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Occurrence of a cyprinid fish (Leuciscinae) from latest Neogene (?Pliocene) sediments of Chotanagpur plateau, eastern India

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A compressed fossil fish bearing close resemblance to sub-family Leuciscinae (family: Cyprinidae) is reported from latest Neogene (?Pliocene) sediments of Chotanagpur plateau, eastern India. The recovered fossil fish contains exceptionally well-preserved skeleton. It

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is characterized by compressed belly, medium-sized head, well-preserved skull, ten caudal vertebrae, moderately long vertebral spines, cycloid scales, and well-preserved dorsal, pectoral, pelvic, anal and caudal fins. The fossil material and associated angiospermic flora indicate the existence of Leuciscinae and freshwater lacustrine environment (with intermittent fluvial incursions during flood events) in the Chotanagpur plateau during the depositional period.

Keywords: Angiospermic flora, fossil fish, freshwater, lacustrine environment.

THE Chotanagpur Plateau in the eastern part of the Indian peninsula, covers an area of about 75,000 sq. km with an average elevation of 600–800 m amsl (ref. 1). Geologically, it consists of Dharwar rocks, Archaean granites (Singhbhum granite batholith) with some sedimentary and metamorphic deposits of iron ore. This plateau is blessed with rich natural resources, fertile soils and forests rich in floristic composition. The Chotanagpur plateau was uplifted during the Cenozoic, which was marked by numerous geomorphic features like waterfalls, rapids, river terraces, etc.².

The study area, Mahuadanr valley, Chotanagpur plateau Jharkhand, represents latest Neogene sedimentary deposits of fluvial origin^{3,4}. The sediments of the area are mainly exposed along the banks of Birha River and its tributaries, extending about 2.6 km in length and 1.5 km wide. The Precambrian Chotanagpur gneiss forms the basement for the deposition of these sediments. The stratigraphic sequence includes lithologies like pyroclastic sediments, conglomerates, sandstones and shales (Figure 1). The studied sedimentary section covers a length of about 50 m and reaches a maximum thickness of 5 m. The lithology comprises of mostly shale and sandstone (Figure 2). The type of shale varies from arenaceous to clayey. The sandstone occurs interbedded between the shale layers. Mudballs having round to elliptical shape also occur embedded in this sandstone unit. The upper fossiliferous unit of 0.5 m contains abundant fossil biota, including angiosperm leaf impressions and compressions, fruit remains, flowers, wood and fish remains. Earlier workers have assigned a latest Neogene to this sedimentary section³⁻⁵. The sediments are usually regarded to be of Pliocene age⁴⁻⁶, but till date there is no definitive evidence for the same. Prior to this report, the sedimentary section was already studied for its vertebrate faunal content of fishes and birds³. Puri and Mishra³ reported fossil fish remains having affinity with modern fishes of the Clupidae family from the latest Neogene sediments of Latehar district, Jharkhand. Here we describe the remains of a well-preserved compressed fish closely resembling the modern fishes of sub-family Leuciscinae from the same locality. This is an authentic record of Leuciscinae fish from Cenozoic sediments of India. Modern Leucisci-

nae belong to one of the main branches of cyprinids and are further composed of secondary branches with clade names Barilini, Rasborini, Cultrini, Acheilognathini, Leuciscini and Phoxinini. The leuciscine has a characteristic mechanism of swimming with its head lifted above the water and its mouth opened to prey upon aquatic and terrestrial insects.

During fieldwork (May 2019), we collected a well-preserved fossil fish specimen with complete skeleton from latest Neogene sediments (?Pliocene) of Mahuadanr valley (23.40°N, 84.11°E; altitude 353 m amsl) (Figure 1)⁷. The fossil fish was carefully recovered using chisel and shovel. After cleaning, macroscopic images of the specimen were photographed using a digital camera (Canon Power Shot A720IS) (Figure 3). The underlying and overlying horizons of the same formation also contained numerous fossil angiospermic leaf remains. The fossil specimen (SKBUH/PPL/JH/FH1) is kept at the Herbarium and Museum, Department of Botany, Sidho-Kanho-Birsha University, Purulia, India (SKBUH). A thorough morpho-anatomical description of the fossil specimen is presented below.

Body moderately deep, compressed belly, length 23 cm and width 6.5 cm; head moderate in size, skull bones well-preserved, 2.5 cm; mouth terminal and mouth gape oblique; parietals seemingly visible, but the structure deformed; the abdominal vertebra disarticulated and displaced anteriorly, nearly about 10 caudal vertebrae well-preserved and articulated in a straight vertebral column, the vertebral column almost elevated anteriorly; the vertebral spines moderately long, relatively slender and almost straight; scales cycloid; dorsal, pectoral, pelvic, anal and caudal fins well-preserved; dorsal fin situated closer to the base of the caudal fin and posterior to pelvic fin that arises near the middle part of the body on dorsal side, approximately 10 fins are visible; pectoral fin preserved, situated posterior to skull, short, pectoral fin rays seemingly visible; pelvic fin situated near the ventral body margin, nearly eight fin rays that are segmented distally; anal fin base long, situated posterior to ventral margin of body with distinct fin rays; caudal fin moderately large, deeply forked with the upper and lower lobes of equal length with more than thirty fin rays, segmented from middle parts, caudal peduncle not constricted.

The above-mentioned morpho-anatomical features of fish specimen suggest its closest resemblance to those of the modern fish members of Leuciscinae. On the basis of morphological description and comparison with data on the morphology of recent Indian fishes, this fossil specimen shows resemblance to the modern genera *Abramis* Cuvier, *Blicca* Heckel, *Chondrostoma* Agassiz and *Leuciscus* Cuvier belonging to the sub-family of freshwater fishes, Leuciscinae. However, we need more samples and further morphometric analyses to confirm the exact generic affinity. Imoto *et al.*⁸ suggested that an ancestral species of Leuciscinae originated in Late Cretaceous of

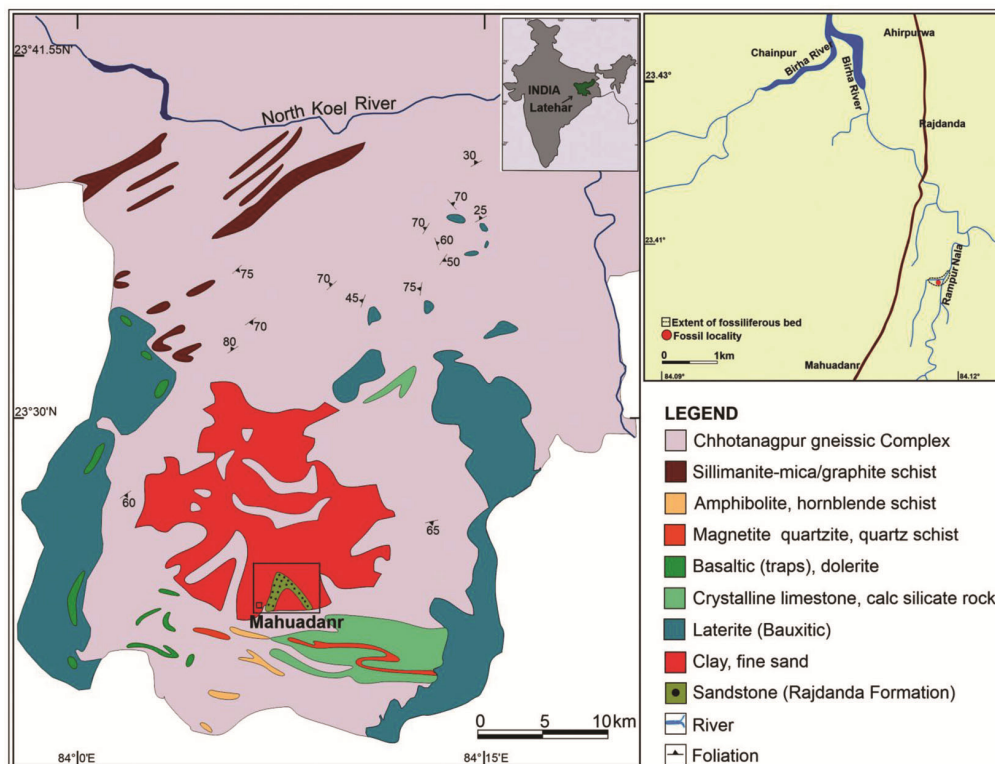


Figure 1. Geological map (modified District Resource Map of Palamu and Garhwa, Jharkhand published under the direction of Director General, Geological Survey of India) and fossil locality map of the area near Mahuadanr, Latehar district, Jharkhand (modified from Toposheet No. F45A3, Survey of India).

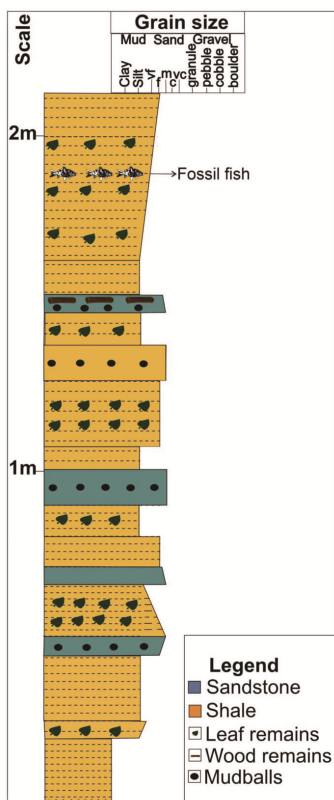


Figure 2. Composite graphic litholog of exposed sedimentary section using software SedLog 3.0.

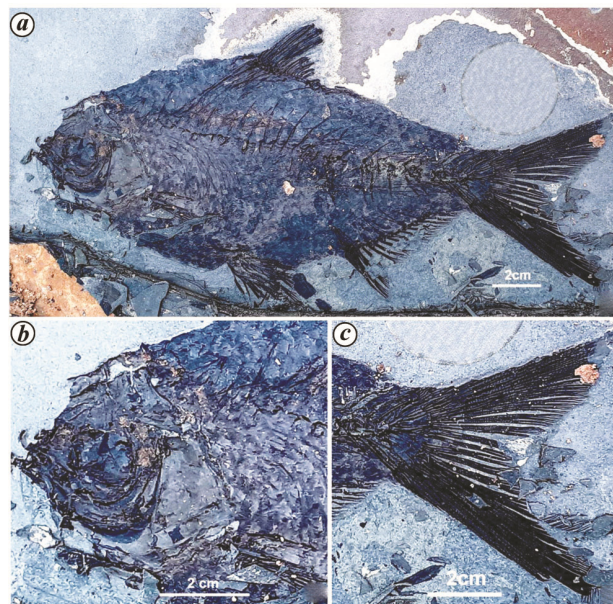


Figure 3. a, Recovered fossil fish specimen (SKBUH/PPL/JH/11). b, Enlarged view of skull of fossil specimen. c, Enlarged view of tail segment of fossil specimen.

Europe based on phylogenetic analysis. However, the oldest fossil record of cyprinid identified as '*Blicca croydonensis*' and having affinity with Leuciscinae fishes comes from early Eocene Woolwich Beds of the London

Basin⁹. However, the identification is still questionable. An ancestral species of Leuciscinae originated in Late Cretaceous (70.7 Mya)⁸. Leuciscinae were reported from Oligocene of Europe^{10,11}. It has been recorded from Miocene of Shanwang Formation, Shanwang, Linqu city, Shandong Province, China¹²; Turkey¹³ and Germany¹⁴. Leuciscinae has also been reported from Pliocene of China¹⁵. However, there are meagre records of cyprinid fossils from India. The fossil cyprinid fish scale comes from the lower Palaeogene (Palaeocene?) sediments of the Deccan intertrappean beds, Central India¹⁶. Till date there is no record of body fossil fish Leuciscini from India. However, fossil fish evidences of other families have been reported from Eocene sediments of Khuiala Formation of the Jaisalmer Basin, Vastan lignite mine, Panandhro lignite mine, western India¹⁷⁻¹⁹ and freshwater Siwalik deposits (Plio-Pleistocene) of north western India^{20,21}. Marine fishes (*Decapterus* (?) *mizoramensis*, *Pentaprion sahnii* and *Bothus* (?) *bhubanicus*) were recorded from Miocene sediments of Surma Group, Mizoram, North East India²². The fish specimen described here is morphologically different from the aforementioned fossil fishes from India, and shows closest resemblance to the modern fish members of Leuciscinae.

Leuciscinae fishes being intolerant to salt water are mainly restricted to freshwater^{9,23}. So, the present evidence of fossil cyprinid may reflect existence of freshwater lacustrine environment. The fish specimen was found associated with prolific and diversified tropical angiospermic plant remains. Plant remains are represented by abundant dicot and monocot leaves, fruit and wood remains. In addition, evidence of abundant aquatic grasses from the fossil locality also suggests a freshwater environment of deposition. So, the presence of tropical terrestrial plants and freshwater vertebrate remains suggests mixing of fauna and flora in fully shallow freshwater conditions. More in-depth anatomical study is necessary for identification of the specimen up to genus as well as species level. Further, geochemical analysis of body parts of the fish remains is yet to be done. We hope that this study provides a launching pad for further detailed studies of the newly collected materials which will provide a clear picture of their morphology, phylogeny and palaeobiogeographical implications in a not-too-distant future.

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