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1 The first Cretaceous damselfly of the Jurassic family Steleopteridae (Odonata: Zygoptera),
2 from Surrey, England

3

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14

15 ABSTRACT

16 *Steleopteron cretacicus* sp. nov., first Cretaceous and most recent representative of the small
17 Mesozoic family Steleopteridae, is described from the Wealden of the UK. This discovery
18 shows that this Jurassic family survived into the Cretaceous. It probably became extinct
19 during or after the great entomofaunal changes of the Albian – Cenomanian event.

20

21 *Keywords:*

22 Insecta; Odonata; Zygoptera; Steleopteridae; sp. nov.; Lower Cretaceous; UK

23

24

25

26 **1. Introduction**

27 The Steleopteridae Handlirsch, 1906 is a small family of very slender damselfly-like
28 Odonata-known from four genera in the Upper Jurassic of Germany and Kazakhstan (Fleck et
29 al., 2001). This group is currently placed in the stem Zygoptera, but its position remains
30 enigmatic. It is characterized by a series of synapomorphies (see Bechly, 2016); the most
31 remarkable being the presence of a very long ovipositor and a very characteristic pattern of
32 transverse pleats between the longitudinal veins (see Fleck et al., 2001). To date, the family
33 was only known from the Jurassic, even if it had a wide distribution. Here we described its
34 first Lower Cretaceous representative, on the basis of a fragmentary fossil wing that shows
35 enough characters to be safely placed in a precise genus.

36

37 **2. Material and method**

38 The wing was observed and photographed dry and under ethanol with a Nikon D800
39 digital microscope camera after minor preparation with a pneumatic hammer. We mainly
40 follow the wing venation nomenclature of Riek & Kukalová-Peck (1984), modified by Nel *et*
41 *al.* (1993). The venational symbols used here are: RA/RP: radial anterior/posterior, IR:
42 convex intercalary radial vein. The wing fragment of late Hauterivian age is from a well-
43 cemented, slightly ferruginous, yellow siltstone scour fill found in the Lower Weald Clay
44 Formation of the former Clockhouse brickworks, UK (for site geology, map and photo. see
45 Jarzembowski and Soszyn'ska-Maj, 2018: fig. 1).

46

47 **3. Systematic palaeontology**

48 Class: Insecta Linneaus, 1758

49 Order: Odonata Fabricius, 1793

50 Family: Steleopteridae Handlirsch, 1906

51 Genus *Steleopteron* Handlirsch, 1906

52 Type species: *Steleopteron deichmuelleri* Handlirsch, 1906. Other species. *Steleopteron*
53 *cretacicus* sp. nov.

54

55 *Steleopteron cretacicus* sp. nov.

56 (Figs. 1-2)

57 *Etymology*. Named after the Cretaceous period.

58 *Holotype*. Specimen NHMUK CH 879viii (Jarzembowski coll.), stored in the Department of
59 Earth Sciences, The Natural History Museum, London, UK.

60 ZooBank number: urn:lsid:zoobank.org:act:2ECA5141-DA58-4B52-869D-AFDAE84388D3

61 *Age and outcrop*. Upper Hauterivian, Lower Cretaceous; Lower Weald Clay Fm beneath BGS
62 bed 3/3a; Clockhouse brickworks, near Capel, Surrey England, UK (latitude 51 deg.8 min. N.,
63 longitude 0 deg. 19.5 min. W.).

64 *Diagnosis*. Wing characters only. Pterostigma covering only one and a half cells and narrower
65 wing than the type species.

66 *Description*. A small fragment of the costo-apical part of a wing, without any trace of
67 coloration except dark wing venation and pterostigma, 9.6 mm long, 3.7 mm wide (distance
68 between C and RP3/4); pterostigma 2.0 mm long, 0.5 mm wide, covering one cell and a half;
69 microsculpture of pterostigma not preserved; pterostigmal brace very weak, identical in
70 strength to the other crossveins near it; eight preserved oblique postnodal crossveins, not
71 aligned with the five preserved postnodal crossveins; at least four sigmoidal crossveins
72 between C and RA distal of pterostigma; area between RP1 and RP2 with a long zigzagged
73 vein and two rows of cells; area between RP2 and IR2 very narrow, 0.3 mm wide, with only
74 one row of cells; area between IR2 and RP3/4 with specialized cells and crossveins, viz.

75 convex veins nearly perpendicular to IR2 separated by concave veins, each group of concave
76 – convex crossveins are defining a set of four cells; RP2, IR2 and RP3/4 straight.

77 *Discussion.* Although fragmentary, this wing shows some very special characters allowing its
78 accurate placement. The very weak pterostigmal brace, the long pterostigma, the strongly
79 zigzagged IR1, the postnodals and postsubnodals not aligned, and the straight RP2 and IR2
80 are present in the two Mesozoic families Protomyrmeleontidae and Steleopteridae. This fossil,
81 however, has a highly specialized pattern of the cells below IR2, described above. This
82 character is absent in the Protomyrmeleontidae and is only present in some Steleopteridae
83 (Fleck et al., 2001). This fossil differs from *Parasteleopteron* Fleck et al. 2001 and
84 *Euparasteleopteron* Fleck et al. 2001 in the presence of only two rows of cells between RP1
85 and RP2. *Auliella* Pritykina, 1968 has specialized rows of cells similar to those of this fossil,
86 but these are in the cubito-anal area, and not in the area between IR2 and RP3/4. The pattern
87 of venation of this fossil is only found in monobasic *Steleopteron* Handlirsch, 1906.
88 *Steleopteron deichmuelleri* Handlirsch, 1906 from the Upper Jurassic of Bavaria (Solnhofen),
89 Germany, differs from this fossil in the longer pterostigma covering two cells and a half,
90 while in *Steleopteron cretacicus* sp. nov., it only covers one and a half cells. Also, the wing of
91 *Steleopteron deichmuelleri* is broader than that of *Steleopteron cretacicus* (distance between
92 C and RP3/4 4.7 mm in *Steleopteron deichmuelleri*, instead of 3.7 mm in *Steleopteron*
93 *cretacicus*). We therefore propose a new species as more complete material is unlikely in the
94 near future due to excavation having ceased and landfill commenced at the type locality (a
95 SSSI).

96

97 **4. Conclusion**

98 This discovery extends the distribution of the extinct Steleopteridae. The family has been
99 recorded from the mainly marine palaeobiota of Sol[e]nhofen to the palaeolake of Karatau.

100 This discovery from a Wealden mudplain demonstrates that it was widely distributed—in
101 Eurasia. It also shows that this Jurassic family survived into the Cretaceous. It probably
102 became extinct during or after the great entomofaunal changes of the Albian – Cenomanian, a
103 major period of extinction and renewal for the clade Odonata (Nel et al., 2010).

104

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111

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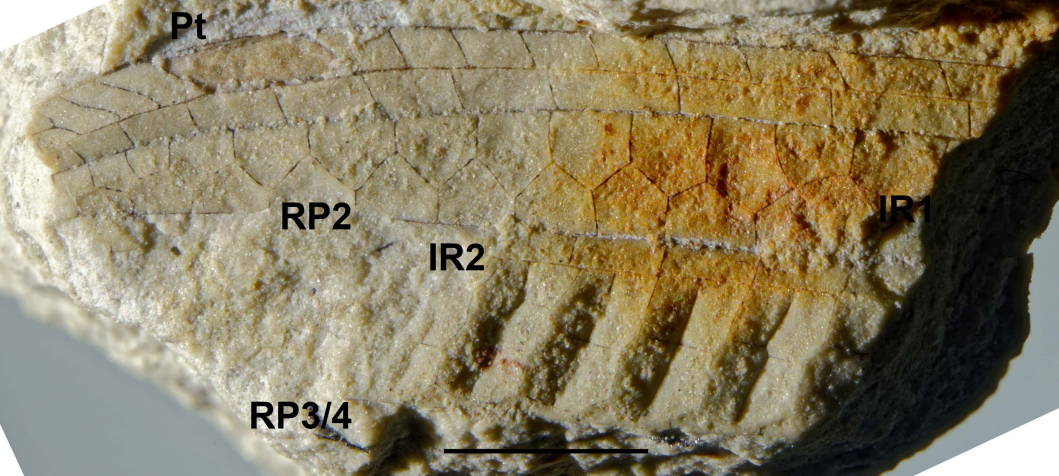
129

130 **Fig. 1.** *Steleopteron cretacicus* sp. nov., holotype. Photograph (scale bar represents 2 mm).

131 **Fig. 2.** *Steleopteron cretacicus* sp. nov., holotype. Line drawing (scale bar represents 2 mm).

132

133



Pt

RP2

IR2

RP3/4

IR1



