

Early Cretaceous plant fossils from Sudda-Meta near Raghudevapuram, East Godavari District, Andhra Pradesh, India

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ABSTRACT

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The present paper deals with the well preserved early Cretaceous megafossils recorded from Sudda-Meta near Raghudevapuram in East Godavari district, Andhra Pradesh, India. The fossil elements include cycadopsids, viz. *Ptilophyllum cutchense* Morris, *Ptilophyllum* sp. cf. *P. institacallum* M.N. Bose, *Pterophyllum* sp., *Otozamites* sp., *Williamsonia blanfordii* Feistm. and *Taeniopteris spatulata* McClell. and pinopsids, viz. by *Elatocladus plana* (Feistm.) Seward, *Elatocladus tenerrimus* (Feistm.) Sahní and *Desmiophyllum indicum* Sahní. The assemblage was compared with previously reported megafossils in order to reassess the palaeofloristic composition of the area. The present finding suggests prevalence of warm and humid climatic conditions during early Cretaceous in East Godavari region of India.

Keywords: Plant fossils, Early Cretaceous, Upper Gondwana, Sudda-Meta, East Godavari District, Andhra Pradesh, India

INTRODUCTION

Cretaceous sediments are exposed along east coast of India, including Odisha, Andhra Pradesh and Tamil Nadu. Several early Cretaceous fossil localities are found in Godavari, Guntur, Krishna, Prakasam and Nellore districts of Andhra Pradesh. The present paper deals with early Cretaceous plant fossils collected from Sudda-Meta near Raghudevapuram (Lat. 17°8'30"N, Long. 81°44'30"E), in East Godavari District, Andhra Pradesh. Mahabale and Satyanarayana (1979) reported 19 megafossils of pteridophytic and gymnospermous affinities from this locality and assigned them an Upper

Jurassic age. Megafossil elements collected from this locality revealed occurrence of cycadopsids and pinopsids. This is dominated by gymnosperms which suggests warm and humid climate during the early Cretaceous age.

MATERIAL AND METHODS

The plant megafossil impressions were collected from yellowish and reddish brown sandstones of early Cretaceous age exposed at Sudda-Meta hillock (about 5 m in height), 2 km south of Raghudevapuram on the Mugualla-Korukonda route in East Godavari district,

Andhra Pradesh (Figure 1). Distinct layers of ferruginous and yellowish sandstones are present in the middle part of this hillock. Some of the megafossils were exposed naturally and were collected as such, whereas others were collected by digging and breaking the rocks. Well preserved specimens were collected and photographed by SLR camera. The fossil specimens were packed in cotton and brought to the laboratory for further investigation. Fossil plant impressions were cleaned with soft brush and photographed using digital camera under incident light and appropriate lenses, followed by identification, description and comparison with the help of relevant literature. All the specimens have been deposited in the Department of Botany, Arts, Commerce and Science College, Palus, India.

SYSTEMATIC PALAEOBOTANY

Phylum: *Tracheophyta* Kenrick & Crane

Class: *Cycadopsida* Brongn.

Order: *Bennettitales* Bessey

Family: *Bennettitaceae* Lign. in Seward

Genus: *Ptilophyllum* Morris 1840

Ptilophyllum cutchense Morris 1840

Figure 3.1

Figured specimen No.: SM/5/2011.

Description: The specimen is an impression of a pinnate frond, showing closely set rhomboid pinnae, measuring 1×0.2 cm, attached on the upper surface of the rachis, apex is obtuse, veins parallel.

Comparison: The specimen resembles *P. cutchense* Morris described by Bose and Kasat (1972) in morphological details. It also shows resemblance with specimens of *P. cutchense* described by Mahabale and Satyanarayana (1979) from Raghudevapuram, East Godavari district, Andhra Pradesh; Bose and Banerji

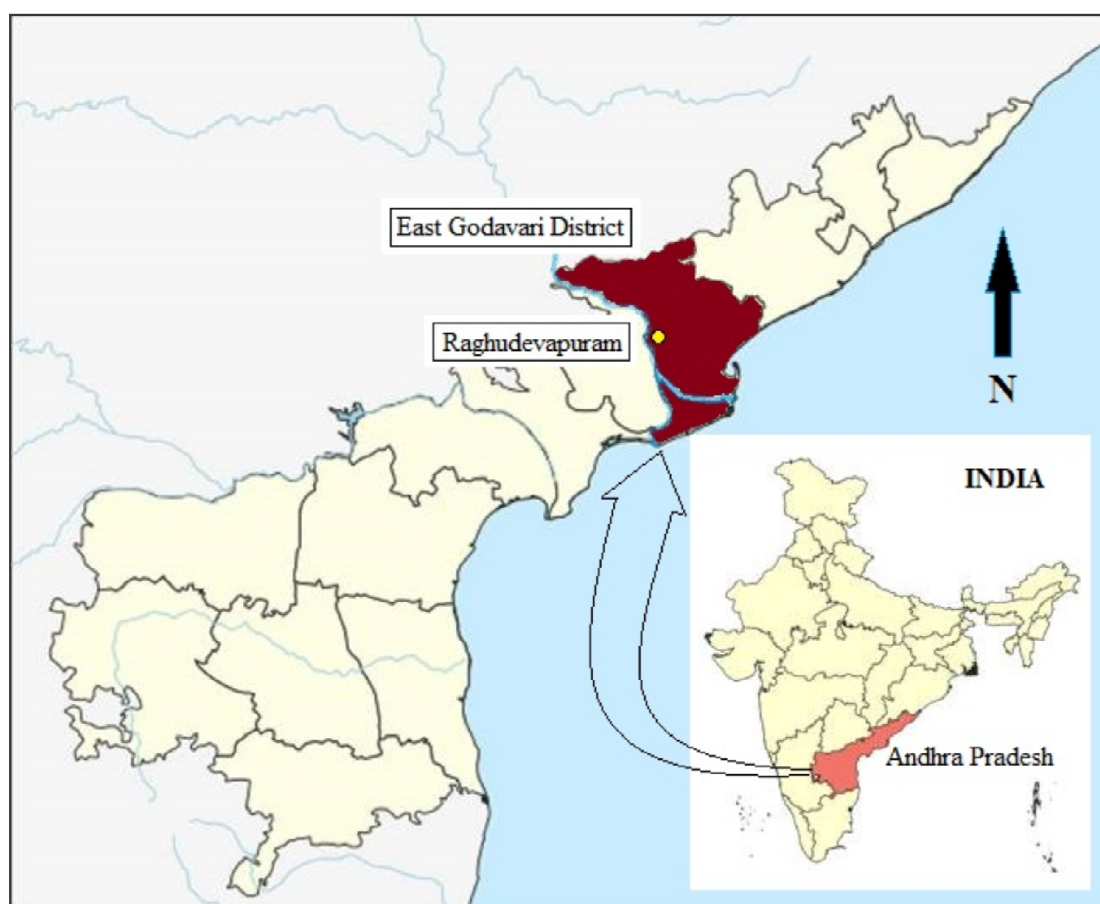


Figure 1. Showing location of Raghudevapuram (2 km north of Sudda-Meta locality), East Godavari district, Andhra Pradesh.



Figure 2. Sudda-Meta hillock, 2 km south of Raghudevapuram, East Godavari District, Andhra Pradesh, from where plant fossils were collected.

(1984) from Kutch, Gujarat; Baksi (1968) from Raghavapuram, West Godavari district, Andhra Pradesh, Dev and Rajanikanth (1988) from Gangapur Formation, Andhra Pradesh; and Dev and Rajanikanth (1988) from Sivaganga Formation, Tamil Nadu. Presence of this specimen in Sudda-Meta, supports common and wider occurrence of *Ptilophyllum cutchense* in India.

Ptilophyllum* sp. cf. *P. institacallum Bose 1959

Figure 3.2

Figured specimen No.: SM/1/2012.

Description: The specimen is a pinnate frond measuring 5.5×1 cm, rachis almost curved from bases of pinnae, pinnae are broad, linear and somewhat falcate, measuring 1.5×0.3 cm. Apex is sub-acute, veins are parallel.

Comparison: The leaf agrees with morphological characters of *P. institacallum* described by Bose (1959) from Sehora in Madhya Pradesh. He also described the cuticle of this taxon. Our specimen is devoid of cuticle, hence described as *Ptilophyllum* sp. cf. *P. institacallum* Bose. It also resembles with *P. institacallum* described by Mahabale and Satyanarayana (1979) from Raghudevapuram in East Godavari district of Andhra Pradesh. Present specimen is also recorded from the same place and supports the occurrence from the locality Sudda-Meta

Genus – *Pterophyllum* Brongn. 1828

***Pterophyllum* sp.**

Figure 3.3

Figured specimen No.: SM/9/2010.

Description: The specimen is a fragmentary frond

measuring 3 cm in length and 1.4 cm in breadth. Rachis 3 mm thick, longitudinally striated, pinnae closely set and attached laterally to the rachis at an angle of 60°. Pinnae are straight with parallel margin, apex not known. Number of veins is 10 per pinna, simple and parallel.

Comparison: The specimen generically agrees with characters of *Pterophyllum* given by Bose and Banerji (1981) in lateral attachment of the pinnae to the rachis and simple parallel veins which are 10 in number; hence it is identified with it. Though present specimen closely resembles with the description of *P. kingianum* Feistm. as described by Bose (1974) from Gollapalli in Andhra Pradesh. However, due to its fragmentary nature species rank is not given and it is described as *Pterophyllum* sp. The plant is common on the east coast. It is a new report from this area.

Genus: *Otozamites* Braun 1843

Otozamites sp.

Figure 3.4

Figured specimen No.: SM/18/2011.

Description: The specimen is a pinnate leaf measuring 5.6 cm in length and 2 cm in width. Rachis is 3 mm thick concealed by pinnae bases. Pinnae are closely set and alternately arranged. They are attached to the rachis by auriculate base. Shape of pinnae is rhomboidal and falcate. They measure 1 cm long and 0.4 cm wide. Apex obtuse, veins 4–5 emerging from base radiating and show forking.

Comparison: The specimen agrees with the generic characters of *Otozamites* Braun in having auriculate base, radiating veins and other characters. It is compared with *Otozamites kachchhensis* described by Bose and Banerji (1984) from Kakadbhit in Kachchh in having shape of pinnae, number of veins, type of apex and its cuticular characters. Present leaf is

devoid of cuticle hence it is described as *Otozamites* sp. This leaf is a new report from Sudda-Meta.

Genus: *Williamsonia* Caruthers 1870

Williamsonia blanfordii Feistm. 1876

Figure 3.5

Figured specimen No.: SM/14/2011.

Description: The specimen is a female flower measuring 2.0 cm in length and 4 cm in width, perianth is uniseriate made up of 8 bracts. They are spirally arranged. Bracts linear in shape and measure 2.5 cm long and 0.5 cm broad, bracts gradually tapering towards apical region. Apex is obtuse, receptacle dome shaped. Semiferous and interseminal scales are marked by tubular structures on the bracts.

Comparison: The specimen resembles with *Williamsonia blanfordii* described by Feistmantel (1876) from Kachchh. It is also reported from Kachchh by Bose and Banerji (1984). There is no published account of *Williamsonia* from Sudda-Meta.

Genus: *Taeniopteris* Brongn. 1832

Taeniopteris spatulata McClell. 1850

Figure 3.6

Figured specimen No.: SM/3/2012.

Description: Ten specimens of *Taeniopteris* leaves were collected from this locality as impressions. The leaves are simple, strap shaped with distinct midrib. Length ranges from 1.5 to 5.1 cm and the breadth ranges from 0.6 to 1.8 cm. Lateral veins arise from the midrib at an angle of 80–90°, parallel and forked near the midrib. Apex is obtuse. Petiole is present in one specimen.

Comparison: The leaf resembles with morphological characters of *T. spatulata* as given by Bose and Banerji (1981) and identified with it. The leaf



Figure 3. 1. *Ptilophyllum cutchense* Morris 1840, $\times 2.75$; Specimen No.: SM/5/2011. 2. *Ptilophyllum* sp. cf. *P. institacallum* Bose 1959, $\times 3$; Specimen No.: SM/1/2012. 3. *Pterophyllum* sp. $\times 2$; Specimen No.: SM/9/2010. 4. *Otozamites* sp. $\times 1.50$; Specimen No.: SM/18/2011. 5. *Williamsonia blanfordii* Feistm. 1876, $\times 2$; Specimen No.: SM/14/2011. 6. *Taeniopteris spatulata* McClell. 1850, $\times 1.75$; Specimen No.: SM/3/2012. 7. *Elatocladus plana* (Feistm.) Seward 1919, $\times 3$; Specimen No.: SM/14/2010. 8. *Elatocladus tenerrimus* (Feistm.) Sahnii 1928, $\times 3.50$; Specimen No.: SM/19/2010. 9. *Desmophyllum indicum* Sahnii 1928, $\times 1.25$; Specimen No.: SM/11/2011.



Figure 3

is widely distributed in Upper Gondwana flora of India. It is found in Bihar, Madhya Pradesh, Kachchh, Andhra Pradesh and Tamil Nadu. Abundance of *Taeniopteris* confirms presence of *Ptilophyllum* flora. It is quite common in this locality.

Class: *Pinopsida* Doweld

Order: *Pinales* Dumort.

Family: *Podocarpaceae* Endl.

Genus: *Elatocladus* T. Halle 1913

Elatocladus plana (Feistm.) Seward 1919

Figure 3.7

Figured specimen No.: SM/14/2010.

Description: The specimen is an unbranched leafy shoot measuring 2.1×1.9 cm. Leaves are linear closely set 1.2×0.2 cm. Stem 2 mm thick, leaves are spirally arranged and spread in one plane attached to the stem by entire base. Apex is sub-acute. Leaf shows a distinct median vein.

Comparison: The specimen resembles with the morphological characters of *E. plana* given by Sahni (1928). The important character is that the leaves are spread in one plane. Bakshi (1968) reported it from Raghavapuram shales in West Godavari district; Mahabale and Satyanarayana (1979) described it from East Godavari district. Vagyani and Jamane (1987) described it from Uppugunduru in Prakasam District of Andhra Pradesh. It is quite common and widely distributed in the east coast of India.

Elatocladus tenerrimus (Feistm.) Sahni 1928

Figure 3.8

Figured specimen No.: SM/19/2010.

Description: The specimen is a leafy shoot measuring 2 cm long and 1.9 cm broad. The stem is 1 mm thick and longitudinally striated. Leaves are spirally arranged and spread in two rows. They are lanceolate and measure 0.8×0.2 cm. Apex is absent. Leaf shows distinct midvein.

Comparison: The specimen resembles in its morphological characters with *E. tenerrimus* and hence it is identified with it. Dev and Rajanikanth (1988)

reported it from Sivaganga Formation in Tamil Nadu. It is reported for the first time from Sudda-Meta locality.

Family: *Araucariaceae* Henckel & Hochst.

Genus: *Desmiophyllum* Lesq. 1878

Desmiophyllum indicum Sahni 1928

Figure 3.9

Figured specimen No.: SM/11/2011.

Description: The specimen is a strap shaped leaf. It measures 7 cm long and 1.4 cm broad. Apex is rounded and margins are entire. It shows 11 parallel veins.

Comparison: The genus represents a linear leaf showing parallel venation. The mode of attachment is not clear. Sahni (1928) described *Desmiophyllum indicum* from the Jabalpur Formation, Sher River in Satpura basin and Bansa in South Rewa district of Madhya Pradesh. Our specimen agrees with it. According to Sahni (1928) affinities of leaf shows a wide range, namely *Cycadales*, *Pinales*, *Ginkgoales* and *Cordaitales*. Bose (1974) considers it as a member of *Araucariaceae*. Vagyani (1984) described it from Vemavaram in Andhra Pradesh. Present specimen is the first report of *Desmiophyllum indicum* from Sudda-Meta hillock.

DISCUSSION

Plant megafossils are the true relics of past vegetation and diversity of plant groups. Their preservation is influenced by sedimentation and climatic factors. The present flora was compared with earlier described floras from East Godavari district, Andhra Pradesh. The flora is represented by gymnosperms and suggests warm and humid climate during their sedimentation. The cycadopsids are represented by *Ptilophyllum catchense* Morris, *Ptilophyllum* sp. cf. *P. institacallum* M.N. Bose, *Pterophyllum* sp., *Otozamites* sp., *Williamsonia blanfordii* Feistm. and *Taeniopteris spatulata* McClell.; whereas pinopsids are represented by *Elatocladus plana* (Feistm.) Seward, *Elatocladus tenerrimus* (Feistm.) Sahni and *Desmiophyllum indicum* Sahni. The fossil assemblage indicates an early Cretaceous age.

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