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RESEARCH ARTICLE

Resurrection of the name *Limnia testacea* (Diptera: Sciomyzidae), with *L. setosa* as a new synonym, and the first record of *L. testacea* from Mongolia

Восстановление названия *Limnia testacea* (Diptera: Sciomyzidae), его новая синонимия с *L. setosa* и первая находка *L. testacea* из Монголии

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Abstract. The status of the names *Pherbina testacea* (Sack, 1939) and *Limnia setosa* Yano, 1978 is revised based on the examination of the type material of both the species, additional specimens and an analysis of the published data. The following taxonomic changes are proposed: *Ph. testacea* is returned to the genus *Limnia*, as *Limnia testacea*, **comb. resurr.**, and *L. setosa*, **syn. nov.**, is placed in synonymy with *L. testacea*. The records of *L. testacea* (under both names) are reviewed. *Limnia testacea* is recorded for the first time from Mongolia, which considerably extends the range of this species.

Резюме. Статус названий *Pherbina testacea* (Sack, 1939) и *Limnia setosa* Yano, 1978 пересмотрен на основе изучения типового материала обоих видов, дополнительных экземпляров и анализа ранее опубликованных данных. Предлагаются следующие таксономические изменения: вид *Ph. testacea* возвращен в род *Limnia*, как *Limnia testacea*, **comb. resurr.**, а *L. setosa*, **syn. nov.**, рассматривается в качестве младшего синонима *L. testacea*. Выполнен обзор находок *L. testacea* (под обоими названиями). *Limnia testacea* впервые отмечен из Монголии, что значительно расширяет ареал вида.

Keywords: snail-killing flies, distribution, Palaearctic, synonymy, Acalyptratae, Sciomyzidae

Ключевые слова: мухи-моллюскоеды, распространение, Палеарктика, синонимия, Acalyptratae, Sciomyzidae

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Introduction

Pherbina Robineau-Desvoidy, 1830, *Psacadina* Enderlein, 1939 and *Limnia* Robineau-Desvoidy, 1830 are three typical genera in the tribe Tetanocerini of the family Sciomyzidae. The generic concepts of these genera are well accepted, with several publications available to use in keying them out. However, *Pherbina testacea* (Sack, 1939) and *Limnia setosa* Yano, 1978 are remarkable in having some atypical characters that cause difficulties in associating them to either *Pherbina* or *Limnia*.

Pherbina testacea is an enigmatic, poorly known species. Sack (1939) described this species as *Limnia testacea* based on three females from "Charbin" (Harbin, northeastern China). At that time, *Limnia* was known as a diverse and speciose genus, with many of its members later being moved to the genera *Euthycera* Latreille, 1829 and *Pherbina*. Although the textual description of *L. testacea* in Sack (1939) was rather good, no

figures were given, which resulted in researchers being unable to fully interpret the species concept. Leclercq (1981) examined the same three specimens from Harbin, designated a lectotype and two paralectotypes, and transferred the species to *Pherbina*. Although Leclercq (1981) provided important drawings of the cell r_1 of both the lectotype and the paralectotype, he did not discuss this taxonomic change. Rozkošný (1992) was able to associate a male specimen with a series of female specimens from the Russian Far East. He described the male for the first time and provided drawings of the terminalia, sterna 4–6, the hypandrium, and the phallus. No other publications about *Ph. testacea* are known.

Yano (1978) thoroughly described *Limnia setosa* from three males and four females, all from Honshu, Japan. Sueyoshi (2001, 2005, 2010) have listed further records from Japan, which indicate that the species is widespread in this country. Rozkošný (1987) copied the drawings of Yano (1978) in his review of the Palaearctic Sciomyzidae but did not study any specimens. Przhiboro (2016) documented *L. setosa* for the first time from Russia (Iturup Island) and provided very detailed pictures of the epandrium and hypandrium. He commented on the slight differences between the Russian specimens and the Japanese type material depicted in Yano (1978) and Rozkošný (1978) (see later in this paper for details) but did not question the identification of the Iturup Island specimen as *L. setosa*. Finally, in 2013 W.L. Murphy (Indiana, USA) identified as *L. setosa* two specimens collected in Mongolia in 2005, that were among the unidentified material in the collection of the University of Delaware (UDCC, Newark, USA), by using the keys in Rozkošný (1987).

Material and methods

The author borrowed and examined the lectotype and two parelectotypes of *Pherbina testacea* from the Senckenberg Deutsches Entomologisches Institut (SDEI), Müncheberg. Toshiharu Mita and Shunsuke Tomura provided the author with detailed photos of the male holotype of *Limnia setosa* from the Insect Collection of the Entomological Laboratory, Faculty of Agriculture, Kyushu University Museum (ELKU). The author borrowed unidentified Sciomyzidae, including a male specimen from the Russian Far East, from the Natural History Museum of Sweden (NRM), Stockholm. With prior approval from the collection manager, Yngve Brodin, this specimen was dissected to enable examination of the terminalia. The identifications of *L. setosa* from Mongolia by Murphy were also used. The data for all these specimens are listed below.

Several additional types and non-type specimens were examined: the paratype of *Limnia paludicola* Elberg, 1965 borrowed from the Royal Belgian Institute of Natural Sciences; the holotype of *Psacadina kaszabi* Elberg, 1979 kept at the Hungarian Natural History Museum was depicted by Zoltán Soltész and these pictures were provided to the author; the specimens of *Pherbina mediterranea* Mayer, 1953, *Ph. intermedia* Verbeke, 1948, *Ph. coryleti* (Scopoli, 1763), *Psacadina verbekei* Rozkošný, 1975, *P. zernyi* Mayer, 1953, *P. disjecta* Enderlein, 1939, *P. vittigera* (Schiner, 1864), the proposed holotype and paratypes of an undescribed species of *Psacadina* Enderlein, 1939, the specimens of *Limnia unguicornis* (Scopoli, 1763), *L. paludicola*, and the Nearctic species *L. ottawensis* Melander, 1920 and *L. louisianae* Melander, 1920, all from the personal collection of J. Mortelmans.

Morphological examination of the specimens was performed with a Novex AR-Zoom stereomicroscope with 40× magnification. The male genitalia were examined, general measurements were made and the photographs of the specimens were taken by use of a Leica M205 stereomicroscope with up to 160× magnification at the LifeWatch Marine Observatory (Flanders Marine Institute, Ostend, Belgium). To prepare the male terminalia for examination, the author employed a technique commonly used to study Sciomyzidae: (1) complete removing the abdomen, (2) soaking the abdomen for 10 minutes in warm KOH, (3) soaking the abdomen for 20 minutes in tap water, (4) soaking the abdomen for 10 minutes more in EtOH/HCl, and (5) soaking the abdomen for 20 minutes more in tap water. After examination, the macerated abdomen is placed in a plastic micro vial containing a few drops of glycerine, and the micro vial is then pinned beneath the specimen. Terminology used in this paper follows that of Cumming & Wood (2009).

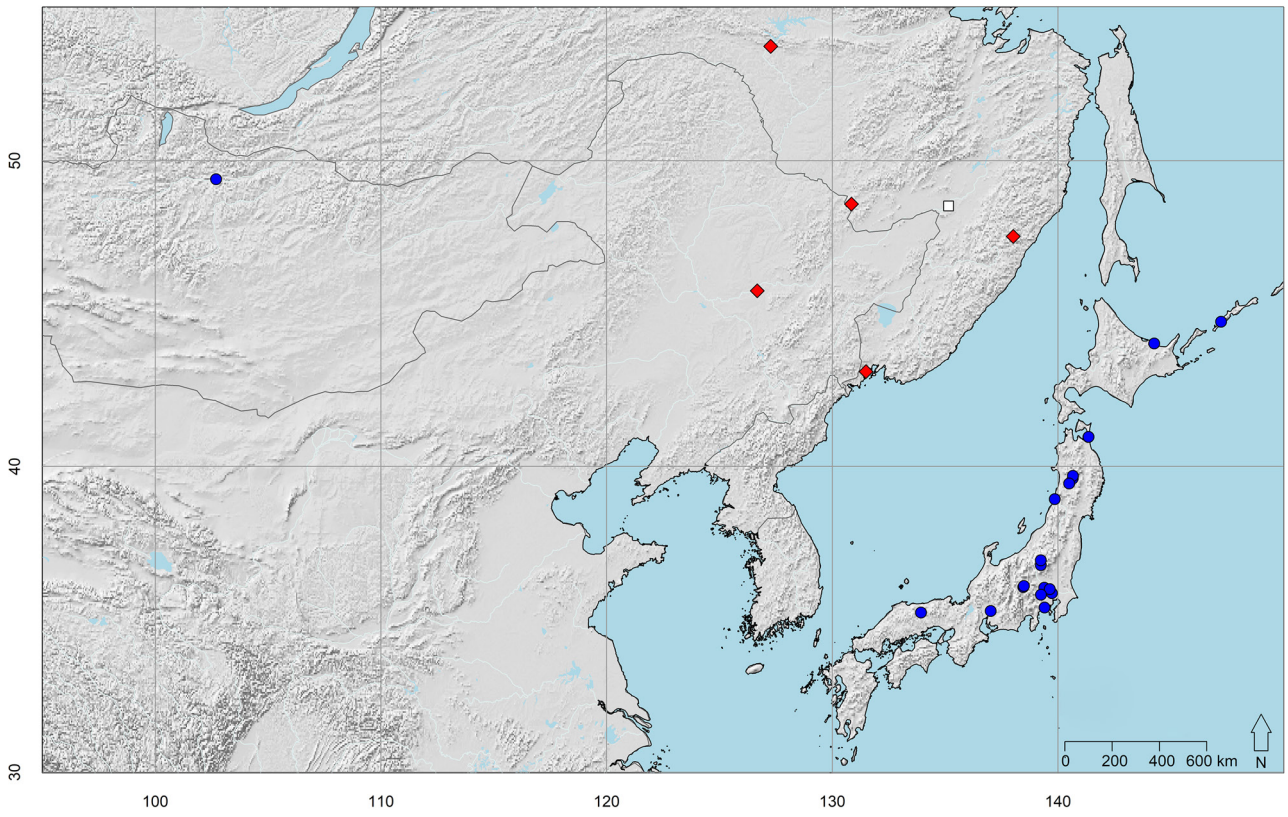

Fig. 1. Distribution of *Limnia testacea* mostly based on published records (blue circles, as *Limnia setosa*; red squares, as *Pherbina testacea*; white squares, newly identified material). For this map, the data from Sack (1939), Yano (1978), Rozkošný (1992), Sueyoshi (2001, 2005, 2010) and Przhiboro (2016) are georeferenced, together with two unpublished records from Mongolia and the Khabarovsk Terr. (Bol'shekhekhtsirskiy Nature Reserve).

Results

Family **Sciomyzidae**

Subfamily **Sciomyzinae**

Tribe **Tetanocerini**

Limnia testacea Sack, 1939, **comb. resurr.**
(Figs 2–6)

Limnia testacea Sack, 1939: 73.
Limnia setosa Yano, 1978: 7, **syn. nov.**

Type material examined. *Lectotype of Pherbina testacea*, female, **China**, "Mandchourie, Charbin / 26.VII.1937. W. Alin" (SDEI). *Paralectotypes of Pherbina testacea*: 2 females, with the same labels (SDEI). *Holotype of Limnia setosa*, male [examined by author from photos], **Japan**, "Type N° 2083 / Holotype *Limnia setosa* Yano male / Japan, Honshu, Aichi, Kasugai, 15 V 1965, T. Okadome / sweeping paddy field" (ELKU).

Additional material examined. **Russia**, *Khabarovsk Terr.*, 1 male, Bol'shekhekhtsirskiy Nature Reserve, sweep-net, 26.VI.1993, B.A.V. Viklund leg. (NHRS-BYWS 0002711 / Loan 053/2018; NRM). **Mongolia**, *Bulgan Aimag*: 1 male, 1 female [not examined by author], 20.7 km ESE of Khutag-Öndör, 49.39419°N 102.69452°E, 25–26.VII.2005, C.R. Bartlett leg., W.L. Murphy det. (UDCC).

Resurrection of the name *Limnia testacea* Sack, 1939

The generic concepts of *Limnia*, *Pherbina* and *Psacadina* are well accepted. The best keys for identifying the genera of Sciomyzidae from the Palaearctic are found in Rozkošný (1987, 1998) and, more recently, in Knutson & Vala (2011). The author tested these three commonly used keys with the type materials of *L. setosa* and *Ph. testacea*, and these types keyed out *Limnia* confidently. The couplets in Rozkošný (1987, 1998) and in Knutson & Vala (2011) used to discriminate *Limnia* from other Tetanocerini

Figs 2, 3. Lectotype of *Limnia testacea* Sack, 1939 (female), lateral (2) and dorsal (3) view.

(including *Pherbina*) are based on (1) the arista with short whitish hairs and (2) the scutum with conspicuous longitudinal stripes. These two characters are obvious in both *L. setosa* and *Ph. testacea*. Regional keys, e.g. those in Sueyoshi (2001, 2010), also returned *Limnia* when run against the type materials of *L. setosa* and *Ph. testacea*.

Several publications have questioned the taxonomic position of *L. setosa* and *Ph. testacea*; they are summarised below (1–5):

(1) Verbeke (1960) gave a good overview by which to separate *Pherbina* (as *Pherbina*, subgenus *Pherbina*) and *Psacadina* (as *Pherbina*, subgenus *Verbekea* Mayer, 1953), and Knutson et al. (1975) gave excellent information on the biology and immature stages of *Pherbina* and *Psacadina*. Both the publications, unfortunately, do not include *Pherbina testacea* (at that time known as *L. testacea*). This oversight further contributed to the fact that most researchers were unaware of the existence of *Ph. testacea*.

(2) Yano (1978: 9) mentioned that *L. setosa* is somewhat peculiar for a *Limnia*: "The species is somewhat peculiar among the genus in having the following characters. Meso- and pteropleura with some bristles in addition to fine hairs. It has not been treated as a character for the genus *Limnia* (e.g. Knutson & Lyneborg, 1965), but for the allied genus *Pherbina*. Arista of antenna, however, has white hairs in this species, not dark as in *Pherbina*. Subalar bristles and other characters also show that his species belongs to the genus *Limnia*". Yano (1978) has not cited Sack (1939) or Leclercq (1981), so I assume that Yano was unaware of the existence of *Ph. testacea*.

(3) A small paragraph from Rozkošný (1992: 43), while giving the first description of the male of *Pherbina testacea*, says: "Compared with other known species [of *Pherbina*], ventral part of sternum 6 without slender projections, relatively narrow and flat. Hypandrium with bicuspidate ventral process in lateral view, deeply emarginate in middle. Sternum 5 fairly narrow, with pointed distal corners as in other species of the genus [*Pherbina*]." Rozkošný presented here an important deviation of the male terminalia of *Ph. testacea* from that of other *Pherbina*, but he did not question

Leclercq (1981) and retained *Ph. testacea* in *Pherbina*.

(4) Tamaki (1997) listed *Pherbina* sp. from Japan, but this specimen was in fact *L. setosa*, according to Sueyoshi (2001).

(5) Sueyoshi (2001) has remarked that *L. setosa* is distinguished from other Palaearctic species of *Limnia* by having two long setae on the posterior margin of the anepisternum, a single long seta on the anepimeron, and pairs of quadrate dark markings in the cell r_1 beyond the apex of the cell *sc*. He documented variation in the number of subalar, anepimeral and anepisternal setae in *L. setosa*.

The problematic position of and difficulty in identifying *Limnia setosa* and *Pherbina testacea* as well as the various literature records describing an interesting, atypical set of characters, suggested that more was going on. In an attempt to refine the diagnoses of *Limnia*, *Pherbina* and *Psacadina*, important generic characters are summarised in Table 1. The same characters were tested successively on the type materials of both *L. setosa* and *Ph. testacea* to help ascertaining the exact generic position of these two species. A comparison of the data in the columns in this table leaves no doubt that both *L. setosa* and *Ph. testacea* belong to *Limnia* and indicates that Sack (1939) was correct in describing his new species as *Limnia* rather than *Psacadina*.

Table 1, with generic characters, is inconclusive in regard to the setulation of pleura, so the proposal to resurrect *L. testacea* comes with the following remarks:

(1) The presence of setae on the anepimeron is indeed atypical of

Figs 4–6. Types of *Limnia setosa* Yano, 1978 and *L. testacea* Sack, 1939. **4**, **5**, holotype of *L. setosa* (male), lateral (4) and dorsal (5) view; **6**, lectotype of *L. testacea* (female), lateral view illustrating the details of head and pleura.

Limnia. However, setulation is variable and is not considered here as a generic character for *Limnia*. Sueyoshi (2001) gave a thorough overview of this variation, as did Seddighi Sadr & Mohamadzade Namin (2017) when describing *Limnia kassebeeri* Seddighi Sadr et Mohamadzade Namin, 2017, a species also bearing one seta on the anepisternum. Przhiboro (2016) described the setae on *L. setosa* as follows: "In our specimens, some external characters differ from those given by Yano (1978: 7–8, 22–23), Rozkošný (1987: 66, 68) and Sueyoshi (2001: 498, 503; 2010: 5): anepisternum at posterior margin with 1–3 distinct setae varying from fine short to medium sized, anepimeron with one medium sized seta and without hairs."

(2) Other species of Tetanocerini with reticulated wings known from the Palaearctic (besides *Limnia*, *Pherbina* and *Psacadina*) can be differentiated by use of the keys in Rozkošný (1987, 1998) and, more recently, in Knutson & Vala (2011).

When all of these characters are considered, the resurrection of *L. testacea* is doubtless the proper action to take.

Synonymy of *Limnia setosa* Yano, 1978 and *Limnia testacea* Sack, 1939

When trying to associate the male specimen from NRM with either *L. setosa* or *L. testacea*, it has become clear that both the species are extremely similar. The keys, descriptions and redescriptions indicated extreme similarity between *L. setosa* and *Ph. testacea*. Moreover, the published drawings of the male terminalia of both the species are extremely similar as well and do not aid researchers in discriminating between the two species.

Because of the morphological similarities of the males described above, I compared external characters of the female type specimens. It was determined that the type specimens of both *L. setosa* and *Ph. testacea* are without any doubt conspecific. The types of both the species are depicted in Figs 2–6, and the characters are summarised in Table 1.

Limnia setosa Yano, 1978, **syn. nov.** is hereby assigned as a junior synonym of *Limnia testacea* Sack, 1939.

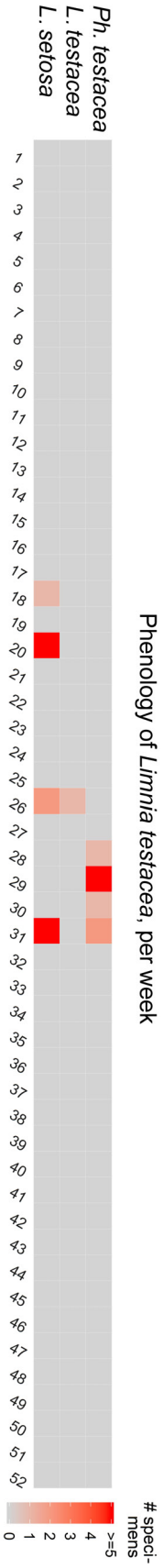

Fig. 7. Seasonal occurrence of *Limnia testacea* mostly based on published records (as *Limnia setosa* or *Pherbina testacea*; the new record is given as *L. testacea*). For this plot, the data from Sack (1939), Yano (1978), Rozkošný (1992), Sueyoshi (2001, 2005, 2010) and Przhiboro (2016) are digitised, together with two unpublished records from Mongolia and the Khabarovsk Terr. (Bol'shekhekhtsirskiy Nature Reserve).

Distribution and seasonal occurrence of *Limnia testacea*

The publications cited in the introduction yielded the data used to generate a distribution map of *L. testacea* (Fig. 1). This species is recorded for the first time from Mongolia, which considerably extends its range to the west. The author was unable to locate any records of *L. setosa* or *L. testacea* other than mentioned in the introduction.

These sources also provided the data used to summarise the seasonal occurrence of *L. testacea* (Fig. 7): the species was collected mainly from late June (week 26) to mid-July (week 31). From Japan, the species is known from May (week 18) to mid-July (week 31). All details on distribution and phenology are available via ScioMapper, an online tool for visualising distributions, phenology, bibliography and taxonomy of the snail-killing flies (Mortelmans, 2019).

Table 1. Generic characters of *Limnia, Pherbina* and *Psacadina*. The same characters are tested for the species duo *L. setosa* and *Ph. testacea*.

Character / Taxon	*Limnia*	*Pherbina*	*Psacadina*	*Pherbina testacea* + *Limnia setosa*
Arista	Entirely white	Entirely black	Entirely black	Entirely white
Frontal vitta	Distinct: narrow, as broad as ocular tubercle	Distinct: large, wide, wider than ocular tubercle	Distinct: rather narrow, narrower than ocular tubercle	Distinct: narrow, as broad as ocular tubercle
Proepisternum (= propleuron)	With setulae, not setae	With setulae, not setae	With setulae, not setae	With setulae, not setae
Anepisternum (= mesopleuron)	With setulae, not setae	With 1–3 strong setae	With 1 strong seta	With 1–3 (weak) setae
Anepimeron (= pteropleuron)	With setulae, not setae	With setae	With setulae, not setae	With setae
Katepisternum (= sternopleuron)	With setulae; setae only ventrally	With setulae; setae only ventrally	With setulae; setae only ventrally	With setulae; setae only ventrally
Subalar seta	Present	Present	Absent	Present
Inner posterior margin of hind coxa	Distinctly haired	With few hairs	Distinctly haired	Distinctly haired
Dark spots in cell r_1	If present, rounded to elongate oval	Rounded to elongate oval	Quadrate (as in *P. disjecta*, *P. vittigera*) to rounded (as in *P. verbekei*, *P. zernyi*)	Quadrate

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