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Description of the male of *Colletes seitzi* ALFKEN, 1900 from Japan, with an illustrated key to the East Asian species of the *C. caspicus* species group (Hymenoptera: Colletidae)

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A b s t r a c t : The hitherto unknown male of the rare bee species *Colletes seitzi* ALFKEN, 1900 is described. The species is endemic to Japan and belongs to the *C. caspicus* species group. An illustrated key to the five East Asian species of the *C. caspicus* species group is provided.

K e y w o r d s : *Colletes*, solitary bee, taxonomy, Japan, East Asia

Introduction

Recently, the Japanese endemic bee *Colletes seitzi* ALFKEN was rediscovered after more than a century, including the previously unknown male (IKUDOME & SUDA 2024). The species was only known from the single female type specimen, that was collected in Yokohama in 1891 and described 125 years ago by ALFKEN (1900). The species belongs to the Palaearctic *C. caspicus* group (sensu NOSKIEWICZ 1936) that currently comprises twelve species, with the Central Asian *C. transitus* KUHLMANN & PROSHCHALYKIN described last (KUHLMANN & PROSHCHALYKIN 2013a). The species group is defined by the following character combination (NOSKIEWICZ 1936): In females the basal declivous part of T1 densely covered with thick, mostly appressed hair hiding the surface; T1 apically depressed, with dense, broad and evenly wide apical hair band; disc of T2 finely and usually shallowly punctate. Males are characterised by T7 apically narrowly rounded; S5 apical hair fringe medially with hairs more than twice as long than laterally (unmodified in *C. transitorius* NOSKIEWICZ and *C. transitus*); S7 relatively short but apically strongly broadened; gonostylus short and ± triangular (slightly more elongate in *C. transitorius* and *C. transitus*).

The five East Asian species of the *C. caspicus* group (*C. alini* KUHLMANN, *C. anceps* RADOSZKOWSKI, *C. caspicus* MORAWITZ, *C. esakii* HIRASHIMA, *C. seitzi*) are among the least studied so as a part of this publication we briefly summarise what is known about them in this region. East Asia as defined here comprises (from north to south) East Siberia (Russia), Mongolia, China, the Korean Peninsula and Japan. In addition, we describe the hitherto unknown male of *C. seitzi* and provide an illustrated key to the five East Asian species of the *C. caspicus* group. Their identification can be challenging, as the species often differ only subtly in their pubescence and sculpturing. Thus, we therefore hope that the key will facilitate further research into the species of this group.

Material and Methods

Terminology as well as measurements used in the description follows those of MICHENER (2007). Puncture density is expressed as the relationship between puncture diameter (d) and the space between them (i), such as i = 1.5d or i < d. T is used as abbreviation of metasomal tergum and S for a metasomal sternum. Hair is described as 'erect' if it protrudes from the body surface, regardless of the angle (opposite: 'appressed'). Body length is measured from the vertex to the apex of the metasoma.

Images were taken with the Digital Microscope Keyence VHX-5000 (Keyence Deutschland GmbH, Neu-Isenburg, Germany) using the VH-Z20R/Z20T (20x to 200x) zoom lens and the OP-42305 super diffused illumination adapter. Photoshop elements (Adobe Systems Software Ireland Limited, Dublin, Republic of Ireland) was used for image processing.

East Asian species of the *Colletes caspicus* species group

Available information on distribution and biology (phenology, flower visitation, nesting) of the East Asian species of the *C. caspicus* group are briefly summarised here. Species are listed in alphabetical order.

Colletes alini KUHLMANN, 2000

NOSKIEWICZ (1936) considered specimens originating from the Asian mainland, that were later recognised as a distinct taxon, to be identical with *C. seitzi*. The misidentification was recognised by KUHLMANN (1999, 2000) who described the continental taxon as the separate species *C. alini*.

Colletes alini is restricted to East Asia and hitherto only known from China, Mongolia and East Russia. It is distributed from the continental Pacific coasts of NE China and SE Russia to the westernmost records in Khakassia Republic (Russia) (KUHLMANN & PROSHCHALYKIN 2011, PROSHCHALYKIN & KUHLMANN 2015), Chovd-Aimag (Mongolia) (KUHLMANN & DORN 2002, KUHLMANN & PROSHCHALYKIN 2013b) and Xinjiang Province (China) (NIU et al. 2014).

The bees are mainly active in July and August with very few earlier records from late May and June (KUHLMANN & DORN 2002, KUHLMANN & PROSHCHALYKIN 2011, KUHLMANN & PROSHCHALYKIN 2013b, NIU et al. 2014, PROSHCHALYKIN & KUHLMANN 2015). The few available flower visitation records (NIU et al. 2014) suggest that *C. alini* is polylectic.

Colletes anceps RADOSZKOWSKI, 1891

The species is widespread in Central Asia and neighbouring southern and western regions (KUHLMANN & PROSHCHALYKIN 2013a), but reaches East Asia only marginally in the far west of China (Xinjiang Province) (KUHLMANN 2009, NIU et al. 2014).

In East Asia specimens were found from June to August (KUHLMANN 2009, NIU et al. 2014). No information is available about flower visitation or nesting biology (KUHLMANN & PROSHCHALYKIN 2013a, NIU et al. 2014).

Colletes caspicus MORAWITZ, 1873

Of all the species treated here, *C. caspicus* has the widest distribution, from Germany to the western parts of East Asia in Russia and China (PROSHCHALYKIN & KUHLMANN 2023). In the East Asian part of Russia *C. caspicus* is only known from the west of East Siberia. Easternmost records are from Krasnoyarsk Territory, Khakassia Republic and Tyva Republic (KUHLMANN & PROSHCHALYKIN 2011, PROSHCHALYKIN & KUHLMANN 2015, PROSHCHALYKIN & KUHLMANN 2023). The species is not mentioned for China by NIU et al. (2014). However, without any further details it is listed for China in PROSHCHALYKIN & KUHLMANN (2023). The latter information is based on unpublished records of 2 males collected 3-4. June and 8-9. June 1908 by P. Kozlov in "Dyn-yuan'-in, N Alashan" (Coll. Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia). According to PROSHCHALYKIN & DATHE (2018), this site is located at N39º40' E106º20' in present-day Inner Mongolia, making it by far the easternmost locality of *C. caspicus*.

In East Asia specimens were found from late May to August (NOSKIEWICZ 1936, PROSHCHALYKIN & KUHLMANN 2015, PROSHCHALYKIN & KUHLMANN 2023). According to MÜLLER & KUHLMANN (2008) *C. caspicus* is, based on four pollen loads from three different sites, polylectic with a strong preference for Fabaceae. No information is available on its nesting biology.

Colletes esakii HIRASHIMA, 1958

Colletes esakii is endemic to Japan (HIRASHIMA 1958, IKUDOME 1989) and widely distributed from Amami-ôshima Island through northern Kyushu to the central region of Honshu (distribution maps in IKUDOME 1989 and IKUDOME & SUDA 2024).

Unlike the other East Asian species of the *C. caspicus* group, the biology of *C. esakii* has been extensively studied (MATSUNO et al. 2009). The main activity period is about six weeks from early July to late August (MATSUNO et al. 2009) but single specimens were also found as late as mid-October (MUROTA 2014, TAKAHASHI 2015). Based on analyses of 37 pure female scopal pollen loads *C. esakii* is assumed to be oligolectic on *Zanthoxylum ailanthoides* SIEB. & ZUCC. (Rutaceae), although pollen of other plant species were found in minor proportions in brood cells (MIYANAGA et al. 2015) and bees were observed to visit other flowers, too (TOGASHI 1991, YAMAMOTO 2017). The nesting biology was investigated in detail by NEGORO (1986), MATSUNO et al. (2009) and MIYANAGA et al. (2015) and immature stages were described by MURAO & TADAUCHI (2005). Nests are parasitised by *Cylindrothecum angustifrons* (TOWNSEND) (Diptera: Sarcophagidae), *Smicromyrme rufipes* (FABRICIUS) (Hymenoptera: Mutillidae) and *Epeolus melectiformis* YASUMATSU (Hymenoptera: Apidae) (TOGASHI 1991, MATSUNO et al. 2009).

Colletes seitzi ALFKEN, 1900

The taxonomic status of *C. seitzi* was confused for a long time (see also comment under *C. alini*). The taxonomic and nomenclatural history of the species was explored in detail by KUHLMANN (1999, 2000) and is therefore only briefly summarised here. After the description of *C. seitzi* (based on a single female from Yokohama; ALFKEN 1900), NOSKIEWICZ (1936) assumed that the species also occurred outside Japan in China and

Mongolia. Based on continental specimens he described the male of "*C. seitzi*" which later turned out to be a closely related new species known today as *C. alini* (KUHLMANN 1999, 2000). *Colletes seitzi* was only recently rediscovered in Japan based on specimens (males and females) collected since 2011 in the vicinity of Yokohama (IKUDOME & SUDA 2024). On the basis of these specimens, the male of *C. seitzi* can now be described here for the first time.

Colletes seitzi is endemic to Japan with an unusually small distribution range. So far it has been found only in the Kantô region (Kanagawa and Chiba Prefectures) of Honshu, a large plain that is isolated by mountainous regions from neighbouring populations of *C. esakii*. According to current knowledge, the distribution areas of both species do not overlap (details of records and distribution maps in IKUDOME 1989 and IKUDOME & SUDA 2024). Based on observations of six females and five males, adults are active for about four weeks, from mid-July to early August (IKUDOME & SUDA 2024). For *C. seitzi* only a single flower visitation record on *Trifolium repens* LINN. (Fabaceae) is documented (IKUDOME & SUDA 2024) but no information is available on the nesting biology.

Description of the male of *Colletes seitzi*

The hitherto unknown male of *C. seitzi* is here described for the first time.

D i a g n o s i s : *Colletes seitzi* differs from the other East Asian species of the *C. caspicus* species group by the following character combination (see also key to males below): Dorsal pubescence intense orange-brown; disc of T1 with coarse punctation and disc of T2 ± as wide as width of apical tergal hair band (Fig. 3); apical hair fringe of S5 medially with few elongate hairs (Fig. 4).

D e s c r i p t i o n

M a l e : Body length: 9.0-10.0 mm (Habitus Fig. 1). Head wider than long. Integument black, mandible apically dark reddish-brown. Face densely covered with long orange brown, erect hair. Malar area slightly elongated, medially about 1/2 as long as width of mandible base, finely striate and matt. Antenna black. Scutum coarsely and densely punctate (i < 0.5d), on the disc slightly coarser and more dispersed, between punctures smooth and shiny. Scutellum convex, sparsely and coarsely punctate (i = 0.5-1.5d). Mesosoma densely covered with long orange brown hair (Fig. 2). Wings fuscous, venation yellowish brown. Legs black, vestiture yellowish brown. Integument of metasoma black, apical tergal depressions apically narrowly translucent dark red to brown. Disc of T1 densely covered with long erect orange brown hair, on disc of T2 only medially a few of these hairs; apical tergal depressions densely covered with long appressed orange brown hair forming broad apical tergal hair bands (Figs 2, 3). Terga apically distinctly depressed, depression smooth and shiny with sparse fine and shallow punctation. Terga densely (i < 0.5d) and coarsely punctate, between punctures smooth and shiny (Fig. 3). S2-S4 with broad and distinct apical hair fringes; S5 with apical hair fringe medially as in Fig. 4. Gonostylus (Fig. 6) and S7 (Fig. 5) as illustrated.

M a t e r i a l e x a m i n e d : JAPAN: 1♂, "Nagasawa-muraoka, Yokosuka City, Kanagawa Pref., Honshu, JAPAN, 14.VII.2012, Y. SAITO leg." (Coll. Kuhlmann, Kiel); 1♂, same data as for preceding, except 23.VII.2011 (Coll. Kuhlmann, Kiel).

Figs 1-6: *Colletes seitzi* ALFKEN, male. (**1**) Habitus lateral; (**2**) metasoma; (**3**) metasomal terga T1-T2; (**4**) metasomal sternum S5, apical hair fringe; (**5**) metasomal sternum S7; (**6**) gonostylus in lateral view.

Key to the East Asian species of the *Colletes caspicus* species group

The dorsolateral angle of the female pronotum can be of diagnostic importance. It can be shaped into a corner or extended into a pointed spike. To see this structure clearly, the hair needs to be brushed aside or removed.

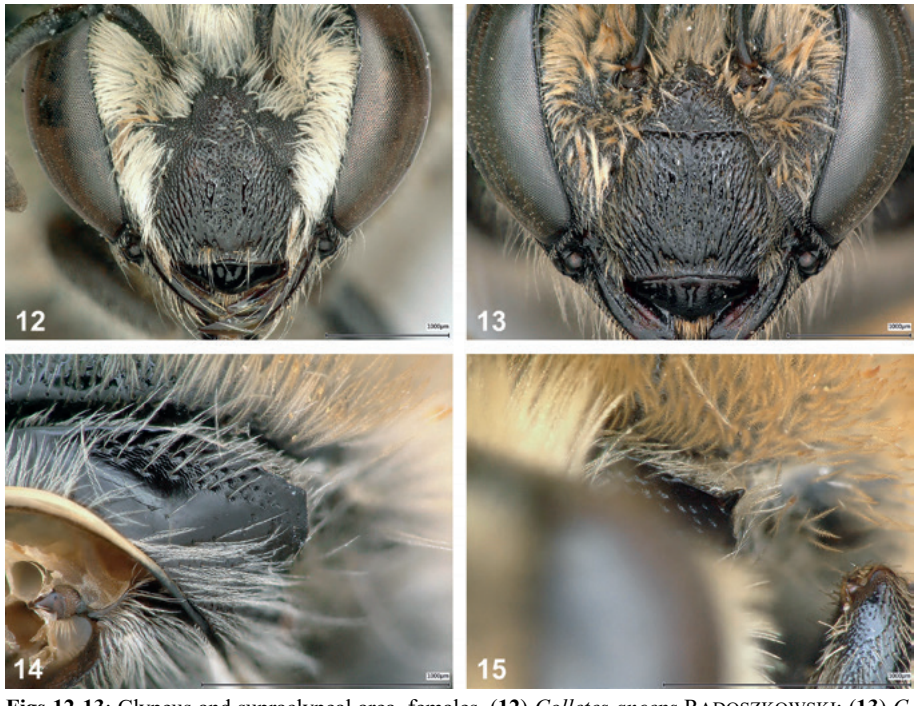
Figs 7-11: Metasomal terga 1-2, females. (**7**) *Colletes alini* KUHLMANN; (**8**) *C. anceps* RADOSZKOWSKI; (**9**) *C. caspicus* MORAWITZ; (**10**) *C. esakii* HIRASHIMA; (**11**) *C. seitzi* ALFKEN.

Females

1 Glabrous medial part of the disc of T1 narrow, at most ± as wide as width of apical tergal hair band (Figs 7, 11) 2

- Glabrous medial part of the disc of T1 broad, at least about 1.5-2 times as wide as width of apical tergal hair band (Figs 8-10) 3

2 Dorsal pubescence light yellowish to whitish; disc of T1 with finer punctation, punctures ± as wide as width of appressed hairs (Fig. 7); dorsolateral angle of the pronotum ± rectangular to rounded (cf. Fig. 14); East Asian mainland..... *C. alini* KUHLMANN



Figs 12-13: Clypeus and supraclypeal area, females. (**12**) *Colletes anceps* RADOSZKOWSKI; (**13**) *C. esakii* HIRASHIMA. **Figs 14-15**: Dorsolateral angle of the pronotum, females. (**14**) *C. caspicus* MORAWITZ; (**15**) *C. seitzi* ALFKEN.

- Dorsal pubescence intense orange-brown; disc of T1 with coarser punctation, punctures ± twice as wide as width of appressed hairs (Fig. 11); dorsolateral angle of the pronotum with a pointed spike (Fig. 15); endemic to Japan..... *C. seitzi* ALFKEN

3 Disc of T1 coarsely and sparsely punctate (i = 1-1.5d) (Fig. 9) .....*C. caspicus* MORAWITZ

- Disc of T1 finely and densely punctate (i < d) (Figs 8, 10).....4

4 Clypeus with a distinct median longitudinal depression, supraclypeal area narrow (Fig. 12); punctation on discs of T1 and T2 slightly finer and shallower (Fig. 8); East Asian mainland..... *C. anceps* RADOSZKOWSKI

- Clypeus without or only with very slight median longitudinal depression, supraclypeal area broad (Fig. 13); punctation on discs of T1 and T2 slightly coarser and deeper (Fig. 10); endemic to Japan..... *C. esakii* HIRASHIMA

Males

1 Disc of T2 ± twice as wide as width of apical tergal hair band (Figs 22, 23).....2

- Disc of T2 ± as wide as width of apical tergal hair band (Figs 2, 20, 21).....3

2 Discs of T1 and T2 coarsely and sparsely punctate (i = 0.5-1.5d) (Fig. 22); apical hair fringe of S5 sparse, whitish, medially shorter (Fig. 18); East Asian mainland..... ..... *C. caspicus* MORAWITZ

- Discs of T1 and T2 finely and densely punctate (i < d) (Fig. 23); apical hair fringe of S5 dense, yellowish to orange, medially longer (Fig. 19); endemic to Japan..... ..... *C. esakii* HIRASHIMA

Figs 16-19: Apical hair fringe of S5, males. (**16**) *Colletes alini* KUHLMANN; (**17**) *C. anceps* RADOSZKOWSKI; (**18**) *C. caspicus* MORAWITZ; (**19**) *C. esakii* HIRASHIMA.

3 Dorsal pubescence orange-brown (Fig. 1); disc of T1 with coarser punctation (Fig. 3); apical hair fringe of S5 as in Fig. 4; endemic to Japan ..... *C. seitzi* ALFKEN

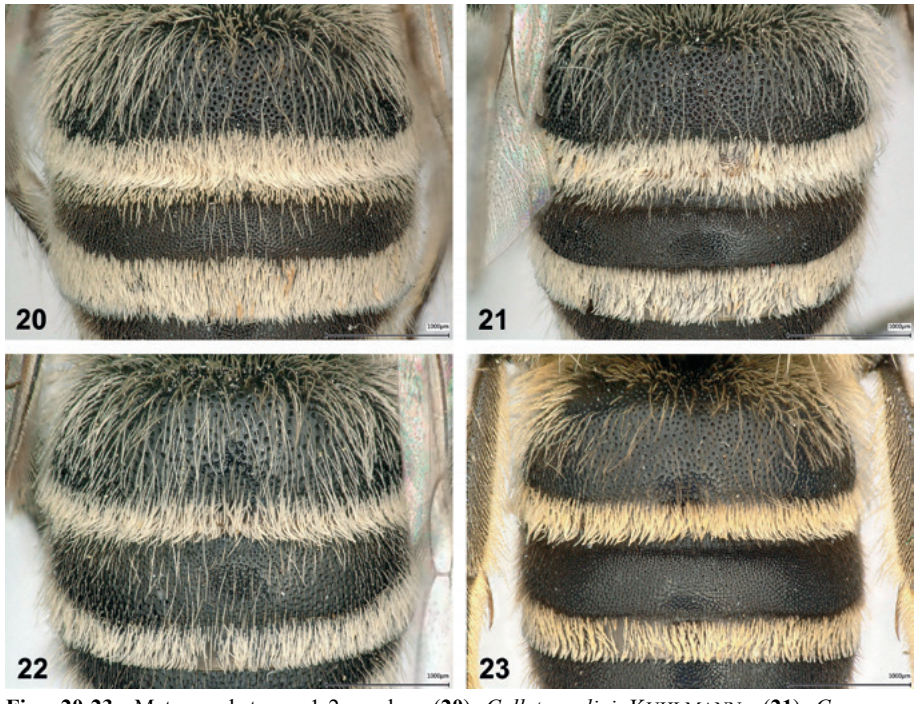
\- Dorsal pubescence light yellowish to whitish; disc of T1 with finer punctation (Figs 20, 21); apical hair fringes of S5 as in Figs 16, 17; East Asian mainland 4

4 Apical hair fringe of S5 medially gradually elongated, the elongated part consists of many hairs (Fig. 17); disc of T2 without erect, long hairs (very rarely single such hairs) (Fig. 21)..... *C. anceps* RADOSZKOWSKI

\- Apical hair fringe of S5 medially strongly and suddenly elongated, the elongated part consists of only a few hairs (Fig. 16); disc of T2 with some erect, long hairs (Fig. 20)..... ..... *C. alini* KUHLMANN

Discussion

The male of *C. seitzi* is described for the first time in this paper. As a result, both sexes of all East Asian species of the *C. caspicus* group are now known. Remarkable is the probably small distribution area of *C. seitzi*, which seems to be restricted to the Kantô region. However, this needs to be confirmed by further sampling in the surrounding area. At present the few records are reminiscent of a relict distribution, that was found for *C. jankowskyi* RADOSZKOWSKI in Japan, although in other parts of the country and a different habitat type (semi-natural grassland) (MURAO et al. 2016). After its discovery, *C. seitzi* has not been found in the densely populated vicinity of Yokohama for over a century. Possibly the short period of activity of only around one month has an effect here, making its detection less likely.



Figs 20-23: Metasomal terga 1-2, males. (**20**) *Colletes alini* KUHLMANN; (**21**) *C. anceps* RADOSZKOWSKI; (**22**) *C. caspicus* MORAWITZ; (**23**) *C. esakii* HIRASHIMA.

Of the five East Asiatic species of the *C. caspicus* group, only the biology of *C. esakii* has been studied in detail (MURAO & TADAUCHI 2005, MATSUNO et al. 2009, MIYANAGA et al. 2015). As far as the limited available data on flower visitation allow a conclusion, the oligolecty of *C. esakii* is unique in this species group. Analyses of scopal pollen loads of four species in the western Palaearctic (including *C. caspicus*) show that they are all polylectic (MÜLLER & KUHLMANN 2008). Thus, *C. esakii* prossibly is an interesting exception within the *C. caspicus* group. Further studies on the floral specialisation of this and other species in East Asia would therefore be welcome to confirm this result.

We hope that the identification key presented in this paper helps to promote further research into the East Asian *Colletes* species.

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Zusammenfassung

Das bislang unbekannte Männchen der seltenen Bienenart *Colletes seitzi* ALFKEN, 1900 wird beschrieben. Die Art ist in Japan endemisch und gehört zur *C. caspicus*-Artengruppe. Ein illustrierter Bestimmungsschlüssel der fünf ostasiatischen Arten der Verwandtschaftsgruppe wird vorgelegt.

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