 m)—This zone is characterized by uncertainties in the development of both core and peripheral mangroves and preponderance of salt marsh and heathland taxa. To obtain finer details of mangrove degradation, this zone is subdivided into two zonules, viz., a,b. This zone covers a period of about seven hundred years ranging between 1,200-500 years B.P.

Zonule N-IIa (2.20 to 1.40 m)—It covers a period

of about 450 years and during this phase Rhizophoraceae, *Avicennia*, *Heritiera*, *Excoecaria*, etc. have reduced considerably as compared to the preceding zone. *Acanthus* records higher values than before. Peripheral mangroves remain sporadically low. Even *Casuarina* does not improve, rather disappears in the beginning and reappears at the close of this phase. Asteraceae increases at the end. There is an overall increase in the values of Poaceae, Cyperaceae and Chenopodiaceae. Aquatic taxa and ferns are sporadically low throughout this phase.

Zone N-II b (1.40 to 0.60m)—It covers a time period of about 250 years and records almost similar vegetation pattern as in the preceding zonule but for slight improvement in the overall values of mangrove taxa. However, *Acanthus* is reduced and *Lumnitzera*, *Terminalia* and *Lagerstroemia* are further reduced. Amongst nonarboreals, Poaceae reduces but Asteraceae, Cyperaceae and Chenopodiaceae improve proportionately. *Potamogeton* is the only fresh water taxon attaining summit and its high values coincides with the fall out point of Chenopodiaceae in this phase. Ferns too maintain consistent low value curve.

Zone N-III (0.60 to 0.00 m)—This zone ecompasses a time span of about 500 years B.P. wherein almost extermination of Rhizophoraceae is recorded. Nevertheless, *Avicennia* and *Heritiera* record uprise in the values. *Casuarina* increases and continues in moderately high pollen curve. Palmae advances in the middle of this phase and rest of the taxa are present in more or less same proportion as before. Poaceae and Cyperaceae record successive improvement upwards whereas Chenopodiaceae after enjoying its fullest growth in the lower two/third of this phase dwindles down upward. Aquatic taxa such as *Potamogeton* declines and *Lemna* increases but both are confined to the lower part of this phase. Ferns continue in low values throughout.

DISCUSSION AND CONCLUSIONS

Lithology of the Nalabana profile suggests that the sediments were laid down at a faster rate and hence age estimation of 3.75 m deep Nalabana profile does not go beyond 2000 years. Palynological investigation of this profile does not incorporate the existence of mangrove throve rather the occurrence of salt marshes is recorded.

Zone N-I, records fairly vast existence of salt marshes. Mangrove taxa are feebly recorded and most of them seems to be drifted. However, some minor fluctuations and shifts in the vegetation within salt marsh environs have been noted and they are defined under each zonule. Zonule N-I a, covers the vegetation development for about 200 years between 2,000-1,800 years B.P. wherein Rhizophoraceae and other mangrove taxa are either locally high or remain sporadic. Poaceae is present far and wide on the mud flat and is followed by Cyperaceae and Chenopodiaceae. Fresh water taxa, although feeble, are also present in this association. The overall vegetation pattern suggests that Nalabana was frequently flushed with fresh water during this phase ceding pace for the flourishment of such components which have the quality to withstand either of the environs.

Zonule N-I b, covering a time span of 200 subsequent years, records extermination of Rhizophoraceae and overall reduction in the mangrove taxa. Poaceae and Chenopodiaceae continue in the similar frequency as before but Cyperaceae records an all time spurt. Fresh water taxa also remain same as before and ferns improve. Thus, the information permeated out of this phase has revealed further increase in the fresh water discharge and cessation in the sea-water inflow into the Chilka Lake.

Zonule N-I c, a phase of about 400 years, has witnessed the reappearance of Rhizophoraceae and general improvement in the mangrove taxa especially *Excoecaria* attaining highest values. Poaceae and Cyperaceae reduced whereas Chenopodiaceae increased. Fresh water taxa also reduced. This feature of vegetational development envisages rise in the sea-tide as a result of that there was relatively more sea water inflow than before.

Zone N-II, covering a time span of about 700 years, records erratic behaviour in the development of mangrove taxa. Efforts are made to understand the significance of this behaviour and therefore, this zone is phased into two zonules as under.

Zonule N-IIa records evident depression amongst the arboreal components in general and mangrove taxa in particular except that *Acanthus* improved its position than before. Poaceae Cyperaceae and Chenopodiaceae advanced considerably. This vegetation composition envisages the periodical intermixing of both fresh and sea water, making brackish water environs with hypersaline conditions. And the process continued like this throughout the phase covering a period of about 450 years.

Zonule N-II b is more or less in sequel to the preceding zonule except for sizeable reduction in *Acanthus* and improvement in *Lumnitzera*, *Terminalia* and *Lagerstroemia* - a community of midland vegetation. Poaceae reduced but Chenopodiaceae and Cyperaceae advanced. *Potamogeton* made a record uprise whereas other fresh water elements and ferns intended to increase. This sequence of vegetation development during the period of 250 years signifies more fresh water discharge and less inflow of sea water into the lake.

Zone N-III, encompassing a period of past 500 years, may be considered as a phase of human holocaust and

could be correlated with Paradip (Gupta & Yadav, 1990). During this phase, most of the typical mangrove taxa have been either ruthlessly damaged or reduced to fractions. However, *Avicennia* and *Heritiera* continued as before. The continuous high curve for *Casuarina* throughout this phase in itself explains the woe of mangals.

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