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New species of cynipid inquilines of the genus *Saphonecrus* (Hymenoptera: Cynipidae: Synergini) from the Eastern Palaearctic, with a re-appraisal of known species world-wide

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Table of contents

Abstract	3
Introduction	4
Materials and methods	5
Results	6
Key to Synergini genera	8
Key to Palaearctic <i>Saphonecrus</i> species	11
<i>Saphonecrus chinensis</i> Tang & Schwéger, new species	13
<i>Saphonecrus gilvus</i> Melika & Schwéger, new species	16
<i>Saphonecrus globosus</i> Schwéger & Tang, new species	20
<i>Saphonecrus leleyi</i> Melika & Schwéger, new species	23
<i>Saphonecrus lithocarpii</i> Schwéger & Melika, new species	25
<i>Saphonecrus longinuxi</i> Schwéger & Melika, new species	29
<i>Saphonecrus morii</i> Schwéger & Tang, new species	31
<i>Saphonecrus nantoui</i> Tang, Schwéger & Melika, new species	34
<i>Saphonecrus nichollsi</i> Schwéger & Melika, new species	37
<i>Saphonecrus pachylomai</i> Schwéger, Tang & Melika, new species	40
<i>Saphonecrus robustus</i> Schwéger & Melika, new species	43
<i>Saphonecrus salicintai</i> Melika, Tang & Schwéger, new species	46
<i>Saphonecrus shanzhukui</i> Melika & Tang, new species	49
<i>Saphonecrus symbioticus</i> Melika & Schwéger, new species	51
<i>Saphonecrus taitungi</i> Schwéger, Tang & Melika, new species	55
Current status of previously described <i>Saphonecrus</i> species.	59
<i>Saphonecrus areolatus</i> Weld, 1926	59
<i>Saphonecrus barbotini</i> Pujade-Villar & Nieves-Aldrey, 1985 (Figs 241–248) and <i>Saphonecrus gallaepomiformis</i> (Boyer de Fonscolombe, 1832) (Figs 249–263)	59
<i>Saphonecrus brevicornis</i> (Ashmead, 1896)	62
<i>Synergus brevis</i> (Weld, 1926), comb. nova	62
<i>Saphonecrus chaodongzhui</i> Melika, Ács & Bechtold, 2004	62
<i>Saphonecrus connatus</i> (Hartig, 1840)	62
<i>Saphonecrus diversus</i> Belizin, 1968	64
<i>Saphonecrus excisus</i> (Kieffer, 1904)	64
<i>Saphonecrus favanus</i> Weld, 1944	67
<i>Saphonecrus flavitibilis</i> Wang & Chen, 2010	68
<i>Saphonecrus gemmariae</i> Ashmead, 1885	68
<i>Synergus hupingshanensis</i> (Liu, Yang & Zhu, 2012), comb. nova	68
<i>Saphonecrus naiquanlini</i> Melika, Ács & Bechtold, 2004	68
<i>Saphonecrus reticulatus</i> Pujade-Villar, Wang & Guo, 2014	70
<i>Saphonecrus serratus</i> Weld, 1926	72
<i>Saphonecrus shirakashii</i> (Shinji, 1940) (Figs 341–355) and <i>Saphonecrus shirokashicola</i> (Shinji, 1941) (Figs 356–362)	78
<i>Saphonecrus sinicus</i> Belizin, 1968	79
<i>Saphonecrus tianmushanus</i> Wang & Chen, 2010	79
<i>Synergus yukawai</i> (Wachi, Ide & Abe, 2011), comb. nova	79
DISCUSSION	80
Acknowledgements	81
REFERENCES	82

Abstract

Fifteen new species of cynipid inquilines, *Saphonecrus chinensis* Tang & Schwéger, *S. gilvus* Melika & Schwéger, *S. globosus* Schwéger & Tang, *S. leleyi* Melika & Schwéger, *S. lithocarpii* Schwéger & Melika, *S. longinuxi* Schwéger & Melika, *S. morii* Schwéger & Tang, *S. nantoui* Tang, Schwéger & Melika, *S. nichollsi* Schwéger & Melika, *S. pachylomai* Schwéger, Tang & Melika, *S. robustus* Schwéger & Melika, *S. salicintai* Melika, Tang & Schwéger, *S. shanzhukui* Melika & Tang, *S. symbioticus* Melika & Schwéger, and *S. taitungi* Schwéger, Tang & Melika, from the Eastern Palaearctic are described. Descriptions, diagnoses, biology, and host associations for the new species, and a key to Palaearctic *Saphonecrus* species are given. All new taxa form distinct units as demonstrated by the molecular phylogenetic analyses of Palaearctic *Saphonecrus* species. The status of some earlier described *Saphonecrus* species is discussed also. The Synergini genus *Lithonecrus* Nieves-Aldrey & Butterill, 2014 is synonymized with *Lithosaphonecrus* Tang, Melika & Bozsó, 2013. Three *Saphonecrus* species are transferred to *Synergus*: *Synergus brevis* (Weld) **comb. nova**, *Synergus hupingshanensis* (Liu, Yang & Zhu) **comb. nova**, and *Synergus yukawai* (Wachi, Ide & Abe) **comb. nova**. *Synophrus vietnamensis*

Abe, Ide, Konishi & Ueno is transferred to *Lithosaphonecrus*: *Lithosaphonecrus vietnamensis* Abe, Ide, Konishi & Ueno), **comb. nova**. The current number of valid *Saphonecrus* species worldwide is 36.

Key words: Cynipidae, inquiline, Synergini, *Saphonecrus*, phylogeny, taxonomy, morphology, new species

Introduction

Most of the estimated 1,400 described species of Cynipidae are gall inducers (Csóka *et al.* 2005). However, around 180 species, classified into ten genera, develop as inquilines inside galls of other cynipids (Pujade-Villar *et al.* 2003, Nieves-Aldrey & Medianero 2010, Bozsó *et al.* 2014, 2015, Nieves-Aldrey & Butterill 2014). Inquilinism is a form of cleptoparasitism, usually considered to represent a unilaterally beneficial relationship that benefits only the inquiline (Askew 1984, Ronquist 1994, 1999). This paper focuses on the inquiline cynipids that feed obligately on plant tissues within developing galls, and to some extent, stimulate the development of tissues characteristic to galls, and particularly, on inquilines that attack hosts in the Cynipini (oak gallwasps). Inquilines which attack Cynipini (hosts) include eight genera, which from seven genera, *Agastoroxenia* Nieves-Aldrey & Medianero, *Saphonecrus* Dalla Torre & Kieffer, *Synergus* Hartig, *Synophrus* Hartig, *Ufo* Melika & Pujade, *Lithosaphonecrus* Tang, Melika & Bozsó, *Lithonecrus* Nieves-Aldrey & Butterill, and *Rhoophilus* Mayr form a distinct monophyletic lineage (Synergini), while *Ceroptres* Hartig, formerly Synergini, is now in Ceroptresini (Ronquist *et al.* 2015).

Saphonecrus was established by Dalla Torre & Kieffer (1910) for the oak inquiline species with an open radial cell of the fore wing (in contrast to *Synergus*, where this cell is close, except in *Synergus plagiotrochi* Nieves-Aldrey & Pujade-Villar, *S. castaneus* Pujade-Villar, Bernardo & Viggiani and one newly described species, *Synergus kawakamii* Tang & Melika (Schwéger *et al.* 2015). Although the separation of this genus from *Synergus* has subsequently been widely questioned (Eady & Quinlan 1963, Ritchie 1984, Pujade-Villar & Nieves-Aldrey 1990), the two genera have never been formally synonymised. Ritchie (1984) regarded the characters distinguishing *Saphonecrus* from *Synergus* as apomorphic, and saw *Saphonecrus* as a specialised monophyletic lineage within *Synergus*. Pujade-Villar & Nieves-Aldrey (1990) revised the European species and maintained the genus, but also questioned its validity. We consider *Saphonecrus* to be polyphyletic and closely allied to *Synergus* (Pénzes *et al.* 2012, Bozsó *et al.* 2014, 2015). The two genera are separated by a combination of characters: *Saphonecrus* species have an open radial cell of the fore wing, the female antenna with 13 segments, and the lateral frontal carina is absent. In contrast, most *Synergus* species have a closed radial cell, the female antenna with 14 segments, and the lateral frontal carina is usually present. The presence/absence of the lateral pronotal carina, open or closed radial cell of the fore wing, and the presence or absence of the basal lobe on tarsal claws in *Saphonecrus* are inconsistent character states which about we shall talk in details.

To this point 24 species of *Saphonecrus* were known worldwide, with 4 species from the Nearctic, 6 species from the Western Palaearctic, 12 from the Eastern Palaearctic, and 2 species from the Oriental region (Pénzes *et al.* 2012, Bozsó *et al.* 2014). The Western Palaearctic species are associated mainly with galls on section Cerris oaks, including Mediterranean evergreen oaks (*Quercus ilex* L., *Q. suber* L., *Q. coccifera* L.) and *Q. cerris* L. in Central Europe, while some are associated with galls that develop on white oaks (section *Quercus*, e.g. *Q. petraea* Liebl., *Q. robur* L.). The species generally have a single generation per year and emerge after overwintering in the gall, but those on evergreen oaks have at least the potential for two generations per year (Pujade-Villar & Nieves-Aldrey 1990). The European species can be divided into three groups on the basis of their biology: (i) species with one annual generation, and associated with galls on section *Quercus* oaks (*S. connatus* (Hartig)); (ii) also univoltine species, associated with galls on section Cerris oaks (*S. undulatus* (Mayr), *S. haimi* (Mayr), and *S. irani* Melika & Pujade-Villar); (iii) two Mediterranean species, with bivoltine life cycles, associated with galls on evergreen oaks (*S. barbotini* Pujade-Villar & Nieves-Aldrey and *S. gallaepomiformis* (Boyer de Fonscolombe)) (Pujade-Villar & Nieves-Aldrey 1990).

Four *Saphonecrus* species were listed for the Nearctic (Burks 1979) and some of them possess some non-typical character states for *Saphonecrus*, and their assignment to *Saphonecrus* must be examined in detail. In 2007, seven *Saphonecrus* species were listed for the Eastern Palaearctic (Abe *et al.* 2007) and two species, *S. serratus* Weld and *S. areolatus* Weld, are known from the Oriental Region (Weld 1926). Recently, new species were described from Japan and China (Liu *et al.* 2012, Wang *et al.* 2010, Wachi *et al.* 2011, Pujade-Villar *et al.* 2014).