



Revisiting the systematic positions of two “*Notocupes*” species from the Lower Cretaceous of South China (Coleoptera: Polyphaga)

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Artematopodidae is a small family with approximately 70 described extant species (Gimmel & Bocakova 2015), occupying a basal position in the superfamily Elateroidea (McKenna *et al.* 2019). The fossil record of artematopodids is sparse, with most species described from the Eocene/Oligocene Baltic amber (Crowson 1973; Hörnschemeyer 1998). Nevertheless, in the past few years, definitive artematopodid fossils have also been reported from the Middle-Late Jurassic Daohugou biota (Cai *et al.* 2015), the Early Cretaceous Jehol biota (Cai *et al.* 2020), and the Miocene Mexican amber (Wu *et al.* 2015). Here we re-examine two fossil specimens from the Lower Cretaceous of South China, which were assigned to the archostematan genus *Notocupes* Ponomarenko by Lin (1980), i.e., *Notocupes undatabdominus* and *N. ? multituberatus*. Our new observation suggests that both specimens do not belong to *Notocupes*. *Notocupes undatabdominus* could belong to the polyphagan family Artematopodidae, and *Notocupes multituberatus* probably belongs to Lasiosynidae.

Material and methods

The fossils of “*Notocupes*” *undatabdominus* (NIGP38559; Figs 1–2) and “*N.*” *multituberatus* (NIGP38565; Fig. 3) originate from the Shouchang Formation at Xiaqiao Village, Laozhu Town, Lishui City, Zhejiang Province, China (Lin 1980), which has been dated to the Aptian of Early Cretaceous (Li *et al.* 2018). Both specimens are deposited in the Nanjing Institute of Geology and Palaeontology (NIGP), Chinese Academy of Sciences, Nanjing, China.

Photographs under incident light were taken with a Zeiss Discovery V20 stereo microscope and stacked in Helicon Focus 7.0.2. Scanning electron microscopic (SEM) images were obtained with a Hitachi SU 3500 scanning electron microscope, operating with an accelerating voltage of 15 kV and a pressure of 80 Pa. Images were further processed in Adobe Photoshop CC to enhance contrast.

Results and discussion

Although “*Notocupes*” *undatabdominus* and “*N.*” *multituberatus* share a somewhat superficially similar body shape with *Notocupes*, they clearly differ with the latter in many critical characters. In *Notocupes*, the elytra have relatively large, maculated window punctures, and the elytral epipleura are relatively wide, each with one row of window punctures. By contrast, “*N.*” *undatabdominus* and “*N.*” *multituberatus* do not possess such window punctures or wide elytral epipleura (Figs 1, 3A). Additionally, in *Notocupes*, the abdominal ventrites are overlapping, and there is no mesoventral cavity for reception of the prosternal process, whereas in “*N.*” *undatabdominus*, the ventrites seem to be connate (Fig. 2D), and there is a distinct mesoventral cavity for reception of the prosternal process (Fig. 2B). Therefore, both fossil species clearly do not belong to *Notocupes*.

Kirejtshuk (2020) also noticed that these two species are not members of *Notocupes*, but he didn’t transfer them into any other formal group and left them without subordinal and familial attribution. Here we suggest that “*N.*” *undatabdominus* belongs to the elateroid family Artematopodidae. The prosternum of “*N.*” *undatabdominus* has a pair of longitudinal carinae (Fig. 2A), which is characteristic of Artematopodidae (Lawrence 2010). Similar well-developed prosternal

carinae also occur in Throscidae and some members of Elateridae. However, the fossil can be easily separated from these families by its body shape (e.g., prothorax distinctly narrower than elytral width across humeri). Besides, the strongly curved suture between abdominal ventrites 4 and 5 is also indicative of placement in Artematopodidae (Fig. 2D). Currently there are three subfamilies in Artematopodidae (Lawrence 2005). “*N.*” *undatabdominus* differs from Electribiinae in the absence of the transverse groove on the pronotum, and from Allopogoninae in having distinct paired prosternal carinae. Unfortunately, the specimen of “*N.*” *undatabdominus* is not well preserved, making it difficult to further compare the fossil with other genera in Artematopodinae.



FIGURE 1. General habitus of “*Notocupes*” *undatabdominus*, holotype, NIGP38559, under incident light, with prosternal carinae (arrowhead in **A**) and the curved suture between ventrites 4 and 5 (arrowhead in **B**) highlighted. Arrows indicate the direction of light. Abbreviations: el, elytron; msc, mesocoxa; msvc, mesoventral cavity; mtc, metacoxa; v3–5, ventrites 3–5. Scale bars: 1.5 mm.

The holotype of “*N.*” *multituberculatus* is even worse preserved than that of “*N.*” *undatabdominus*. The ventral characters of “*N.*” *multituberculatus* are essentially missing, making it hard to accurately determine its systematic position. Nevertheless, based on the general appearance and elytral morphology, “*N.*” *multituberculatus* could belong to the fossil taxon Lasiosynidae. Each elytron of “*N.*” *multituberculatus* has approximately 11 rows of longitudinal striae (Fig. 3A), with stria 2 (or perhaps stria 3) shortened posteriorly and outer striae not extending to the shoulder region anteriorly (Fig. 3C). These features correspond well to the diagnostic features of Lasiosynidae (Kirejtshuk *et al.* 2010; Yan *et al.* 2014). We further tentatively transfer “*N.*” *multituberculatus* into genus *Lasioisyne*, as *Lasioisyne multituberculata* **comb. nov.**

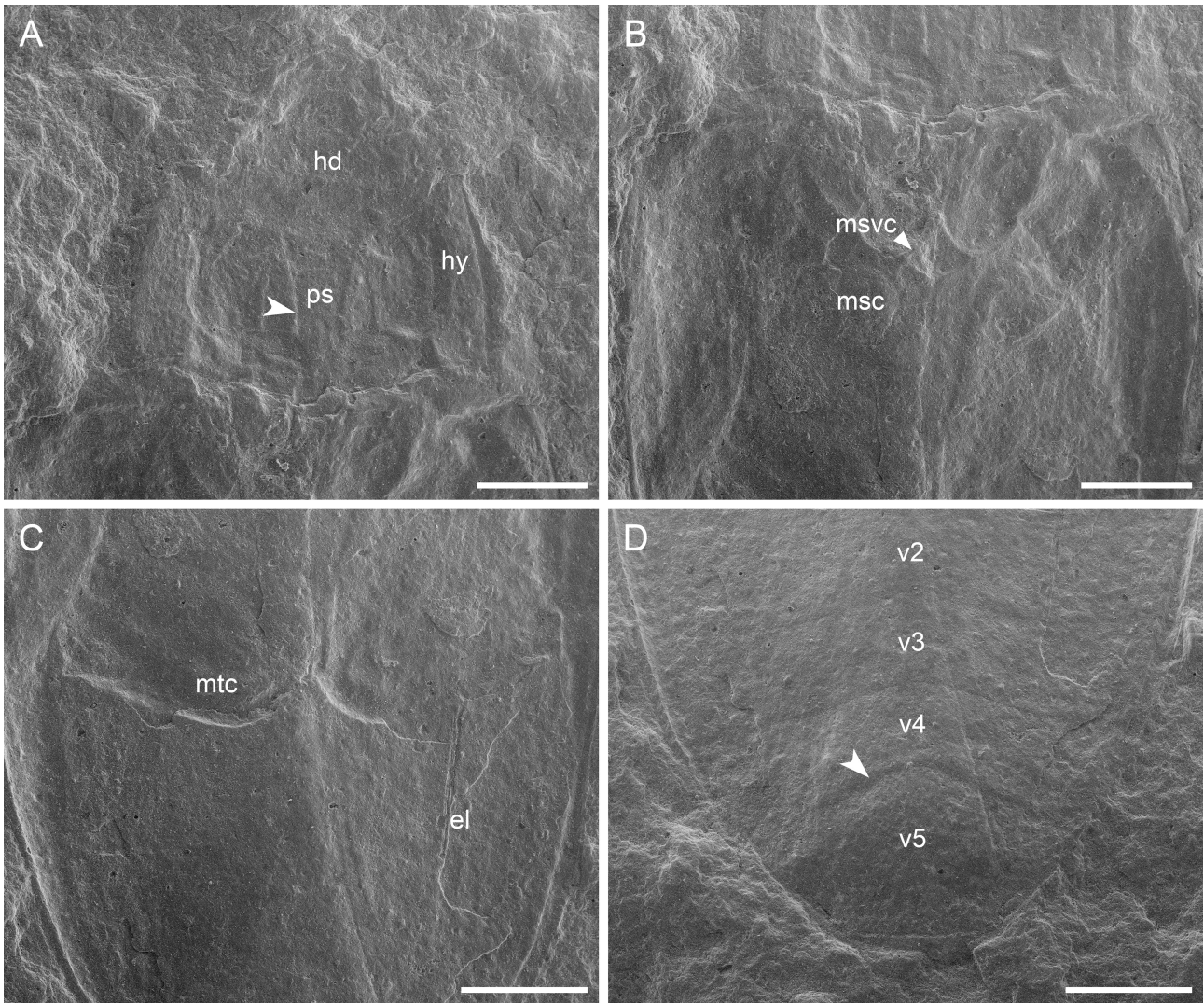


FIGURE 2. Details of “*Notocupes*” *undatabdominus*, holotype, NIGP38559, under scanning electron microscopy. **A**, Head and prothorax, showing the prosternal carinae (arrowhead). **B**, Mesothorax. **C**, Metacoxae and abdominal base. **D**, Abdominal apex, showing the curved suture between ventrites 4 and 5 (arrowhead). Abbreviations: el, elytron; hd, head; hy, hypomerion; msc, mesocoxa; msvc, mesoventral cavity; mtc, metacoxa; v2–5, ventrites 2–5. Scale bars: 600 μ m.

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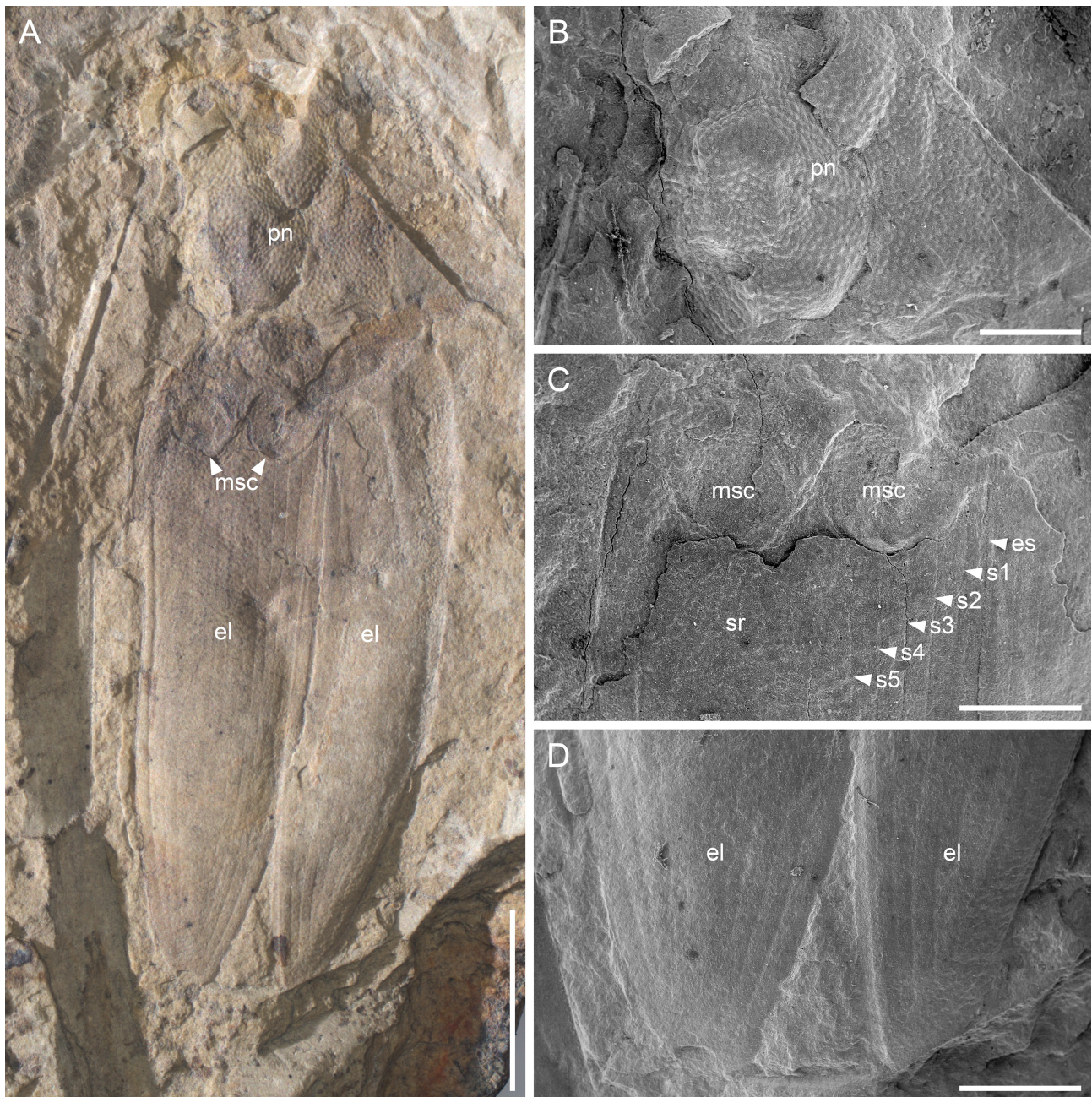


FIGURE 3. *Lasiosyne multituberala* **comb. nov.**, holotype, NIGP38565, under incident light (**A**) and scanning electron microscopy (**B–D**). **A**, Habitus. **B**, Prothorax. **C**, Mesocoxae and elytral base. **D**, Elytral apex. Abbreviations: el, elytron; es, elytral suture; msc, mesocoxa; pn, pronotum; s1–5, striae 1–5; sr, shoulder region. Scale bars: 3 mm in **A**, 1 mm in **B–D**.

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