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Zoropelecinus zigrasi, a pelecinid wasp in mid-Cretaceous amber from Myanmar (Hymenoptera: Pelecinidae)

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Abstract. The proctotrupoid wasp family Pelecinidae (Proctotrupomorpha: Proctotrupoidea) is recorded in Early Cretaceous amber for the first time, previous amber inclusions being from the Late Cretaceous or Tertiary. ***Zoropelecinus zigrasi*** Engel & Grimaldi, new genus and species, is described and figured from an exquisitely preserved female in Albian-Cenomanian amber from Myanmar. The genus is similar to other fossil pelecinids of the genera *Pelecinopteron* Brues (Paleogene ambers of the Baltic and Siberia) and *Henopelecinus* Engel & Grimaldi (Turonian amber, New Jersey). Although two subfamilies have at times been recognized (or even treated as two families), the Iscopininae are clearly paraphyletic with respect to Pelecininae and therefore of no classificatory value, and are accordingly synonymized herein (**new synonymy**).

INTRODUCTION

The wasp family Pelecinidae (Proctotrupoidea) is today a meager shadow of what was previously a more widely distributed and morphologically disparate lineage. The three living species are restricted to the New World and classified within a single genus, *Pelecinus* Latreille, while fossil pelecinids are known from Eurasia and comprise a growing diversity of species documented from the mid-Paleogene through to the Middle Jurassic (Appendix). Quite unlike their modern counterparts, however, the fossil species are all rather diminutive, the largest amber species being *Pelecinopteron tubuliforme* Brues from the Eocene of Europe which ranges from 10–15 mm in total length

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(Brues, 1933; Engel, 2002) and the largest compression being *Eopelecinus yuanjiawaensis* Duan & Cheng from the Early Cretaceous Yixian Formation of China at slightly more than 23 mm in length (Duan & Cheng, 2006; Zhang *et al*., 2002). This size is still slight by comparison with the 25–60 mm lengths of the modern fauna. It seems evident that there was a steady increase in size via phyletic giantism (*sensu* Gould & MacFadden, 2004) across the Cenozoic. Modern pelecinids are parasitoids of scarabs, the elongate metasoma of females being used to oviposit directly onto beetle larvae within the soil. Since this distinctive metasomal morphology is similarly present in most of the known fossils, it may be relatively safe to assume (as an initial working hypothesis) that they held a related mode of life and host preference. Indeed, parasitoidism of scarabeids is likely plesiomorphic among the Pelecinidae, although this life-history trait is itself an apomorphic shift from the more broadly plesiomorphic condition among most parasitoid Apocrita of victimizing wood-boring beetles.

Herein we report the recent discovery of a single female pelecinid in amber from Myanmar (Fig. 1), extending the amber record of this family into the later part of the Early Cretaceous. The species exhibits typical features of the family characterized on the basis of Late Cretaceous, Tertiary, and Recent taxa, and is presently the oldest known material of Pelecinidae preserved in amber.

MATERIAL AND METHODS

The age, origin, and paleofauna of Burmese amber has been reviewed most recently by Grimaldi *et al*. (2002), Cruickshank & Ko (2003), Ross *et al*. (2010), and Shi *et al*. (2012). Photomicrography and measurements were done with Nikon SMZ1500 stereomicroscope and NIS-Elements software. Format and terminology for the descriptions follows that of Johnson (1998), Johnson & Musetti (1999), Engel (2002), and Engel & Grimaldi (2006). There has been some disagreement regarding the recognition of forewing vein Rs2, with some authors treating this as an incomplete rs-m crossvein – for the sake of consistency, we follow Zhang & Rasnitsyn (2004) in the use of Rs2, and these authors have also illustrated vein nomenclature for the group.

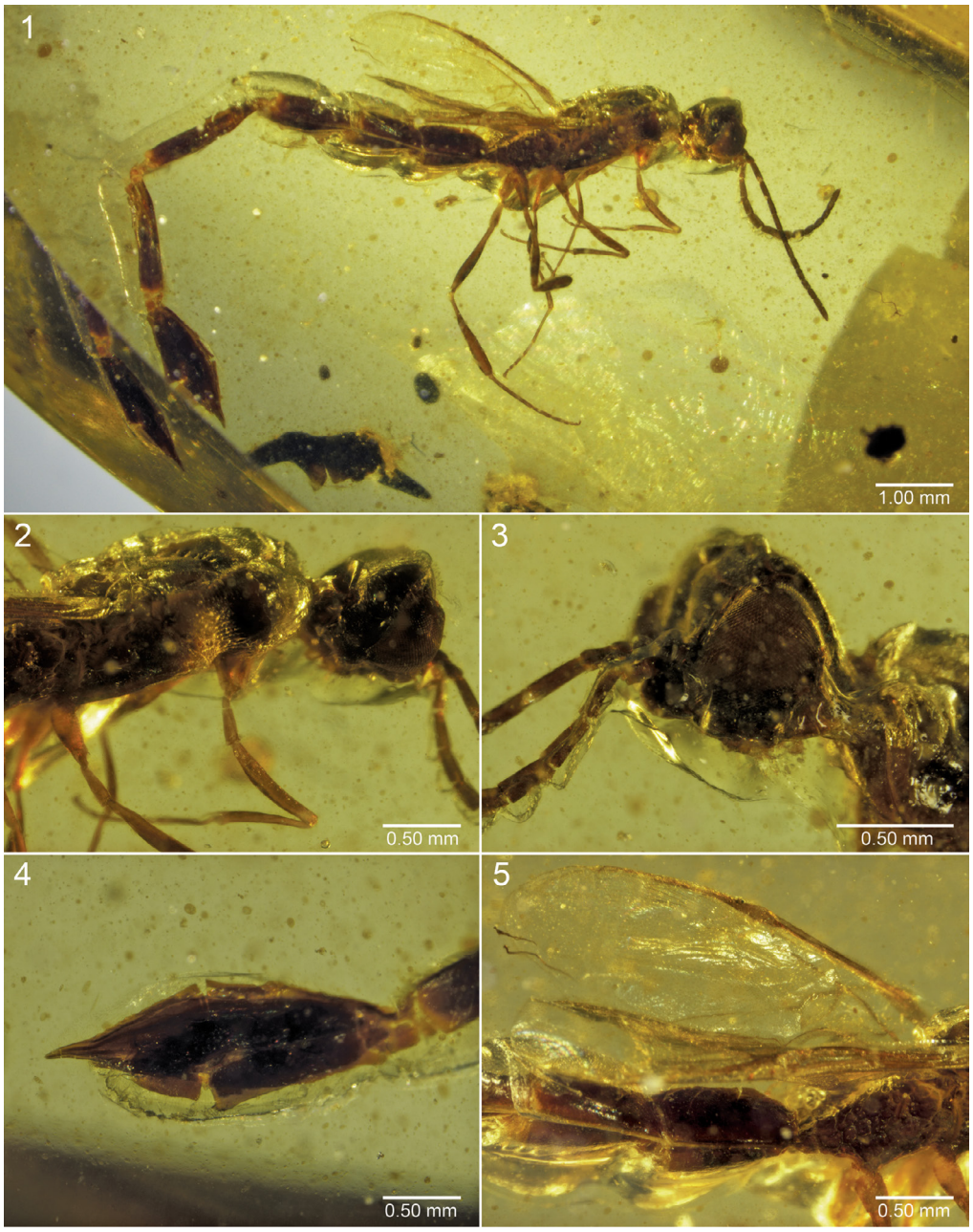
SYSTEMATIC PALEONTOLOGY

Family Pelecinidae Haliday

Pelecinidae Haliday, 1839: ii. Type genus: *Pelecinus* Latreille, 1800.
Pelecinopteridae Brues, 1933: 17. Type genus: *Pelecinopteron* Brues, 1933.
Iscopininae Rasnitsyn, 1980: 86. Type genus: *Iscopinus* Kozlov, 1974. **New synonymy**.

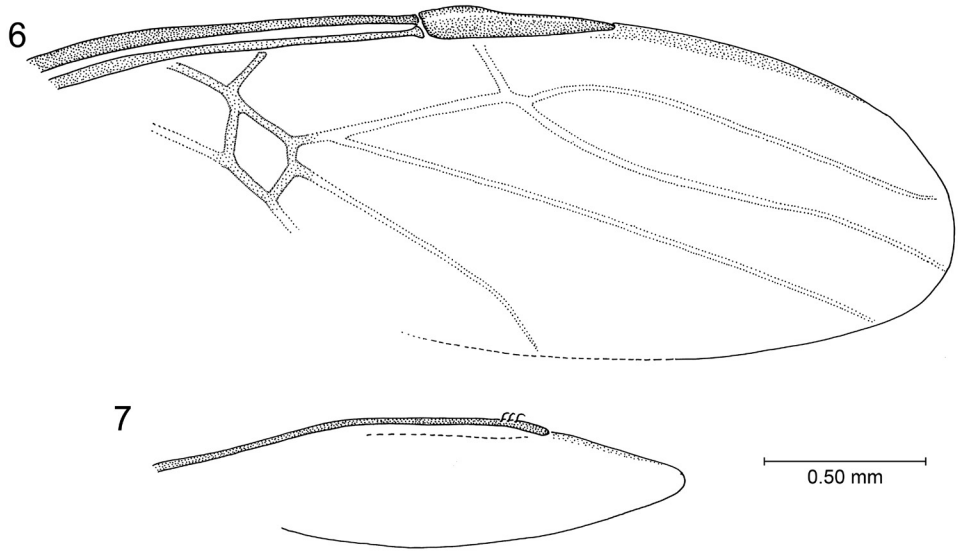
DIAGNOSIS: Body length in extant taxa large (*ca*. 25–60 mm), variable among fossil species (*ca*. 5–23 mm). Forewing frequently with Rs forked, Rs1 forming closed marginal cell in basal taxa, becoming more diffuse and extending toward wing apex in crown-group lineages; Rs2 sometimes absent or present only as a stub, otherwise elongate and extending as a diffuse vein toward wing apical margin. Female metatibia frequently clavate; metabasitarsus relatively short. Female metasoma elongate, slender; male metasoma frequently shorter and pedunculate but sometimes elongate as in female.

COMMENTS: Aside from the living genus *Pelecinus* and its three species (Johnson & Musetti, 1999), the currently included fossil genera and species are outlined in the



Figures 1–5. Photomicrographs of holotype female (JZC-Bu229) of *Zoropelecinus zigrasi*, new genus and species. **1.** Right lateral aspect of holotype female. **2.** Right lateral aspect of head and mesosoma. **3.** Left lateral aspect of head. **4.** Apicalmost metasomal segment. **5.** Basal two metasomal segments and posterior of mesosoma.

appendix. Several of the genera and species described as compressions with trivial differences from the Early Cretaceous of Asia should perhaps be synonymized but this must await a thorough revision of those faunas.



Figures 6–7. Wing venation of *Zoropelecinus zigrasi*, new genus and species; tubular veins indicated by solid lines, nebulous veins with a dashed outline, and pigmentation with stippling. **6.** Forewing. **7.** Hind wing.

Zoropelecinus Engel & Grimaldi, new genus
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TYPE SPECIES: *Zoropelecinus zigrasi* Engel & Grimaldi, new species.

DIAGNOSIS: ♀: Body size minute relative to modern species (*ca*. 12.7 mm). Antenna 14-segmented, positioned just below midpoint of face (Fig. 3); combined lengths of scape and pedicel slightly greater than length of first flagellomere; flagellomeres longer than wide; malar space short, slightly shorter than basal mandibular width; ocelli positioned above dorsal tangent of compound eyes; occipital carina present (Fig. 2). Pronotum relatively short, dorsal length much less than compound eye width, dorsally with posterior section transverse, not delimited by anterior carina, gently sloping anterior to posterior; mesoscutellum weakly arched. Forewing with venation largely nebulous except C and Sc+R sclerotized, membrane hyaline without infuscate patterning (Fig. 5); pterostigma elongate, tapering to point on anterior wing margin (Fig. 6); R not extending beyond pterostigma except as unsclerotized fuscous line on membrane at anterior wing margin; r-rs arising very slightly basad pterostigma midlength; no closed marginal cell; Rs forking basal to pterostigmal apex; Rs1 and Rs2 branches equal, with Rs1 basally arching toward anterior wing margin before extending out to wing apex; M and Cu reaching wing apex. Hind wing without venation except C along basal three-quarters of costal margin's length (Fig. 7); without closed cells; membrane hyaline. Metafemur slender, slightly expanded apically (not greatly clavate); metatibia slender, slightly expanded apically; tibial spur formula 1-2-2; metabasitarsus more than twice as long as metatarsomere II. Metasoma elongate (Fig. 1); first three segments longer than wide, thicker than remaining metasomal segments; fourth and fifth segments elongate, thin, and tubular; sixth segment elongate, expanded medially, tapering to apex (Fig. 4).

Etymology: The new genus-group name is a combination of *zoros* (Greek, "pure") and *Pelecinus* Latreille, type genus of the family. The name is masculine.

Comments: The new genus differs immediately from all other pelecinid genera in the swelling of the face below the antennal toruli and from the only other Cretaceous amber pelecinid, *Henopelecinus pygmaeus* Engel & Grimaldi in Turonian New Jersey amber, by the 14-segmented antenna and presence of an occipital carina. *Zoropelecinus* differs from *Pelecinopteron* Brues, from mid-Eocene Baltic amber, in the 14-segmented antenna and shorter first flagellomere (first flagellomere greatly longer than combined lengths of scape and pedicel in *Pelecinopteron*). From *Protopelecinus* Zhang & Rasnitsyn and *Shoushida* Liu *et al*. the new genus differs in the absence of a closed marginal cell, an apomorphic feature present in all of the amber and living species of Pelecinidae. *Zoropelecinus* differs from all other Mesozoic pelecinid wasps in the presence of a forked Rs (the simple Rs is one of the hallmark features of the Iscopininae but is clearly plesiomorphic and the iscopinines simply form a grade relative to the remainder of the family).

Zoropelecinus zigrasi Engel & Grimaldi, new species
ZooBank: urn:lsid:zoobank.org:act:EBF00CA1-DD35-41DD-BF31-27D7AAF0EEC2
(Figs. 1–7)

Diagnosis: As for the genus (*vide supra*).

Description: ♀: As described for the genus with the following additions: Total body length 12.7 mm; forewing length 3.0 mm. Integument dark brown throughout; setae short, simple and scattered. Head length 0.97 mm; compound eye length 0.59 mm, width 0.36 mm; integument of face imbricate with shallow, faint, small punctures separated by a puncture width or less; ocelli arranged in an equilateral triangle on dorsal surface of vertex, positioned above dorsal tangent of compound eye; gena narrower than compound eye in profile; frontal line distinctly impressed from median ocellus to point between antennal toruli; scape length 0.23 mm; pedicel length 0.13 mm; first and second flagellomeres each 0.26 mm in length; third and fourth flagellomeres each 0.23 mm in length; fifth and sixth flagellomeres each 0.20 mm; seventh flagellomere 0.18 mm; eighth through eleventh flagellomeres each 0.15 mm in length; twelfth flagellomere 0.20 mm in length. Mesoscutum with notauli deeply impressed and areolate, converging posteriorly, integument otherwise imbricate with small, faint punctures separated by 1–2 times a puncture's width; pleura with coarse, shallow, contiguous punctures; propodeum coarsely areolate. Metafemur shorter than metatibia, metafemur length 1.0 mm, metatibia length 1.3 mm; metabasitarsus length 0.69 mm; metatarsomere II length 0.26 mm; metatarsomere III length 0.20 mm; metatarsomere IV length 0.10 mm; metatarsomere V length 0.13 mm; pretarsal claws simple; arolium not greatly enlarged. Metasoma elongate; tergum I length 0.89 mm; tergum II length 0.97 mm; tergum III length 1.20 mm; tergum IV length 2.24 mm; tergum V length 1.66 mm; tergum VI length 1.89 mm; metasomal terga and sterna I–II distinct and not fused laterally, but segments IV–VI laterally fused; base of first metasomal tergum with very short, longitudinal rugae, otherwise metasoma imbricate and impunctate.

♂: Unknown.

Holotype: ♀, JZC-Bu229, mid-Cretaceous amber from Myanmar; in the private collection of Mr. James Zigras, available for study through the Division of Invertebrate Zoology, American Museum of Natural History, New York.

ETYMOLOGY: The specific epithet is a patronym honoring James S. Zigras, discoverer of this and many other outstanding inclusions in Mesozoic amber.

DISCUSSION

Given the potential diversity of pelecinid wasps now understood to have existed during the Cretaceous (Appendix) it is little wonder that a second species has now been recovered in amber from this period. In fact, it is instead more peculiar that a larger number of specimens and putative species have not been forthcoming given the vastness of the Burmese amber deposits and fauna. It is clear that the classification of Mesozoic Pelecinidae is over split and the plethora of species described from deposits in China perhaps represent variation and differing sexes within a much more restricted set of actual biological entities (*vide* Appendix). Unfortunately, a poor understanding of potential infraspecific variation coupled with the limitations of preservation as compressions hinders a more refined perspective of these taxa. Accordingly, it is greatly hoped that further pelecinids are recovered from Cretaceous ambers and that from these we might gain a better perspective of the Mesozoic diversity of the family, relationships among the constituent groups, and perhaps an insight into possible population variation for early pelecinid species.

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REFERENCES

Brues, C.T. 1933. The parasitic Hymenoptera of the Baltic amber. Part 1. *Bernstein Forschungen* 3: 4–178.

Cruickshank, R.D., & K. Ko. 2003. Geology of an amber locality in the Hukawng Valley, northern Myanmar. *Journal of Asian Earth Science* 21(5): 441–455.

Duan, Y., & S.-L. Cheng. 2006. A new species of Pelecinidae (Insecta, Hymenoptera, Proctotrupoidea) from the Lower Cretaceous Jiufotang Formation of western Liaoning. *Acta Palaeontologica Sinica* 45(3): 393–398. [In Chinese]

Engel, M.S. 2002. The fossil pelecinid *Pelecinopteron tubuliforme* Brues in Baltic amber (Hymenoptera: Pelecinidae). *Journal of Hymenoptera Research* 11(1): 5–11.

Engel, M.S., & D.A. Grimaldi. 2006. A diminutive pelecinid wasp in Cretaceous amber from New Jersey (Hymenoptera: Pelecinidae). *Northeastern Naturalist* 13(2): 291–297.

Feng, H., C. Shih, D. Ren, & C. Liu. 2010. New male pelecinid wasps (Hymenoptera: Pelecinidae) from the Yixian Formation of western Liaoning (China). *Geologica Carpathica* 61(6): 463–468.

Gould, G.C., & B.J. MacFadden. 2004. Gigantism, dwarfism, and Cope's rule: "Nothing in evolution makes sense without a phylogeny". *Bulletin of the American Museum of Natural History* 285: 219–237.

Haliday, A.H. 1839. *Hymenopterorum synopsis ad methodum clm. Fallenii utplurimum accomodata*. Hipploytus Bailliere; London, UK; [iv] pp.

Johnson, N.F. 1998. The fossil pelecinids *Pelecinopteron* Brues and *Iscopinus* Kozlov (Hymenoptera: Proctotrupoidea: Pelecinidae). *Proceedings of the Entomological Society of Washington* 100(1): 1–6.

Johnson, N.F., & L. Musetti. 1999. Revision of the proctotrupoid genus *Pelecinus* Latreille (Hymenoptera: Pelecinidae). *Journal of Natural History* 33(10): 1513–1543.

Kozlov, M.A. 1974. An Early Cretaceous ichneumon of the family Pelecinidae (Hymenoptera, Pelecinoidea). *Paleontologicheskiy Zhurnal* 1974(1): 144–146. [English translation in *Paleontological Journal* 8(1): 136–138]

Latreille, P.A. 1800. Description d'un nouveau genre d'insectes. *Bulletin des Sciences par la Société Philomathique de Paris* 2: 155–156.

Liu, C., C. Shih, & D. Ren. 2009. The earliest fossil record of the wasp subfamily Pelecininae (Hymenoptera: Proctotrupoidea: Pelecinidae) from the Yixian Formation of China. *Zootaxa* 2080: 47–54.

Liu, C., T. Gao, C. Shih, & D. Ren. 2011. New pelecinid wasps (Hymenoptera: Proctotrupoidea: Pelecinidae) from the Yixian Formation of western Liaoning, China. *Acta Geologica Sinica* 85(4): 749–757.

Rasnitsyn, A.P. 1980. Origin and evolution of Hymenoptera. *Trudy Paleontologicheskogo Instituta Akademii Nauk SSSR* 174: 1–192. [In Russian]

Rasnitsyn, A.P. 2008. Hymenopterous insects (Insecta: Vespida) in the Upper Jurassic deposits of Shar Teg, SW Mongolia. *Russian Entomological Journal* 17(3): 299–310.

Shi, G., D.A. Grimaldi, G.E. Harlow, J. Wang, J. Wang, M. Yang, W. Lei, Q. Li, & X. Li. 2012. Age constraint on Burmese amber based on U-Pb dating of zircons. *Cretaceous Research* 37: 155–163.

Shih, C., C. Liu, & D. Ren. 2009. The earliest fossil record of pelecinid wasps (Insecta: Hymenoptera: Proctotrupoidea: Pelecinidae) from Inner Mongolia, China. *Annals of the Entomological Society of America* 102(1): 20–38.

Shih, C., H. Feng, C. Liu, Y. Zhao, & D. Ren. 2010. Morphology, phylogeny, evolution, and dispersal of pelecinid wasps (Hymenoptera: Pelecinidae) over 165 million years. *Annals of the Entomological Society of America* 103(6): 875–885.

Zhang, H., & A.P. Rasnitsyn. 2004. Pelecinid wasps (Insecta, Hymenoptera, Proctotrupoidea) from the Cretaceous of Russia and Mongolia. *Cretaceous Research* 25(6): 807–825.

Zhang, H., A.P. Rasnitsyn, & J. Zhang. 2002. Pelecinid wasps (Insecta: Hymenoptera: Proctotrupoidea) from the Yixian Formation of western Liaoning, China. *Cretaceous Research* 23(1): 87–98.

Zhang, J.-F. 2005. Eight new species of the genus *Eopelecinus* (Hymenoptera: Proctotrupoidea: Pelecinidae) from the Laiyang Formation, Shandong Province, China. *Paleontological Journal* 39(4): 417–427.

Zhang, J.-F., & A.P. Rasnitsyn. 2006. New extinct taxa of Pelecinidae *sensu lato* (Hymenoptera: Proctotrupoidea) in the Laiyang Formation, Shandong, China. *Cretaceous Research* 27(5): 684–688.

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APPENDIX

Fossil species of Pelecinidae (*s.l.*), all are preserved as compressions with the exception of *Pelecinopteron tubuliforme* Brues (Eocene), *Henopelecinus pygmaeus* Engel & Grimaldi (Turonian), and *Zoropelecinus zigrasi* Engel & Grimaldi, new genus and species (Albian-Cenomanian).

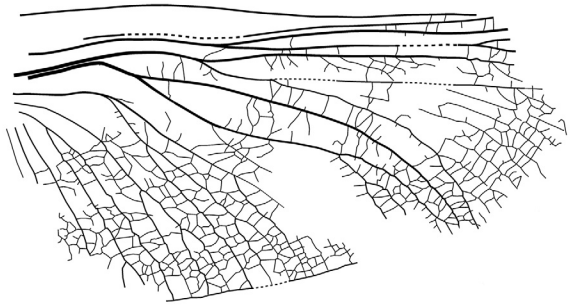
Taxon	Deposit	Age	Citations
Pelecinopteron Brues			
P. tubuliforme Brues	Baltic amber	Lutetian	Brues, 1933; Johnson, 1998; Engel, 2002
Henopelecinus Engel & Grimaldi			
H. pygmaeus Engel & Grimaldi	New Jersey amber	Turonian	Engel & Grimaldi, 2006
Zoropelecinus Engel & Grimaldi, **n. gen.**			
Z. zigrasi Engel & Grimaldi, **n. sp.**	Myanmar amber	Cenomanian	Herein
Iscopinus Kozlov			
I. baissicus Kozlov	Baissa, Russia	Berriasian	Kozlov, 1974; Johnson, 1998
I. separatus Zhang & Rasnitsyn	Obeshchayushchiy, Russia	Cenomanian	Zhang & Rasnitsyn, 2004
I. simplex Zhang & Rasnitsyn	Baissa, Russia	Berriasian	Zhang & Rasnitsyn, 2004
I. suspectus Zhang & Rasnitsyn	Baissa, Russia	Berriasian	Zhang & Rasnitsyn, 2004
Protopelecinus Zhang & Rasnitsyn			
P. deformis Zhang & Rasnitsyn	Bon Tsagan, Mongolia	Aptian	Zhang & Rasnitsyn, 2004
P. dubius Zhang & Rasnitsyn	Bon Tsagan, Mongolia	Aptian	Zhang & Rasnitsyn, 2004
P. furtivus Zhang & Rasnitsyn	Baissa, Russia	Berriasian	Zhang & Rasnitsyn, 2004
P. regularis Zhang & Rasnitsyn	Baissa, Russia	Berriasian	Zhang & Rasnitsyn, 2004
Abropelecinus Feng *et al.*			
A. annulatus Feng *et al.*	Yixian, China	Barremian	Feng *et al.*, 2010
Allopelecinus Zhang & Rasnitsyn			
A. terpnus Zhang & Rasnitsyn	Laiyang, China	Barremian	Zhang & Rasnitsyn, 2006
Azygopelecinus Feng *et al.*			
A. clavatus Feng *et al.*	Yixian, China	Barremian	Feng *et al.*, 2010
Megapelecinus Shih *et al.*			
M. changi Shih *et al.*	Yixian, China	Barremian	Shih *et al.*, 2010
M. nashi Shih *et al.*	Yixian, China	Barremian	Shih *et al.*, 2010

Appendix. Continued from preceding page.

Taxon	Deposit	Age	Citations
Scorpiopelecinus Zhang *et al.*			
S. versatilis Zhang *et al.*	Yixian, China	Barremian	Zhang *et al.*, 2002
Shoushida Liu *et al.*			
S. regilla Liu *et al.*	Yixian, China	Barremian	Liu *et al.*, 2009
Sinopelecinus Zhang *et al.*			
S. daspletis Zhang & Rasnitsyn	Laiyang, China	Barremian	Zhang & Rasnitsyn, 2006
S. delicatus Zhang *et al.*	Yixian, China	Barremian	Zhang *et al.*, 2002
S. epigaeus Zhang *et al.*	Yixian, China	Barremian	Zhang *et al.*, 2002
S. hierus Zhang & Rasnitsyn	Laiyang, China	Barremian	Zhang & Rasnitsyn, 2006
S. magicus Zhang *et al.*	Yixian, China	Barremian	Zhang *et al.*, 2002
S. viriosus Zhang *et al.*	Yixian, China	Barremian	Zhang *et al.*, 2002
Eopelecinus Zhang *et al.*			
E. eucallus Zhang	Laiyang, China	Barremian	Zhang, 2005
E. exquisitus Zhang & Rasnitsyn	Baissa, Russia	Berriasian	Zhang & Rasnitsyn, 2004
E. fragilis Zhang & Rasnitsyn	Khutel-Khara, Mongolia	Barremian	Zhang & Rasnitsyn, 2004
E. giganteus Zhang	Laiyang, China	Barremian	Zhang, 2005
E. hodoiporus Zhang	Laiyang, China	Barremian	Zhang, 2005
E. huangi Liu *et al.*	Yixian, China	Barremian	Liu *et al.*, 2011
E. laiyangicus Zhang	Laiyang, China	Barremian	Zhang, 2005
E. leptaleus Zhang	Laiyang, China	Barremian	Zhang, 2005
E. mecometasomatus Zhang	Laiyang, China	Barremian	Zhang, 2005
E. mesomicrus Zhang	Laiyang, China	Barremian	Zhang, 2005
E. minutus Zhang & Rasnitsyn	Khutel-Khara, Mongolia	Barremian	Zhang & Rasnitsyn, 2004
E. pusillus Zhang	Laiyang, China	Barremian	Zhang, 2005
E. rudis Zhang & Rasnitsyn	Baissa, Russia	Berriasian	Zhang & Rasnitsyn, 2004
E. scorpioideus Zhang & Rasnitsyn	Baissa, Russia	Berriasian	Zhang & Rasnitsyn, 2004
E. shangyuanensis Zhang *et al.*	Yixian, China	Barremian	Zhang *et al.*, 2002
E. similaris Zhang *et al.*	Yixian, China	Barremian	Zhang *et al.*, 2002
E. tumidus Liu *et al.*	Yixian, China	Barremian	Liu *et al.*, 2011
E. vicinus Zhang *et al.*	Yixian, China	Barremian	Zhang *et al.*, 2002
E. yuanjiawaensis Duan & Cheng	Chaoyang, China	Barremian	Duan & Cheng, 2006

Appendix. Continued from preceding page.

Taxon	Deposit	Age	Citations
Praescopinus Rasnitsyn			
P. excellens Rasnitsyn	Shar Teg, Mongolia	Kimmeridgian	Rasnitsyn, 2008
Archaeopelecinus Shih *et al*.			
A. jinzhouensis Shih *et al*.	Daohugou, China	Bathonian	Shih *et al*., 2009
A. tebbei Shih *et al*.	Daohugou, China	Bathonian	Shih *et al*., 2009
Cathaypelecinus Shih *et al*.			
C. daohugouensis Shih *et al*.	Daohugou, China	Bathonian	Shih *et al*., 2009



Pharciphyzelus lacefieldi Beckemeyer & Engel, 2011

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