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A revision of the Palaearctic Pimeliini (Coleoptera: Tenebrionidae): the genus *Sternodes* Fischer von Waldheim, 1837

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Abstract. The genus *Sternodes* Fischer von Waldheim, 1837 currently consists of one species with two subspecies from Karakum, Sundukli deserts and several surrounding areas. *Sternodes pallasi* Semenov-Tian-Shanskij et Bogatchev, 1940 is resurrected from a junior synonym of *Sternodes caspicus* (Pallas, 1781). The following new synonymy is established: *Sternodes caspicus caspicus* (Pallas, 1781) = *Sternodes caspicus eous* Semenov-Tian-Shanskij et Bogatchev, 1940, **syn. n.** The lectotype is designated for *S. caspicus eous*. As a result, two valid species (without subspecies) are known in the genus. They differ in the structure of head, prosternal process and elytra. Both species are sympatric in Repetek (Karakum Desert, eastern Turkmenistan), but *S. caspicus* has spring-summer activity, while *S. pallasi* was collected in late autumn.

Key words: resurrected species, new synonymy, Tenebrionidae, Pimeliinae, Middle Asia, sand deserts.

Ревизия палеарктических Pimeliini (Coleoptera: Tenebrionidae): род *Sternodes* Fischer von Waldheim, 1837

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Резюме. В современном понимании род *Sternodes* Fischer von Waldheim, 1837 состоит из одного вида с двумя подвидами из пустынь Каракум, Сундукли и некоторых близлежащих территорий. Один таксон восстановлен из младших синонимов *Sternodes caspicus* (Pallas, 1781): *Sternodes pallasi* Semenov-Tian-Shanskij et Bogatchev, 1940, **sp. resurr.** Установлена следующая новая синонимия: *Sternodes caspicus caspicus* (Pallas, 1781) = *Sternodes caspicus eous* Semenov-Tian-Shanskij et Bogatchev, 1940, **syn. n.** Для *S. caspicus eous* обозначен лектотип. В результате в роде *Sternodes* известно два валидных вида без подвинов. Они отличаются строением головы, простерального отростка и надкрылий. Оба вида симпатрично обитают в Репетеке (пустыня Каракум, Восточный Туркменистан), но *S. caspicus* имеет весенне-летнюю активность, тогда как *S. pallasi* был собран поздней осенью.

Ключевые слова: восстановленный вид, новая синонимия, Tenebrionidae, Pimeliini, Средняя Азия, песчаные пустыни.

According to current literature, the genus *Sternodes* Fischer von Waldheim, 1837 consists of one species with two subspecies [Iwan et al., 2020]: *S. caspicus caspicus* (Pallas, 1781) from western Turkmenistan and *S. caspicus eous* Semenov-Tian-Shanskij et Bogatchev, 1940 from eastern Turkmenistan, Uzbekistan and some border territories of Iran and Afghanistan [Kühnelt, 1957; Medvedev, Nepesova, 1985]. The northern border of *S. caspicus* range is limited by Amudarya River, and the eastern by the Bukhara oasis (based on the collection of the Zoological Institute of the Russian Academy of Sciences (ZIN, St Petersburg, Russia)). Thus, the species is absent in Kyzylkum Desert. The species lives on sand dunes and is well adapted for moving along shifting sands [Medvedev, 1965]. Adults feed on a wide range of herbaceous plants and organic matter [Sumakov, 1908; Nepesova, 1980; Kaplin, 2008].

Sternodes caspicus is one of the most recognizable desert species of the Palaearctic due its large size and white

pattern on the elytra. This circumstance has led to its use both in various biological and ecological studies [Faussek, 1906; Sumakov, 1908; Medvedev, 1965; Medvedev, 2004; Zotov, Alpatov, 2004; Kaplin, 2008, 2019, etc.] and as a commercial object coveted in private collections.

This study continues a series of papers on the taxonomy of Palaearctic Pimeliini published by the first author and his colleagues [Chigray, 2019; Chigray et al., 2022], where several genera were analyzed. Below we briefly review all known taxa of the species rank in the genus *Sternodes*, which was revised 84 years ago [Semenov-Tian-Shanskij, Bogatchev, 1940].

Material and methods

Material is deposited in ZIN.

Beetles were studied using binocular microscopes Micromed MC-4 Zoom Led. Beetle photographs were taken

with a Canon EOS 5D Mark IV Body, Canon MP-E65MM F2.8 Macro lens and Canon Macro Twin Lite MT-26X-RT flash bulb, and stacking was done using Stack-shot 3X with enlarged macro rails s/n 3734; the photosystem is installed on a Kaiser Copy Stand RS 1 reproduction machine. Images were stacked in Helicon Focus 7.7.4 Pro.

One specimen of *S. caspicus* cleaned in an ultrasonic bath with detergent at 70 °C, three times for 20 minutes with a break of several hours (with the ultrasound turned off and a temperature of 50 °C). After washing, the surface was cleaned with 96% ethanol and ethyl acetate. This made it possible to completely clear the elytra from wax coating. The remaining dry beetles were moistened in a desiccator for subsequent dissection to preserve the waxy crust.

Sternodes Fischer von Waldheim, 1837

Type species *Sternodes karelini* Fischer von Waldheim, 1837 by monotypy.

Diagnosis of the genus was given by Medvedev and Nepesova [1985].

Sternodes caspicus (Pallas, 1781) (Figs 1–12)

Tenebrio caspicus Pallas, 1781: 47, tab. C, fig. 13.

= *Sternodes karelini* Fischer von Waldheim, 1837: 11, tab. 1 (synonymized by Ménétriés [1849]).

= *Sternodes caspicus eous* Semenov-Tian-Shanskij et Bogatchev, 1940: 204, **syn. n.**

Type material. Lectotype of *Sternodes caspicus eous* (Figs 4, 5), ♂ (ZIN), designated here: “Закасп. обл.: Пенетек 12.V.1889. А. Семенов” (Transcaspien region, Repetek, leg. A. Semenov; now in Turkmenistan: 38°33'45"N / 63°10'38"E), “*Sternodes caspicus eous* sbsp. nov. Semenov T. Sh. & A. Bogačev det. typ.”, “Lectotypus *Sternodes caspicus eous* Semenov et Bogatchev, 1940 des. M. Nabozhenko, 2024”. Paralectotypes: 157 specimens (ZIN) from Turkmenistan (Repetek, Farab, Chardzhou) and Uzbekistan (surroundings of Bukhara, Sundukli Desert, Dengizkul Lake), date range from April to July 1887–1891.

Material. 120 specimens: Turkmenistan: “Trans Caspi G. Turkmenien”, “Turkomania”, Krasnovodsk (now Türkmenbaşy), Cheleken Peninsula, Dordzha Peninsula, Jebel, Akhcha-Kuyma, Neftedag and Nebitdag (now Balkanabat and surroundings), north of Ashgabat, Repetek, Chardzhou, Farab; Uzbekistan: Khiva. Date range from the late March to the early August 1887–1990.

Notes. Pallas [1781] described this species under the name *Tenebrio caspicus* from the eastern coast of the Caspian Sea. Later Fischer von Waldheim [1837] erected the genus *Sternodes* with one species *S. karelini* Fischer von Waldheim, 1837 (junior synonym of *S. caspicus*). Semenov-Tian-Shanskij and Bogatchev [1940] described a new subspecies, *S. caspicus eous* from eastern Karakum and Sundukli Desert, which is distinguished from the nominotypical subspecies (western Karakum) in the following characters: body is little larger, granules on glabrous stripes are less expressed and sparser, second (outer) glabrous stripe has additional oblique branch directed forward (Figs 1, 6, *alb*). This branch was the main diagnostic character in the original diagnosis. They did not take into account that the description of *S. karelini* is supplied with high-quality images, which clearly show the absence of lateral branches on the second glabrous elytral stripe, as in their *S. caspicus eous*. Kryzhanovskij [1961] confirmed both subspecies and, like his teacher A.P. Semenov-Tian-Shanskij, used their distribution to

argue for the differences between the coleopteran fauna in the western and eastern Karakum. Skopin [1962] ignored *S. caspicus eous* for larva collected in Repetek, the type locality of the subspecies. Later, Kryzhanovskij [1965] listed only the species *Sternodes caspicus* without subspecies. Medvedev with coauthors [Medvedev, 1965; Medvedev, Nepesova, 1985] also did not recognize the existence of two subspecies of *Sternodes*. They used only a species name for *S. caspicus* without two subspecies. Meanwhile, Bogatchev [1965] did not agree with the opinion of three mentioned colleagues and continued to indicate two subspecies as valid taxa. Thus, although the subspecies *S. caspicus eous* has not been indicated by several Russian authors since 1962, it was not formally synonymized, and listed in the catalogue [Iwan et al., 2020] as a valid subspecies.

Examination of more than 300 specimens of *S. caspicus* from all the range confirms slight differences between western and eastern populations of this species: oblique short branch on the second glabrous stripe is more common in individuals from western Turkmenistan. However, some individuals in western populations have not this branch (Fig. 2), and specimens from eastern populations (including those from the type locality) have the lateral branch of stripe (Fig. 6). In both populations we can find specimens with an intermediate state of this character: the branch is very short, sometimes expressed only on one elytron. Such characters as body size and density of small elytral granules are strongly variable in different populations. Male genitalia are identical in western and eastern populations. Thus, the following new synonymy is proposed: *Sternodes caspicus caspicus* (Pallas, 1781) = *Sternodes caspicus eous* Semenov-Tian-Shanskij et Bogatchev, 1940, **syn. n.**

Distribution. Turkmenistan: from the Caspian Sea to the right bank of Amudarya River (ZIN material); Uzbekistan: Khorezm region: Karakum Desert south of Khiva, Sundukli Desert (ZIN material); Iran: Lotfabad, Iranian-Turkmen border [Kühnelt, 1957; Kryzhanovskij, 1965]; Afghanistan: Kushka (formerly a village of the same name located on the Turkmen and Afghan sides of the Kushka River, now Serhetabat in Turkmenistan and Torgundi in Afghanistan) [Kühnelt, 1957].

Sternodes pallasi

Semenov-Tian-Shanskij et Bogatchev, 1940, **sp. resurr.**
(Figs 13–19)

Sternodes pallasi Semenov-Tian-Shanskij et Bogatchev, 1940: 205.

Material. 1 ex., holotype (ZIN), goldish circle, “Пенетек 23.10.38 г. Виноградов” (Repetek, leg. B.S. Vinogradov), “Type *Sternodes pallasi* sp. n. A. Semenov T. Sh. A. Bogačev det.”, “Holotypus *Sternodes pallasi* Semenev et Bogačev det. 1940”.

Notes. This species was described by one specimen from the same type locality as *Sternodes caspicus eous*. Kryzhanovskij [1965: 170] mentioned this with the words “maybe deformity?”. Medvedev and Nepesova [1985: 87] interpreted this taxon as a junior synonym of *S. caspicus*: “*S. pallasi* Sem. et A. Bog., described from Repetek, represents an evasive specimen of *S. caspicus* Pall.”. However, differences between the holotype of *S. pallasi* and *S. caspicus* are so extensive and fundamental that this cannot be a deformity or variability. Probably, doubts of



Figs 1–6. *Sternodes caspicus*, habitus, labels.

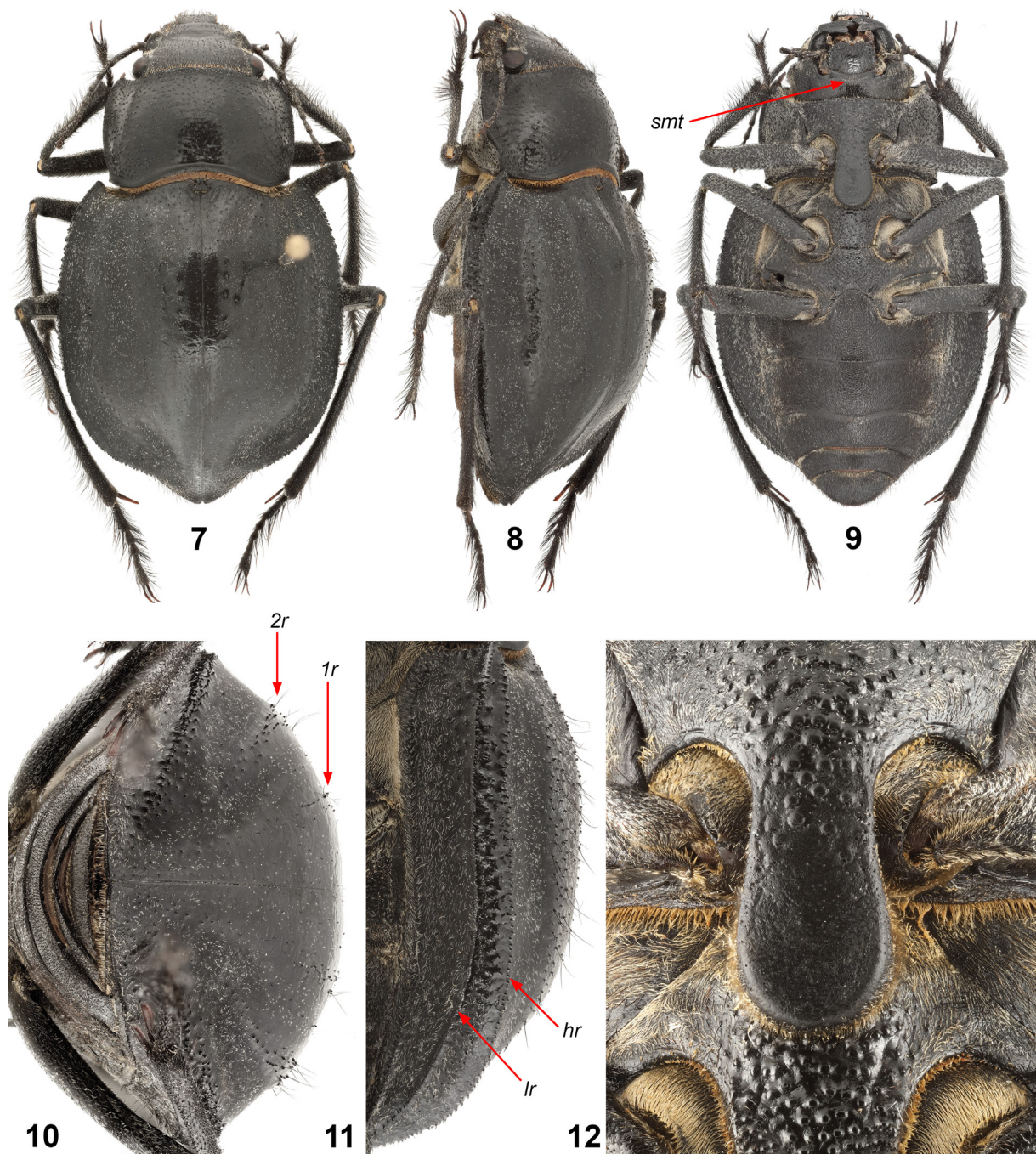
1 – western Turkmenistan, Caspian coast; 2 – western Turkmenistan, Akhcha-Kuyma; 3 – eastern Turkmenistan, Repetek, non-type; 4 – lectotype of *S. caspicus eous*, Repetek; 5 – labels of the lectotype; 6 – Repetek, non-type. *1r* – first glabrous row of tubercles, *2r* – second glabrous row of tubercles, *alb* – additional lateral branch of tubercles.

Рис. 1–6. *Sternodes caspicus*, общий вид, этикетки.

1 – Западный Туркменистан, каспийское побережье; 2 – Западный Туркменистан, Ахча-Куйма; 3 – Восточный Туркменистан, Репетек, не типовой экземпляр; 4 – лектотип *S. caspicus eous*, Репетек; 5 – этикетки лектотипа; 6 – Репетек, не типовой экземпляр. *1r* – первый голый ряд зернышек, *2r* – второй голый ряд зернышек, *alb* – дополнительный латеральный ряд зернышек.

O.L. Kryzhanovskij and G.S. Medvedev were due to the fact that the species was never discovered after the original description, despite intensive research of the Repetek Reserve by Soviet scientists. However, the authors of the original description also paid special attention to the fact that the beetle was found at the end of October and *S. pallasi* is a late autumn or possibly even a winter species [Semenov-Tian-Shanskij, Bogatchev, 1940: 205]. Almost all specimens of *S. caspica* (more than 300 in ZIN) were

collected from the end of March to July, two very worn specimens, deposited in ZIN, were collected in mid-August. Four paralectotypes of *S. caspicus eous* were collected by Prof. B.S. Vinogradov 16 October in Repetek, but they are broken and worn out and were probably already dead at the time of collection. Apart from Vinogradov's autumn collections in 1938, no one collected *Sternodes* in Repetek in late autumn. This can explain the attempt to “hide” this taxon in synonyms and forget about it.



Figs 7–12. *Sternodes caspicus* (Turkmenistan, Akhcha-Kuyma), habitus and details of structure, waxy coating removed. 7 – habitus dorsally; 8 – habitus dorso-laterally; 9 – habitus ventrally; 10 – elytra, posterior view; 11 – elytra, lateral view; 12 – prosternal process. *smt* – submentum; *1r* – first glabrous row of tubercles; *2r* – second glabrous row of tubercles; *hr* – humeral row of tubercles; *lr* – lateral row of tubercles.

Рис. 7–12. *Sternodes caspicus* (Туркменистан, Ахча-Куйма), габитус и детали строения, восковой налет удален.

7 – габитус дорсально; 8 – габитус дорсо-латерально; 9 – габитус вентрально; 10 – надкрылья, вид сзади; 11 – надкрылья латерально; 12 – простернальный отросток. *smt* – субментум; *1r* – первый голый ряд зернышек; *2r* – второй голый ряд зернышек; *hr* – плечевой ряд зернышек; *lr* – боковой ряд зернышек.

As Semenov-Tian-Shanskij and Bogatchev [1940] correctly pointed out, the main difference between *S. pallasi* and *S. caspicus* is the absence of a white waxy crust on the elytra and even the alternation of areas with dense small grains and smooth areas where it could be located (Figs 13, 14). The second important diagnostic

character is the different structure of the prosternal process (Fig. 17). Professor B.S. Vinogradov experimented with live beetles *in situ*, in which he proved that the white crust of *Sternodes caspicus*, after removal, is restored again when fed with potato starch [Semenov-Tian-Shanskij, Bogatchev, 1940]. Some specimens in ZIN collection are worn, but



Figs 13–19. *Sternodes pallasii*, holotype, habitus, details of structure and labels.

13 – habitus dorsally; 14 – habitus dorso-laterally; 15 – habitus ventrally; 16 – habitus ventro-laterally; 17 – prosternal process; 18 – anterior half of elytra laterally; 19 – labels of the holotype. *hr* – humeral row of tubercles; *lr* – lateral row of tubercles; *smt* – submentum.

Рис. 13–19. *Sternodes pallasii*, голотип, габитус, детали строения и этикетки.

13 – габитус дорсально; 14 – габитус дорсо-латерально; 15 – габитус вентрально; 16 – габитус вентро-латерально; 17 – простернальный отросток; 18 – передняя половина надкрылий латерально; 19 – этикетки голотипа. *hr* – плечевой ряд зернышек; *lr* – латеральный ряд зернышек; *smt* – субментум.

individuals without crust are absent. To remove the crust, we washed the dry specimen three times in an ultrasonic bath at high temperature, and then tried to remove the residue with ethyl acetate. The above experiments and elytral structures indicate that *S. pallasii* is a species that

does not have a waxy white crust originally. Since the crust protects the beetles from overheating and reflects the sun's rays, it is logical to assume that a late-autumn species like *S. pallasii* that lives in moderate or even relatively low temperatures does not require a protective waxy layer.

Table 1. Differences between two species of the genus *Sternodes*.
Таблица 1. Различия между двумя видами рода *Sternodes*.

<i>Sternodes caspicus</i>	<i>Sternodes pallasii</i>
Submentum not depressed (Fig. 9, <i>smt</i>) / Субментум не вдавленный (рис. 9, <i>smt</i>)	Submentum depressed (Figs 15, 16, <i>smt</i>) / Субментум вдавленный (рис. 15, 16, <i>smt</i>)
Prosternal process wide, widely rounded at apex (Fig. 12) / Простернальный отросток широкий, широко закругленный на вершине (рис. 12)	Prosternal process narrow, with sub-acute narrowing apex (Fig. 17) / Простернальный отросток узкий, сужающийся, с почти острой вершиной (рис. 17)
Humeral angles strongly projected, acute (Figs 1–4, 6–8) / Плечевые углы сильно выступающие, острые (рис. 1–4, 6–8)	Humeral angles not projected, obtuse, rounded apically (Figs 13–15) / Плечевые углы не выступающие, тупые, закругленные на вершине (рис. 13–15)
Elytra and pseudopleura with white waxy coating or crust (Figs 1–4, 6) / Надкрылья и псевдоэпиплевры с белым восковым налетом или коркой (рис. 1–4, 6)	Elytra and pseudopleura without white waxy coating or crust (Figs 13–14) / Надкрылья и псевдоэпиплевры без воскового налета или корки (рис. 13–14)
Elytra with two wide longitudinal rows of tubercles without white coating and with small tubercles bearing short subrecumbent straight and bent and very long erected straight setae (Figs 10–11); inner and middle white rows without small tubercles, but with one line of sparse large tubercles bearing long erected setae (well visible at Figs 3, 4, 6) / Надкрылья с двумя продольными рядами зернышек без белого налета и с маленькими зернышками, несущими короткие полуприлегающие прямые и изогнутые щетинки и очень длинные торчащие щетинки; внутренний и средний белый ряды без маленьких зернышек, но с одной линией редких более крупных бугорков, несущих длинные торчащие щетинки (хорошо видны на рисунках 3, 4, 6)	Elytra evenly covered with small tubercles bearing short recumbent bent setae (Figs 13, 14, 18) / Надкрылья равномерно покрыты маленькими зернышками, несущими короткие прилегающие изогнутые щетинки (рис. 13, 14, 18)
Dorsal elytral surface along lateral side under waxy coating depressed and covered with very fine, short white recumbent pubescence (Figs 7, 8, 10, 11) / Дорсальная поверхность вдоль бокового края под восковым налетом вдавлена и покрыта очень тонким и коротким белым опушением (рис. 7, 8, 10, 11)	Dorsal elytral surface evenly convex and glabrous between tubercles (Figs 13, 14) / Дорсальная поверхность надкрылий равномерно выпуклая и голая между зернышками (рис. 13, 14)
Humeral row of acute granules forms lateral margin of elytra, and lateral row of microgranules located on ventral side between lateral margin and pseudopleura (Figs 8, 11) / Плечевой ряд заостренных зерен образует боковой край надкрылий, а латеральный ряд микрогранул расположен на вентральной подогнутой стороне между наружным краем и псевдоэпиплеврами (рис. 8, 11)	Humeral row of acute granules located on dorsal side, and lateral row of microgranules forms lateral margin of elytra and does not shift on ventral side (Fig. 14) / Плечевой ряд заостренных зерен расположен на дорсальной стороне, а латеральный ряд микрогранул образует боковой край надкрылий и не смещается на вентральную сторону (рис. 14)

Diagnostic characters of both species are presented in Table 1.

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