

Research article

urn:lsid:zoobank.org:pub:28A67A43-CFF6-412A-B2D8-596113B09D01

Species of the genus *Chrysotus* Meigen, 1824 (Diptera: Dolichopodidae) from Japan, with descriptions of two new species

Oleg P. NEGROBOV^{1,*}, Tatsunori KUMAZAWA², Toshihiro TAGO³ & Viktor N. FURSOV⁴

¹ Voronezh State University, Universitetskaya sq., 1, Voronezh 394006, Russia.

² Osaka Museum of Natural History, 1–23, Nagai Park, Higashi-sumiyoshi, Osaka 546-0034, Japan.

³ 29-13-101, Motogou, 1-chome, Kawaguchi, Saitama, 332-0011, Japan.

⁴ I.I. Schmalhausen Institute of Zoology, Kyiv, Ukraine.

* Corresponding author: negrobov@list.ru

² Email: pseudocampsicnemus@gmail.com

³ Email: tago-ke@za2.so-net.ne.jp

⁴ Email: ufensia@gmail.com

¹ urn:lsid:zoobank.org:author:18FC9848-2BE3-4809-8A91-070E6C6EB8FE

² urn:lsid:zoobank.org:author:579148A7-D61D-4D7C-B1BB-8B7573B7FAF6

³ urn:lsid:zoobank.org:author:EC82645A-5E91-4977-B0DD-6437FA3976D7

⁴ urn:lsid:zoobank.org:author:FFF72665-7496-4A78-A577-7C10AA998B69

Abstract. Two new species of the genus *Chrysotus* Meigen, 1824 are described: *Ch. masunagai* Negrobov, Kumazawa, Tago sp. nov and *Ch. saigusai* Negrobov, Kumazawa & Tago sp. nov. *Chrysotus parilis* Parent, 1926 is recorded from Japan for the first time. An identification key to all known species of the genus *Chrysotus* of Japan is presented together with a tree diagram showing relationships among them.

Keywords. Japan, *Chrysotus*, Dolichopodidae, new species.

Negrobov O.P., Kumazawa T., Tago T. & Fursov V.N. 2016. Species of the genus *Chrysotus* Meigen, 1824 (Diptera: Dolichopodidae) from Japan, with descriptions of two new species. *European Journal of Taxonomy* 197: 1–15. <http://dx.doi.org/10.5852/ejt.2016.197>

Introduction

The cosmopolitan genus *Chrysotus* is the largest of the subfamily Diaphorinae, including more than 440 species (Grichanov 2014; Wei *et al.* 2015), of which 91 occur in the Palaearctic Region (Negrobov unpublished data). The Palaearctic species of *Chrysotus* were revised Negrobov and co-authors in a series of publications (Negrobov 1980; Negrobov & Maslova 1995; Negrobov *et al.* 2000, 2003; Maslova *et al.* 2011). In the Oriental region of China more than one hundred species of the genus *Chrysotus* are known (Wei 2012; Wei *et al.* 2015; Liu *et al.* 2013, 2015).

There are few morphological differences between the species of the genus, but most species can be well distinguished by the structure of the apex of the phallus. Negrobov *et al.* (2000) published the most

recent keys of the Palaearctic species of the genus. A key, with 28 species from China, to the males of the genus was also published by Yang *et al.* (2011).

Meanwhile, only a few studies on the species of the genus in Japan are available (Saigusa 2008). Masunaga (2014) listed only 3 species: *Chrysotus cilipes* Meigen, 1824, *Ch. nudisetus* Negrobov & Maslova, 1995 and *Ch. pulchellus* Kowarz, 1874. The record of *Chrysotus pulchellus* for Japan probably belongs to the new species *Ch. masunagai* sp. nov. described herein. Recently, two species of the genus have been recorded, *Ch. tagoi* Negrobov, Maslova & Fursov, 2015 and *Ch. kumazawai* Negrobov, Maslova & Fursov, 2015 (Negrobov *et al.* 2015), but it is assumed that there are more species present in Japan. Here, we present additional records of the genus from Japan, including two new species.

Material and methods

Specimens were collected by Dr. V.N. Fursov (Schmalhausen Institute of Zoology of the National Academy of Sciences Ukraine) and Mr. T. Tago from Japan.

Holotypes of the new species are deposited in the Osaka Museum of Natural History (OMNH, Japan) and the Zoological Institute of the Russian Academy of Sciences (ZIN, Saint Petersburg, Russia), and some of the paratypes are housed in the collections of the Schmalhausen Institute of Zoology of the National Academy of Sciences Ukraine (IZU), the Osaka Museum of Natural History (OMNH, Japan) and the Voronezh State University (VSU, Russia). We follow Cumming & Wood (2009) for the terminology. Male terminalia were treated in 10% KOH and glycerol for observing genital structures.

Relationships among species were investigated using a tree-diagram constructed in the TNT program (Goloboff *et al.* 2003). Characters were selected on the basis of their diagnostic value in the key of the genus *Chrysotus*. All 20 characters were equally weighted. Character polarity was based on outgroup comparison, with the most plesiomorphic state indicated by “0” and the apomorphic state indicated by “1” or “2” according to Capellari (2013). The following characters were investigated:

1. Face narrower than the length between ocellar bristles or equal (0). Face wider than the length between ocellar bristles (1).
2. Postpedicel higher than long (0). Postpedicel longer than height (1).
3. Arista subapical (0). Arista apical (1).
4. Palpus brown (0). Palpus pale (1).
5. Lower postocular setae pale (0). Lower postocular setae black (1).
6. Fore coxae dark (0). Fore coxae yellow at distal part (1).
7. Fore coxae with dark hairs (0). Fore coxae with white or yellow hairs (1).
8. Fore femur mostly dark (0). Fore femur yellow (1).
9. Mid femur dark (0). Mid femur yellow (1).
10. Basal part of hind femur dark (0). Basal part of hind femur yellow (1).
11. Hind trochanter dark (0). Hind trochanter yellow (1).
12. Hind tibia brown (0). Hind tibia yellow (1).
13. Hind femora with anteroventral hairs on entire length of femur (0). Hind femora without anteroventral hairs on entire length of femur (1).
14. Hind tibia with short erect anteroventral hairs at lateral side, their length approximately equal to the diameter of tibia (0). Hind tibia without short erect anteroventral hairs at lateral side (1).
15. First segment of hind tarsus with short erect hairs (0). First segment of hind tarsus without short erect hairs (1).
16. Apical part of CuA₁ approximately in 2.5 times longer than dm-cu (0). Apical part of CuA₁ less than in 2.5 times longer than dm-cu (1).
17. Abdomen metallic green (0). Abdomen purple or blue (1).

Table 1. Morphological characters matrix of the *Chrysotus* species from Japan.

Species	Morphological characters																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
<i>Ch. cilipes</i> Meigen, 1824	0	0	0	1	0	1	1	1	1	0	1	1	0	0	0	0	1	2	0	
<i>Ch. laesus</i> (Wiedemann, 1817)	1	0	1	0	0	0	1	0	0	1	0	0	1	1	1	1	1	0	0	2
<i>Ch. masunagai</i> sp. nov.	0	1	0	1	0	1	0	0	1	0	1	0	0	0	0	0	1	2	1	
<i>Ch. nudisetus</i> Negrobov & Maslova, 1995	0	0	0	0	1	0	0	0	0	1	0	1	1	1	1	0	0	0	2	0
<i>Ch. parilis</i> Parent, 1926	0	0	0	1	0	1	1	1	1	0	1	1	1	1	1	0	0	1	2	1
<i>Ch. saigusai</i> sp. nov.	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	2	0	
<i>Ch. tagoi</i> Negrobov <i>et al.</i> , 2015	0	0	0	0	0	1	0	1	1	0	1	1	1	0	0	0	0	2	0	
<i>Ch. kumazawai</i> Negrobov <i>et al.</i> , 2015	0	0	0	1	0	1	0	0	0	1	1	1	1	0	0	0	1	1	1	

18. Eandrium in the basal part without small projection (0). Eandrium in the basal part with small projection (1).
19. Apical half of surstylus with two thickened triangular bristles (0). Apical half of surstylus with one thickened triangular bristle (1). Apical half of surstylus without thickened triangular bristles (2).
20. Phallus with two lateral processes at apex (0). Phallus with one lateral process at apex (1). Phallus without lateral processes at apex (2).

Results

Taxonomic descriptions

Class Hexapoda Blanchard, 1816
 Order Diptera Linnaeus, 1758
 Family Dolichopodidae Latreille, 1809
 Genus *Chrysotus* Meigen, 1824

We found the following six species in the collection of Mr. T. Tago and of the Schmalhausen Institute of Zoology of National Academy of Sciences Ukraine, including a species new to Japan and two species new to science.

Chrysotus cilipes Meigen, 1824

Material examined

JAPAN: 9 ♂♂, Saitama Prefecture, Misato City, Edogawa river bank, 9 Aug. 2008, 15 May 2010, leg. T. Tago.

Distribution

Western Europe, Abchazia, Afghanistan, Armenia, Azerbaijan, China, Japan, Kazakhstan, Korea, Mongolia, Turkey, Ukraine and Russia (Leningrad, Novgorod, Pskov, Moscow, Voronezh, Adygea, Kabardino-Balkaria, Krasnodar, Rostov, Tomsk, Altai, Krasnoyarsk, Baikal, Transbaikalia, Yakutia, Amur, Maritime Territory). There are a few records of the species in Japan (Negrobov *et al.* 2008; Masunaga 2014).

Chrysotus laesus (Wiedemann, 1817)

Material examined

JAPAN: 29 ♂♂, Honshu, Aichi Prefecture, Nagoya, Nagakute-cho Park, 23–30 May 1999, leg. V. Fursov.

Distribution

Western Europe, Armenia, Georgia, Japan and Russia (Karelia, Saint Petersburg, Pskov, Yaroslavl, Moscow, Ryasan, Bashkiria, Tatarstan, Kursk, Lipetsk, Voronezh, Krasnodar, Adygea, North Caucasus, Orenburg, Omsk, Tomsk, Altai, Krasnojarsk, Irkutsk, Buryatia, Yakutia, Amur).

Chrysotus nudisetus Negrobov & Maslova, 1995

Chrysotus sp. 3t – Tago 2010: 44.

Material examined

JAPAN: 1 ♂, Saitama Prefecture, Misato City, Edogawa river bank, 9 Aug. 2008, leg. T. Tago; 1 ♂, Chiba Prefecture, Nagareyama City, Ichinoya, 30 Sep. 2008, leg. T. Tago; 1 ♂, Saitama Prefecture, Hidaka City, Yokote, 12 Jul. 2009, leg. T. Tago; 1 ♂, Saitama Prefecture, Ootaki, Chichibu City, Mameyakibashi, 7 Aug. 2010, leg. T. Tago.

Distribution

Japan and Russia: Sakhalin, Primorye, Khabarovsk, Magadan, Chukotka. The species was described from Japan and the Far East of Russia by Negrobov & Maslova (1995).

Chrysotus parilis Parent, 1926

Material examined

JAPAN: Saitama Prefecture, Misato City, Edogawa river bank, 9 Aug. 2008 (3 ♂♂, 2 ♀♀), 13 Oct. 2008 (1 ♂), 15 May 2010 (2 ♂♂), leg. T. Tago; 1 ♂, Honshu, Ibaraki Prefecture, Tsukuba, Yawara, rice fields, 16 Jul. 1997, leg. V. Fursov; 1 ♂, Honshu Aichi Prefecture, Nagoya, Nagakute-cho Park, 23–30 May 1999, leg. V. Fursov.

Distribution

China, Japan. The species originally described from China is here recorded for the first time from Japan.

Chrysotus masunagai Negrobov, Kumazawa & Tago, sp. nov.
urn:lsid:zoobank.org:act:CA904F5D-F488-4B95-B043-0D598C014071

Figs 1, 5A

Chrysotus sp. 2t – Tago 2010: 43.

Diagnosis

Face narrow; postpedicel small; lower postocular setae white; fore coxa with black hairs; femora mostly yellow; mid tibia with 2 anterodorsal and 2 posterodorsal setae; hind femur and with long setae, hind tibia with short hairs; phallus with two lateral processes on tip.

Etymology

The species is named after the famous dipterologist Dr. Kazuhiro Masunaga from Japan.

Material examined

Holotype

JAPAN: 1 ♂, Ibaraki Prefecture, Tsukuba, Yawara, 16 Jun. 1997, leg. V. Fursov (ZIN, Russia).

Paratypes

JAPAN: 1 ♂, labeled, Saitama Prefecture, Misato City, Edogawa river bank, 13 Oct. 2008, leg. T. Tago; 4 ♂♂, same data, 28 Apr. 2012, leg. T. Tago; 1 ♂, same data, 15 May 2010, leg. T. Tago (OMNH, 2 paratypes VSU).

Description

Male

MEASUREMENTS. Body length: 1.3–1.4 mm, wing length: 1.4–1.5 mm.

HEAD. Frons green with purple tinge, without pollen. Face narrow, its width narrower than the width between ocellar bristles in lower part. Frons green at the top, with pollinosity at the bottom. Antenna black, postpedicel small, triangular, length 1.3 times greater than height. Arista subapical, with short hairs. Length of arista more than two times longer than length of postpedicel. Proboscis and palpus brown with black hairs without pollen. Lower postocular setae pale.

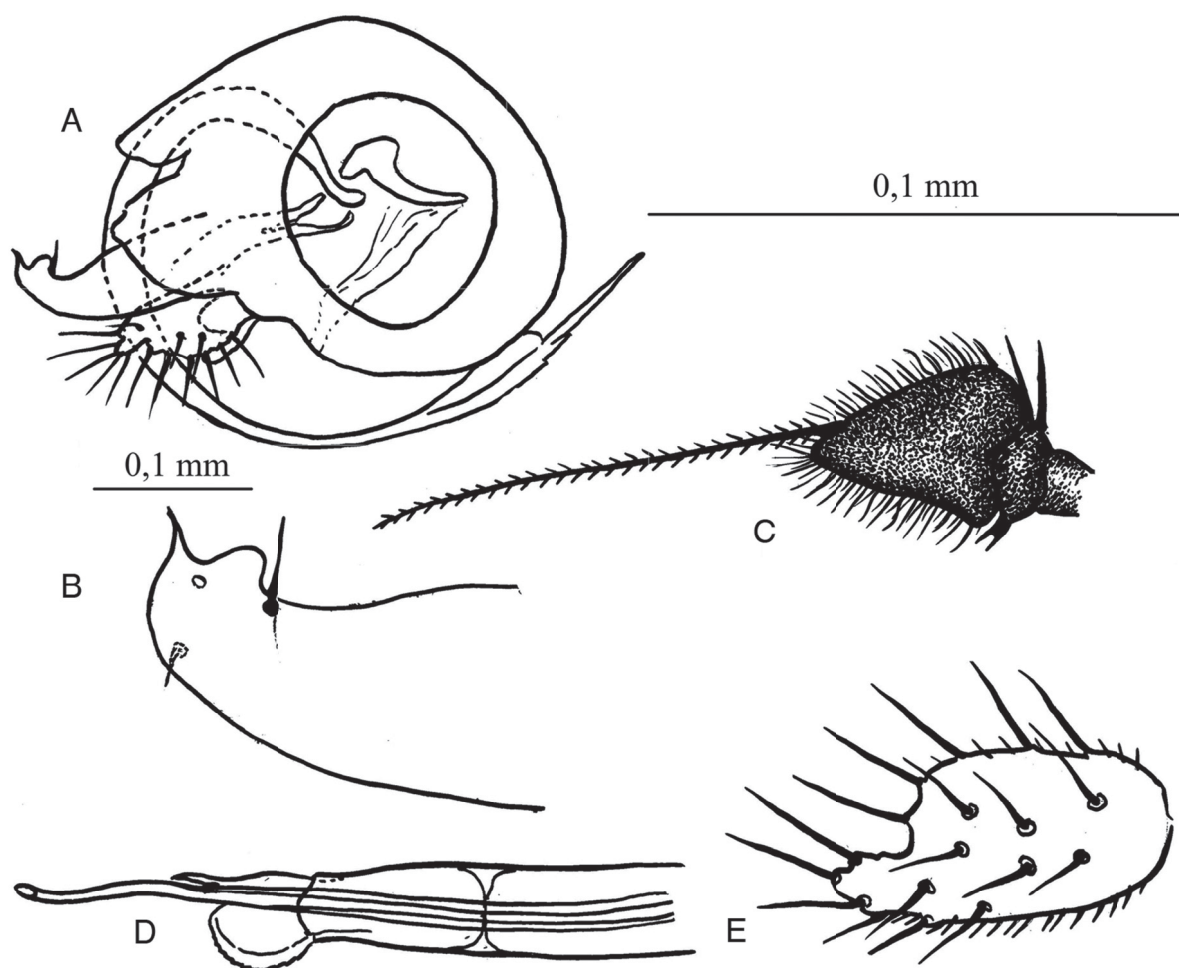


Fig. 1. *Chrysotus masunagai* Negrobov, Kumazawa & Tago sp. nov., ♂, paratype, coll. 28 Apr. 2012. **A.** Hypopygium, lateral view. **B.** Apex of surstylus, lateral view. **C.** Antenna. **D.** Apex of phallus, lateral view. **E.** Cerci, lateral view.

THORAX. Metallic green, scutum with bronze tinge and without pollen. Pleura with pollen, propleuron with 1–2 setae. 5 pairs of strong dorsocentral setae. Acrostichal setae long, irregular 6–7 pairs, arranged in two rows. Scutellum with 2 long and 2 short lateral setae.

LEG. Fore coxa yellowish brown, mid and hind coxa dark; femora mostly yellow, except dorsal surfaces of fore femur, middle part of the mid femur and apical third part of the hind femur dark; fore and mid tibiae yellow, hind tibia dark; tarsi yellow except hind tarsus and apical parts of fore and mid tarsus dark. All coxae with dark hairs and setae. Fore femur with long white anteroventral hairs, length approximately equal to the width of femur. Fore tibia with 1 anterodorsal seta and short posteroventral hairs. Ratio of fore tibia and tarsus (from 1 to 5) 2.6: 1.5: 0.6: 0.5: 0.3: 0.4. Mid femur with a short preapical seta. Mid tibia with 2 anterodorsal and 2 short posterodorsal setae. Ratio of mid tibia and tarsus (from 1 to 5) 3.4: 1.6: 0.8: 0.6: 0.4: 0.3. Hind femur with several long preapical setae and short anteroventral hairs on entire length femur. Hind tibia with 3–4 short anterodorsal setae and short erect anteroventral hairs, its length approximately equal to the diameter of tibia. First segment of hind tarsus with short erect hairs. Ratio of hind tibia and tarsus (from 1 to 5) 3.7: 1.2: 1.0: 0.6: 0.4: 0.3.

WING. Hyaline with dark veins; R_{4+5} and M_{1+2} parallel at apex. Length of costal section between R_{4+5} and M_{1+2} more than 2 times longer than that between R_{2+3} and R_{4+5} ; *m-cu* distinctly shorter than apical part of CuA_1 . Halter and cilia on lower calypter yellow.

ABDOMEN. Metallic green, grey pollinose laterally, covered with black hairs. Epanthrium oval in the basal part of the oval; apical part of surstylus bent. Apex of phallus with two short lateral processes, left process is rounded. Cercus with brown hairs, top of the left side with long processes.

Female

Unknown.

Addition to the key

In the key to the Palearctic species of *Chrysotus* (Negrobov *et al.* 2000), the new species *Chrysotus masunagai* sp. nov. runs to *Chrysotus verralli* Parent, 1923 and can be distinguished from the latter by following characters:

45. Femora almost yellow; dorsal side of fore femur, middle part of the mid femur and apical part of the hind femur dark. Hind trochanter yellow
..... *Ch. masunagai* Negrobov, Kumazawa, Tago sp. nov.
– Femora dark. Hind trochanter black. England *Ch. verralli* Parent, 1923

Chrysotus saigusai Negrobov, Kumazawa & Tago sp. nov.

[urn:lsid:zoobank.org:act:D4B29EEA-1EF5-4210-A383-94EFE3ED35EA](https://zoobank.org/act:D4B29EEA-1EF5-4210-A383-94EFE3ED35EA)

Figs 2, 5B

Chrysotus sp. 1t – Tago 2010: 43.

Diagnosis

Face narrow, width in lower part less than distance between ocellar bristles; antenna black; postpedicel transverse-oval, with a triangular tip; lower postocular setae white; fore coxa with black hairs; femora mainly green-brown; mid tibia with 2 anterodorsal and 2 posterodorsal setae; hind femur with long setae, hind tibia with short hairs; phallus with two lateral processes on tip.

Etymology

The species is named after the famous dipterologist Dr. Toyohei Saigusa from Japan.

Material examined

Holotype

JAPAN: ♂, Honshu, Aichi Prefecture, Kasugai, Univ. Experim. Farm, on grass near ponds, 19 Jun. 2004, leg. V. Fursov (ZIN).

Paratypes

JAPAN: 4 ♂♂, same data as holotype, leg. V. Fursov; 5 ♂♂, Honshu, Nagoya, Higashiyama Park, oak forest, 2 May 1999, leg. V. Fursov; 14 ♂♂, Honshu, Nagoya, Higashiyama Park, oak forest, 11 Aug. 1999, leg. V. Fursov; 1 ♂, Ibaraki Prefecture, Tsukuba, Sakuragaoka, swept grass near forest, 26 Apr. 1997, leg. V. Fursov; 2 ♂♂, Ibaraki Prefecture, Tsukuba, Sakuragaoka, 3 May 1997, leg. V. Fursov; 2 ♂♂, Ibaraki Prefecture, Tsukuba, Sakuragaoka, 5 May 1997, leg. V. Fursov; 2 ♂♂, Ibaraki Prefecture, Tsukuba, Yaware, near rice fields, 17 Jun. 1997, leg. V. Fursov; 4 ♂♂, Ibaraki Prefecture, Tsukuba, Yaware, 25 Jun. 1997, leg. V. Fursov; 2 ♂♂, Ibaraki Prefecture, Tsukuba, Hanare, near rice fields, 14 Jun. 1997, leg. V. Fursov; 2 ♂♂, Honshu, Nagoya, Midori-ku, Odaka Green Park, 5 May 1999, leg. V. Fursov; 1 ♂, Honshu, Nagoya, Nissin-shi, 5 Apr. 1999, leg. V. Fursov (IZU, VSU, ZIN);

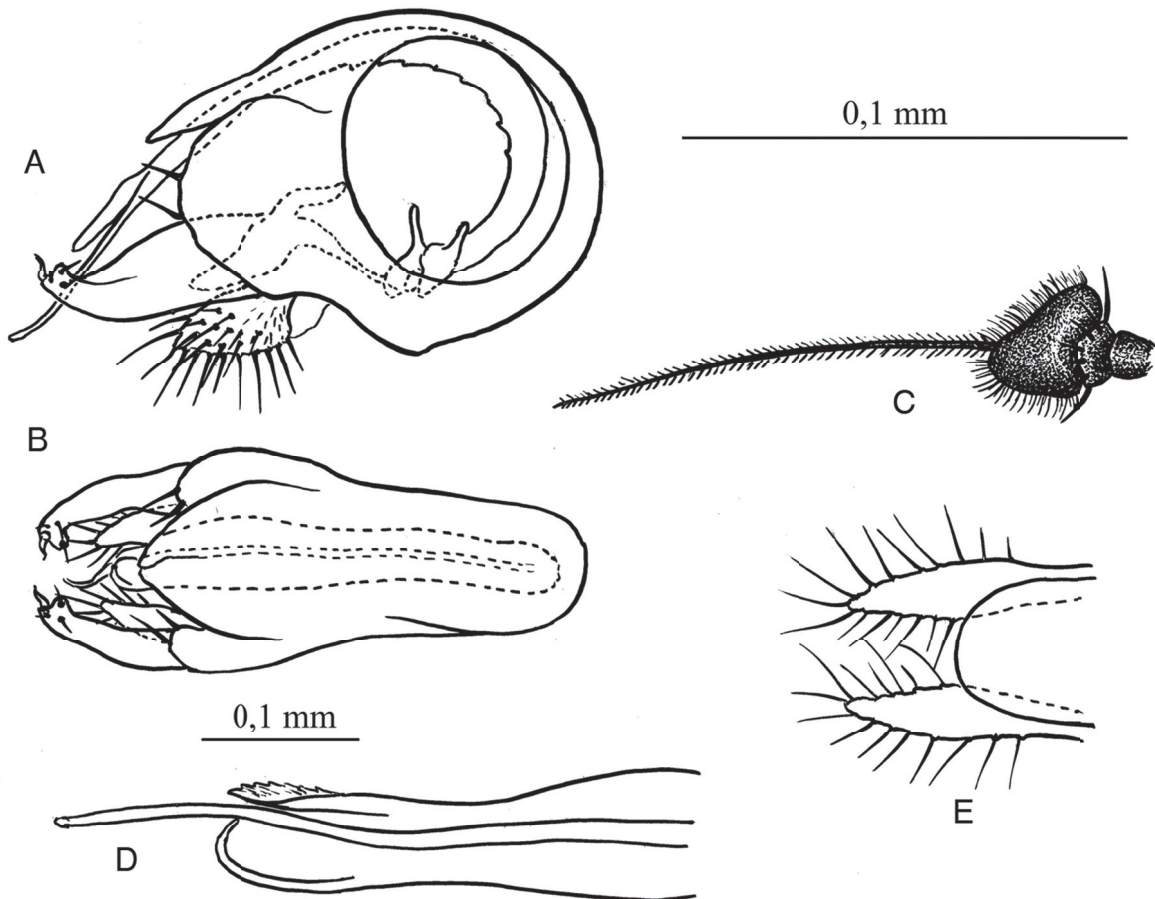


Fig. 2. *Chrysotus saigusai* Negrobov, Kumazawa & Tago sp. nov., ♂, paratype, coll. 8 Jul. 2012. **A.** Hypopygium, lateral view. **B.** Hypopygium, ventral view. **C.** Antenna. **D.** Apex of phallus, lateral view. **E.** Cerci, ventral view.

1 ♂, Tochigi Prefecture, Kanuma City, Shimokasuo, 8 Jul. 2012, leg. T. Tago; 1 ♂, Saitama Prefecture, Saitama City, Akigase Park, Sakura wood, 1 Oct. 2011, leg. T. Tago (OMNH, Japan); 1 ♂, Kuril Islands, island Kunashir, Alekhine, 8–12 Aug. 1984, leg. Kirejtshuk (ZIN).

Description

Male

MEASUREMENTS. Body length: 1.2–1.3 mm, wing length: 1.2–1.3 mm.

HEAD. Frons green with purple tinge, without pollen. Face narrow, its width narrower than the width between ocellar bristles in lower part. Frons green at the top, with pollinosity on the bottom. Antenna black, postpedicel small, a right-angled triangular, its length about equal to its height. Arista subapical, with short hairs. Length of arista approximately five times longer than length of postpedicel. Proboscis and palpus brown with black hairs without pollen. Lower postocular setae pale.

THORAX. Metallic green, scutum with bronze tinge and without pollen. Pleura with pollen, propleuron with 1–2 setae. 5 pairs of strong dorsocentral setae. Acrostichal setae long, irregular 6–7 pairs, arranged in two rows. Scutellum with 2 long and 2 short lateral setae.

LEG. All coxae dark; femora mostly dark, except apical part of fore femur, apical and basal part of mid femur and basal part of hind femur yellow; trochanters yellow or yellowish-brown; fore and mid tibiae yellow, hind tibia yellowish-brown; most part of mid and hind tarsi yellow, basal parts hind tarsus yellowish-brown. Coxae with dark hairs and setae. Fore femur with 3 long preapical setae. Fore tibia with 1 anterodorsal seta and short posteroventral hairs. Fore tarsus with short hairs. Ratio of fore tibia and tarsus (from 1 to 5) 2.8: 1.7: 0.7: 0.5: 0.4: 0.5. Mid femora with 3 short preapical setae and short anteroventral hairs. Mid tibia with 2 anterodorsal and 2 short posterodorsal setae. Ratio of mid tibia and tarsus (from 1 to 5) 3.8: 2.1: 1.0: 0.7: 0.5: 0.4. Hind femora with 4 long preapical setae and short anteroventral hairs on entire length of femur. Hind tibia with 4 short anterodorsal, 3 posterodorsal setae and short erect anteroventral hairs, their length approximately equal to the diameter of tibia. First segment of hind tarsus with short erect hairs. Ratio of hind tibia and tarsus (from 1 to 5) 4.4: 1.5: 1.2: 0.7: 0.5: 0.4.

WING. Hyaline with dark veins; R_{4+5} and M_{1+2} slightly divergent at apex. Length of costal section between R_{4+5} and M_{1+2} about twice longer than that between R_{2+3} and R_{4+5} ; *m-cu* distinctly shorter than apical part of CuA_1 . Halter and cilia on lower calypter yellow.

ABDOMEN. Metallic green, pollinose laterally, covered with black hairs. Epandrium oval in the basal part with the small projection; apical tip of surstylus bent. Phallus with two lateral processes at apex. Cercus oval with black hairs.

Female

Unknown.

Addition to the key

In the key to the Palearctic species of *Chrysotus* (Negrobov *et al.* 2000), the new species *Chrysotus saigusai* Negrobov, Kumazawa & Tago sp. nov. runs to *Chrysotus defensus* Negrobov & Maslova, 2000 and can be distinguished from the latter by the following characters:

58. Basal part of hind femur and hind trochanter black. The phallus before the apex with two long dorsal processes. Caucasus *Ch. defensus* Negrobov & Maslova, 2000
– Basal part of hind femur and hind trochanter yellow. The phallus before the apex with short lateral processes *Ch. saigusai* Negrobov, Kumazawa & Tago sp. nov.

Key to the males of Japanese *Chrysotus*

- 1. Femora mostly dark-green or brown2
- Femora mostly yellow5

- 2. Postocular setae black (Fig. 3A–C)*Ch. nudisetus* Negrobov & Maslova, 1995
- Postocular setae pale3

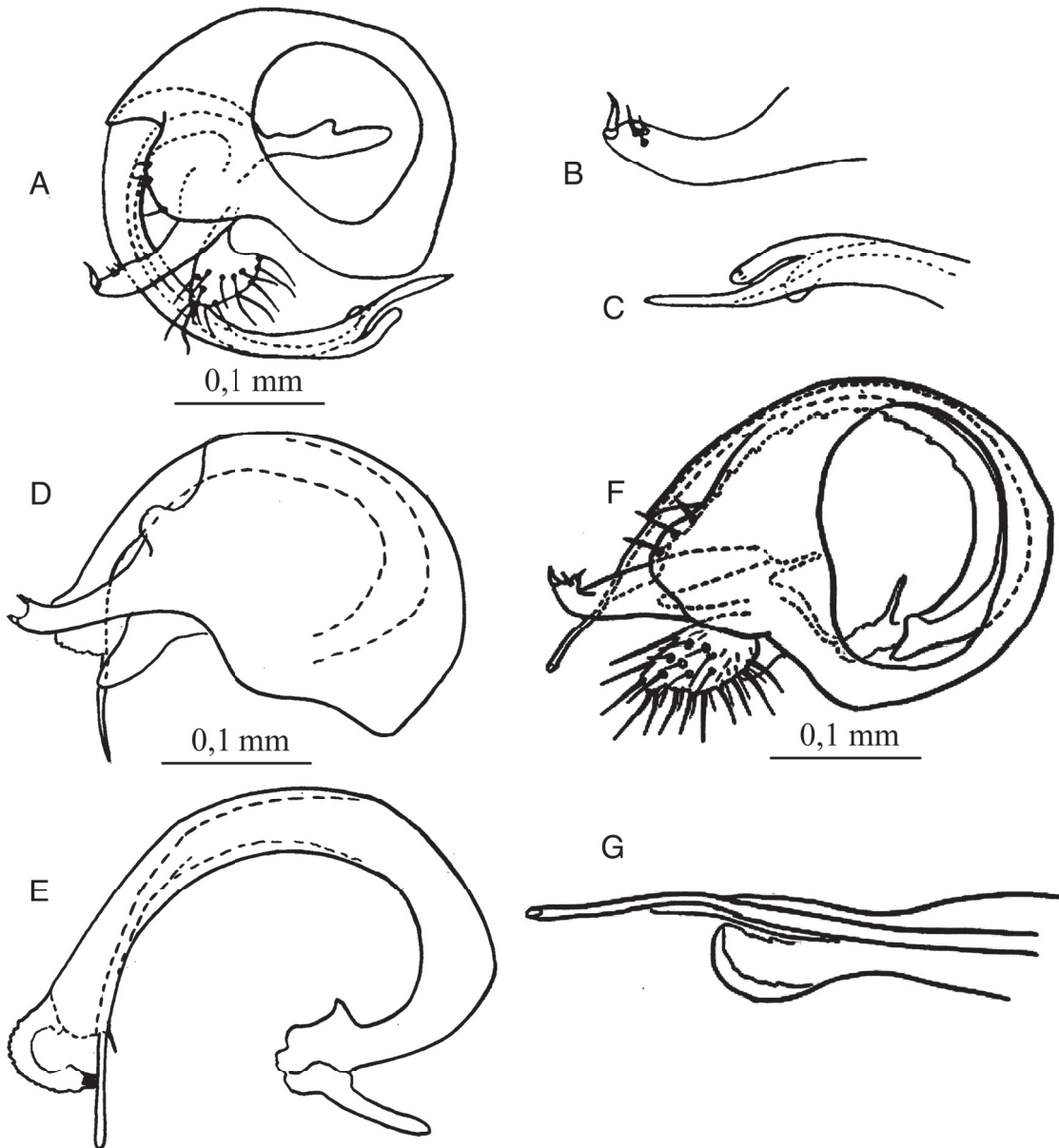


Fig. 3. A–C. *Chrysotus nudisetus* Negrobov & Maslova, 1995, ♂, paratype, Russia (Sakhalin). A. Hypopygium, lateral view. B. Surstylus, ventral view. C. Apex of phallus, lateral view. — D–E. *Chrysotus laesus* (Wiedemann, 1817), Russia (European part). D. Hypopygium, lateral view. E. Phallus, lateral view. — F–G. *Chrysotus kumazawai* Negrobov, Maslova & Fursov, 2015, ♂, paratype, coll. 20 Jul. 1997 by V. Fursov. F. Hypopygium, lateral view. G. Apex of phallus, lateral view.

3. Face wide, more than 2 times wider than the length between ocellar bristles. Thorax and abdomen with purple tinge. Postpedicel large, approximately 2 times wider than long (Fig. 3D–E) *Ch. laesus* (Wiedemann, 1817)
- Face narrow, narrower than the length between ocellar bristles. Thorax and abdomen green. Postpedicel small, approximately as long as wide 4
4. Postpedicel triangular apically. Surstylus approximately 1.5 times longer than cercus. Apicoventral epandrial lobe well developed, broad oval, without excavation *Ch. saigusai* Negrobov, Kumazawa & Tago sp. nov.
- Postpedicel oval apically. Surstylus approximately equal to cercus. Apicoventral epandrial lobe not developed, with excavation at apex (Fig. 3F–G) *Ch. kumazawai* Negrobov, Maslova & Fursov, 2015
5. Fore coxae with black hairs 6
- Fore coxae with white hairs 7

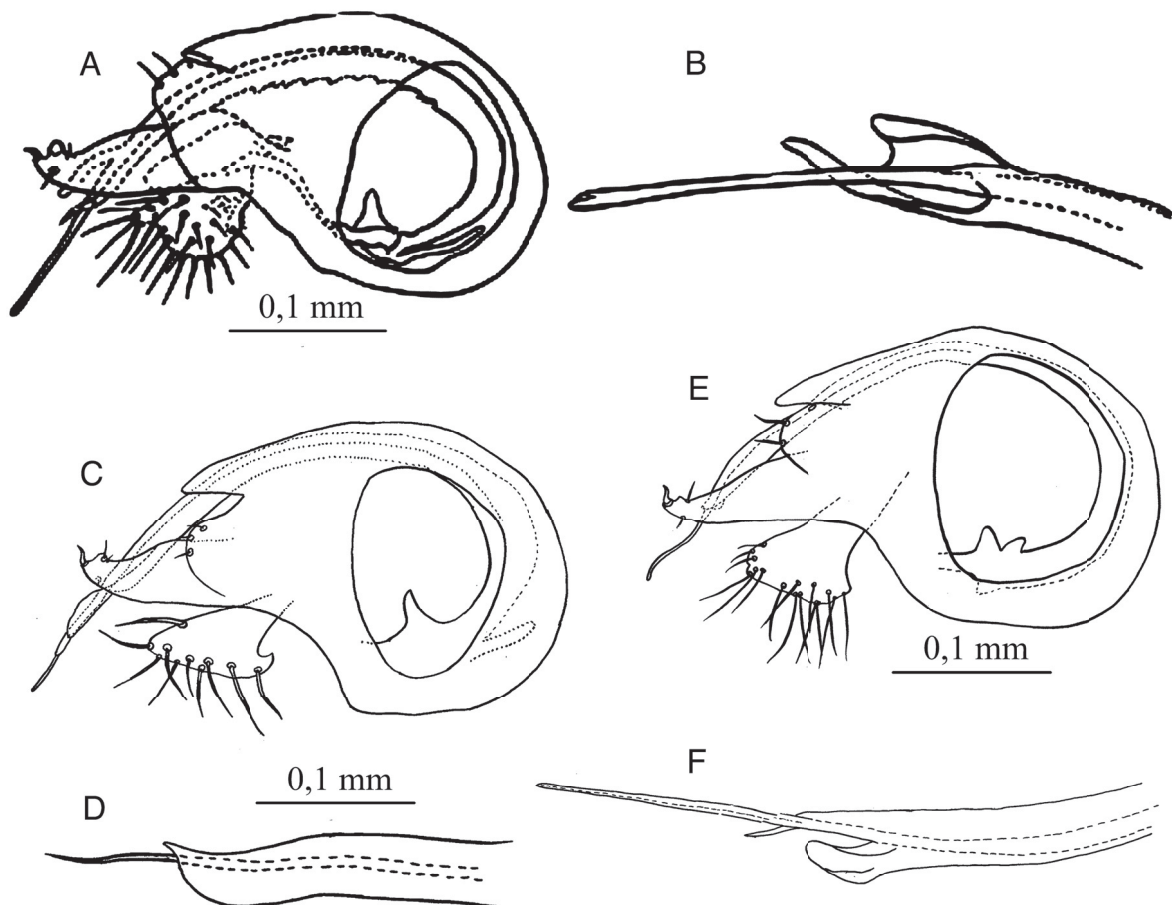


Fig. 4. A–B. *Chrysotus tagoi* Negrobov, Maslova & Fursov, 2015, ♂, paratype, Japan (Honshu, Ibaraki Pref., Tsukuba), coll. 16. Jul. 1997 by V. Fursov. A. Hypopygium, lateral view. B. Apex of phallus, lateral view. — C–D. *Chrysotus parilis* Parent, 1926, Russia (Primorje). C. Hypopygium, lateral view. D. Apex of phallus, lateral view. — E–F. *Chrysotus cilipes* Meigen, 1824, Russia (Primorje). E. Hypopygium, lateral view. F. Apex of phallus, lateral view.

6. Postpedicel longer than wide. Dorsal part of fore femora, middle femora in the middle part and apical third of hind femora dark. Phallus with oval process at apex on the left side
 *Ch. masunagai* Negrobov, Kumazawa, Tago sp. nov.
 – Postpedicel small, approximately as long as wide. Hind femora with dark spot at apex, the rest of femora yellow. Phallus with claw-shaped process at apex on the left side (Fig. 4A–B)
 *Ch. tagoi* Negrobov, Maslova & Fursov, 2015
7. Hind tibia without long erect hairs. Hind tibia at apex without group of ventral hairs. Postpedicel large, triangular at apex (Fig. 4C–D) *Ch. parilis* Parent, 1926
 – Hind tibiae and hind tarsi with long erect hairs, longer than tibia width. Hind tibia at apex with group of ventral hairs. Postpedicel small, oval apically (Fig. 4E–F) *Ch. cilipes* Meigen, 1824

Cladistic analyses

According to Capellari (2013), the absence of a small projection in the basal part of the epandrium represents the plesiomorphic character state. The combination of this character state with such character states as pale palpus, dark fore coxae, yellow hind tibia with short erect anteroventral hairs and short erect hairs on the first segment of hind tarsus separate the group of *Ch. saigusai* and *Ch. tagoi* from all other Japanese *Chrysotus* (Fig. 6). The species *Ch. saigusai* can be separated from *Ch. tagoi* by having anteroventral hairs on the entire length of hind femora and mostly dark fore femora.

The presence of the epandrial projection is the typical character states of the species *Ch. cilipes*, *Ch. parilis* and *Ch. masunagai* sp. nov., they are, however, included in the group with *Ch. saigusai*

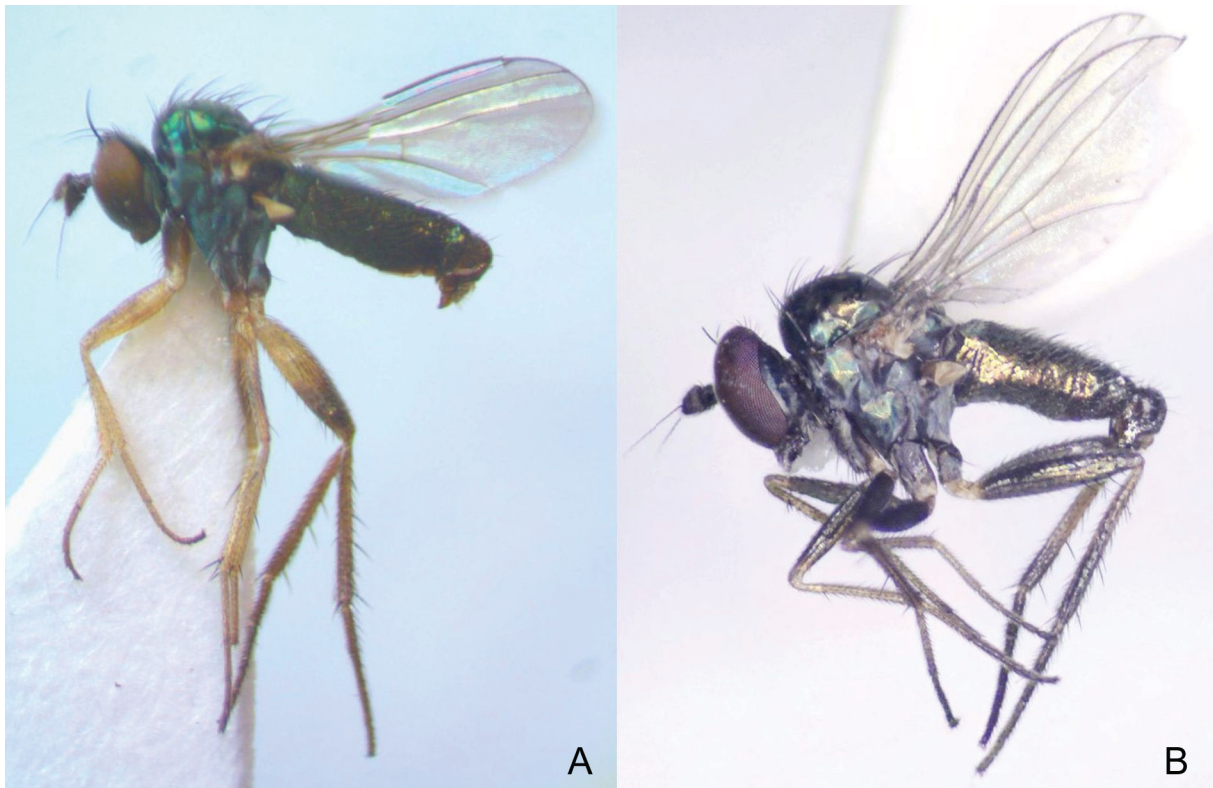


Fig. 5. Male habitus, lateral view. **A.** *Chrysotus masunagai* Negrobov, Kumazawa & Tago sp. nov., ♂, paratype, coll. 15 May 2010. **B.** *Chrysotus saigusai* Negrobov, Kumazawa & Tago sp. nov., ♂, paratype, coll. 8 Jul. 2012.

sp. nov. and *Ch. tagoi* on the basis of the characters of face width, position of arista, cooler of postocular bristles, fore coxa, hind trochanter and morphology of CuA_1 . Concerning the distinctive characters of the group including *Ch. cilipes*, *Ch. parilis* and *Ch. masunagai* sp. nov., in addition to the above mentioned, the following character states can be ascribed: yellow middle femora and dark basal part of hind femur. The morphological similarity between *Ch. cilipes* and *Ch. parilis* is sufficiently significant, while the relationship with *Ch. masunagai* sp. nov. is unstable.

The species *Ch. laesus*, *Ch. nudisetus* and *Ch. kumazawai* compose the group with the least stable internal connections. Their association is based on the similarity of color of fore, middle and hind femora and the absence of the anteroventral hairs on entire length of hind femur.

Discussion

The genus *Chrysotus* is paraphyletic or possibly polyphyletic within the subfamily Diaphorinae (Capellari & Amorim 2012). Bickel (2010) considers species of *Chrysotus* as various small-size Diaphorinae species, mostly with inadequate description. Knowledge on the phylogenetic relationships of the genus is poor. Therefore, it is important to investigate phylogenetic relationships of *Chrysotus* species using both morphological and biogeographical data.

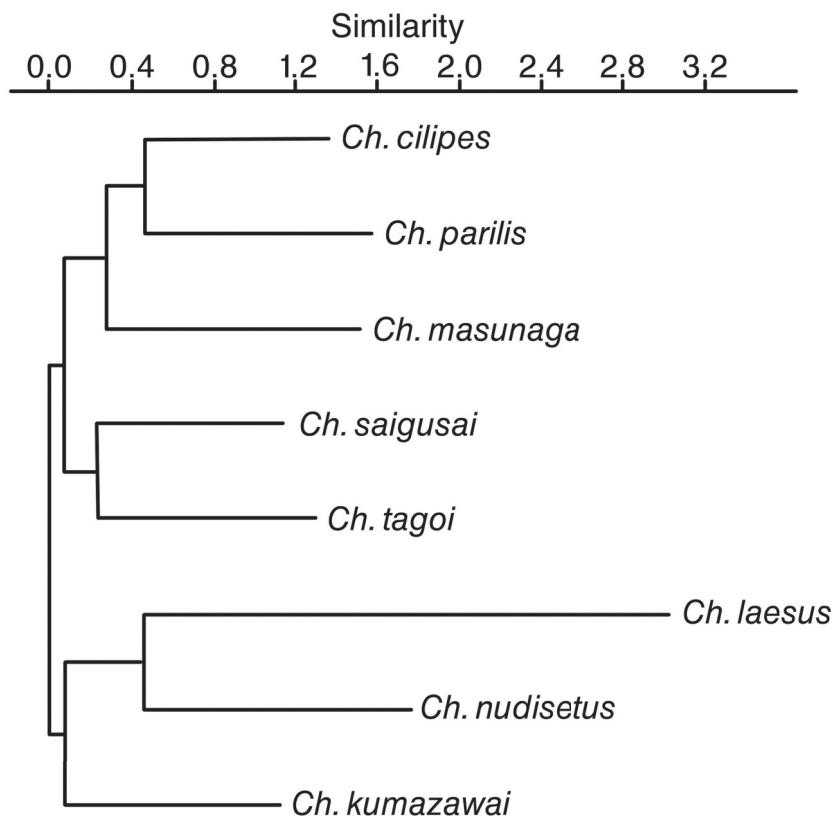


Fig. 6. Consensus cladistic tree of 6 equally parsimonious trees obtained from 20 morphological characters for the *Chrysotus* Meigen, 1824 species from Japan.

Eight species of the genus *Chrysotus* have been reported from the studied country and four of them are endemic, while the others have trans-Palearctic (*Ch. cilipes*, *Ch. laesus*, *Ch. parilis*) and East-Palearctic (*Ch. nudisetus*) distributions.

The present cladistic analysis was made in two ways. When we consider the characteristics used in the Palearctic keys of the genus, we were considering the possible relationship between the endemic and trans-Palearctic species, thus inserting the endemic species in the general scheme.

The morphology of the genus *Chrysotus* is relatively variable, and the most important diagnostic characters are the morphology of the apical part of the phallus, the color of the legs and the form of the postpedicel. It should be noted that the use of the full list of characteristics does not allow for allocating the endemic species in a separate cluster on any of the cladistic trees.

The cladistic analysis was carried out on the basis of a different combination of characters. It allowed for the identification of groups of characters that separate the Japanese endemic species from the trans-Palearctic species. This group of characters includes color of coxae and trochanter, ratio of apical part of CuA₁ and dm-cu, the presence of erect hairs at hind tibia and the first segment of hind tarsus and morphology of hypopygium. Most of the cladistic trees that were based on this combination of characters demonstrated the allocation of two clusters comprising pairwise *Ch. masunagai* sp. nov. – *Ch. kumazawai* and *Ch. saigusai* sp. nov. – *Ch. tagoi*. However, other stable regularities should also be noted, which is shown in a number of cladistic trees. The clusters of endemic species often have been associated with Palearctic species. So *Ch. masunagai* sp. nov. – *Ch. kumazawai* have been associated with *Ch. parilis* and *Ch. saigusai* sp. nov. – *Ch. tagoi* have been associated with *Ch. cilipes*. None of the combinations of characters showed a clear allocation of these endemic species.

Most of the characteristics, including head morphology and color of legs, which are used for the diagnosis of the Palearctic species, cannot be used for the Japanese species. Thus, further study of the phylogenetic relationships of *Chrysotus* species should be carried out, using a wider range of species, including both trans-Palearctic and endemic species.

Acknowledgements

We express our gratitude to Dr. L. Wei for information about the species of the genus *Chrysotus* in China, to the assistant of Voronezh University M. Chursina for the parsimony analysis of the species and head of the Laboratory Olga Selivanova for creating the figures. We express our gratitude to Dr. Martin Drake for making available the species of *Chrysotus* from England. The work was supported by the Russian Foundation for Basic Research, grant No. 14-04-00264-a.

References

- Bickel D. 2010. New World *Achradocera* in Hawai'i, Tonga, and French Polynesia, with discussion of the genus (Diptera: Dolichopodidae). *Bishop Museum Occasional Papers* 64: 14–20.
- Capellari R. S. 2013. Análise cladística de Diaphorinae (Diptera: Dolichopodidae). *Tese de doutorado apresentada a Faculdade de Ciências e Letras de Ribeirão Preto*. Universidade de São Paulo, São Paulo.
- Capellari R.S. & Amorim D.S. 2012. Systematic position of the monotypic Azorean genus *Falbouria* Dyte with notes on the definition of *Chrysotus* Meigen (Diptera: Dolichopodidae). *Zootaxa* 3489: 81–88.
- Cumming J.M. & Wood D.M. 2009. Adult morphology and terminology [Chapter]. In: Brown B.V., Borkent A., Comins J.M., Wood D.M., Woodley N.E. & Zombardo M.F. (eds) *Manual of Central American Diptera*. Volume 1: 9–50. NRC Research Press, Ottawa.

- Goloboff P., Farris J. & Nixon K. 2003. *Tree analysis using New Technology* [online]. Available from <http://www.lillo.org.ar/phylogeny/tnt> [accessed 25 Nov. 2015]
- Grichanov I. Ya. 2014. *Alphabetic list of generic and specific names of predatory flies of the epifamily Dolichopodidae (Diptera)*. Plant Protection News Supplement 14. All Russian Institute of Plant Protection RAAS, St. Petersburg.
- Liu R., Wang M. & Yang D. 2013. *Chrysotus* Meigen (Diptera, Dolichopodidae) from Tibet with description of four new species. *Zootaxa* 3717 (2): 169–178. <http://dx.doi.org/10.11646/zootaxa.3717.2.3>
- Liu R., Wang M. & Yang D. 2015. *Chrysotus* Meigen (Diptera, Dolichopodidae) from Shanxi, China, with descriptions of two new species. *Zoological Systematics* 40 (1): 86–92.
- Maslova O.O., Negrobov O.P. & Selivanova O.V. 2011. Fauna of species of genus *Chrysotus* (Diptera, Dolichopodidae) of Russia. Part 1. Group of species *Chrysotus cilipes* Meigen and *Ch. laesus* Wied. *Entomologicheskoe obozrenie* 110 (1): 464–468. [in Russian]
- Masunaga K. 2014. Dolichopodidae. In: Nakamura T., Saigusa T. & Suwa M. (eds) *Catalogue of the Insects of Japan, Vol. 8. Diptera. Part 1, Nematocera – Brachycera*: 439–447. Entomological Society of Japan, Fukuoka.
- Negrobov O.P. 1980. A revision of palearctic *Chrysotus* Mg. (Dipt., Dolichopodidae) I: *Ch. cilipes* Mg and *Ch. laesus* Wied. groups. *Entomologicheskoe obozrenie* 59: 415–420. [in Russian]
- Negrobov O.P. & Maslova O.O. 1995. Revision of palearctic species of genus *Chrysotus* Mg. (Diptera, Dolichopodidae). *Entomologicheskoe obozrenie* 74 (2): 456–466. [in Russian]
- Negrobov O.P., Maslova O.O. & Fursov V.N. 2015. New data on the genus *Chrysotus* Meigen, 1824 (Diptera: Dolichopodidae) from Japan and Russia. *Far Eastern Entomologist* 293: 10–15.
- Negrobov O.P., Maslova O.O. & Selivanova O.V. 2008. Two species of *Chrysotus* (Diptera, Dolichopodidae) new to Japan. *Dipterists Digest* 18: 44.
- Negrobov O.P., Tsurikov M.N. & Maslova O.O. 2000. Revision of the Palaearctic species of the genus *Chrysotus* Mg. (Diptera, Dolichopodidae), III. *Entomologicheskoe obozrenie* 79: 227–238. [in Russian]
- Negrobov O.P., Tsurikov M.N. & Maslova O.O. 2003. Revision of palearctic species of genus *Chrysotus* Mg. (Diptera, Dolichopodidae). IV *Entomologicheskoe obozrenie* 82 : 223–228. [in Russian]
- Saigusa T. 2008. Order Diptera. In: Hirashima Y., Morimoto K. (eds.) *Iconographia insectorum Japonicorum colore naturali edita*. Vol. III: 255–283. Hokuryūkan, Tokyo. [in Japanese]
- Tago T. 2010. Records of 68 species of Dolichopodidae from the Kanto region (Diptera, Dolichopodidae). *Hana-abu*. 30: 1–96. [in Japanese]
- Wei L. 2012. *Chrysotus* Meigen (Diptera, Dolichopodidae) from China with descriptions of new species. *Oriental Insects* 46 (1): 30–52. <http://dx.doi.org/10.1080/00305316.2012.675659>
- Wei L., Zhang L. & Zhou Z. 2015. A review of the genus *Chrysotus* Meigen (Diptera, Dolichopodidae) from China with definition of papuan species group. *Oriental Insects* 48 (3–4): 187–298. <http://dx.doi.org/10.1080/00305316.2015.1005960>
- Yang D., Zhang L., Wang M. & Zhu Y. 2011. Dolichopodidae. *Fauna Sinica: Insecta*, 53. Science Press, Beijing. [in Chinese, with English summary]

Manuscript received: 4 December 2015

Manuscript accepted: 5 February 2016

Published on: 17 May 2016

Topic editor: Koen Martens

Desk editor: Kristiaan Hoedemakers

Printed versions of all papers are also deposited in the libraries of the institutes that are members of the *EJT* consortium: Muséum national d'Histoire naturelle, Paris, France; Botanic Garden Meise, Belgium; Royal Museum for Central Africa, Tervuren, Belgium; Natural History Museum, London, United Kingdom; Royal Belgian Institute of Natural Sciences, Brussels, Belgium; Natural History Museum of Denmark, Copenhagen, Denmark.