

To the biology of *Suillia flavifrons* (Zetterstedt, 1838) (Diptera: Heleomyzidae) with a description of the immature stages

К биологии *Suillia flavifrons* (Zetterstedt, 1838) (Diptera: Heleomyzidae) с описанием преимагинальных стадий

A.L. Ozerov^{1*}, M.G. Krivosheina²
А.Л. Озеров^{1*}, М.Г. Кривошеина²

¹ Zoological Museum, Lomonosov Moscow State University, Bol'shaya Nikitskaya 2, Moscow 125009 Russia.

¹ Зоологический музей, Московский государственный университет им. М.В. Ломоносова, Большая Никитская ул., 2, Москва 125009 Россия.

² A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Leninsky prospect, 33, Moscow 119071 Russia.

² Институт проблем экологии и эволюции им. А.Н. Северцова РАН, Ленинский проспект, 33, Москва 119071 Россия.

Andrey Ozerov: ozerov2455@rambler.ru ORCID <https://orcid.org/0000-0003-0889-5024>

Marina Krivosheina: dipteramarina@rambler.ru ORCID <https://orcid.org/0000-0001-9064-1378>

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КЛЮЧЕВЫЕ СЛОВА: Diptera, Heleomyzidae, *Suillia flavifrons*, личинка, пупарий, описание, биология, *Carex vesicaria*, сапрофаг.

ABSTRACT. The biology of *Suillia flavifrons* (Zetterstedt, 1838) was studied. Larvae were collected in Moscow Region (Russia) in June in stems of sedge *Carex vesicaria* Linnaeus. The morphology of the three instar larva and puparium was studied and described for the first time for the species.

РЕЗЮМЕ. Изучена биология мухи-шипокрылки *Suillia flavifrons* (Zetterstedt, 1838). Личинки были собраны в Московской области в стеблях осоки *Carex vesicaria* Linnaeus. Изучена морфология личинки 3-го возраста и пупария, которые впервые для вида описываются в данной работе.

Introduction

When collecting larvae of *Cordilura* Fallén, 1810 (Diptera: Scathophagidae) developing in the stems of sedges (*Carex* spp., fam. Cyperaceae), larvae of the family Heleomyzidae were also collected. This was clarified after hatching of the collected larvae. All hatched adults were identified as *Suillia flavifrons* (Zetterstedt, 1838) (Fig. 1).

Heleomyzidae are small to medium-sized flies (usually about 4–7 mm) with variations in body colour from yellowish or yellow-reddish to brown or blackish. They are widely distributed around the world, but especially numerous in areas with cool temperate climate.

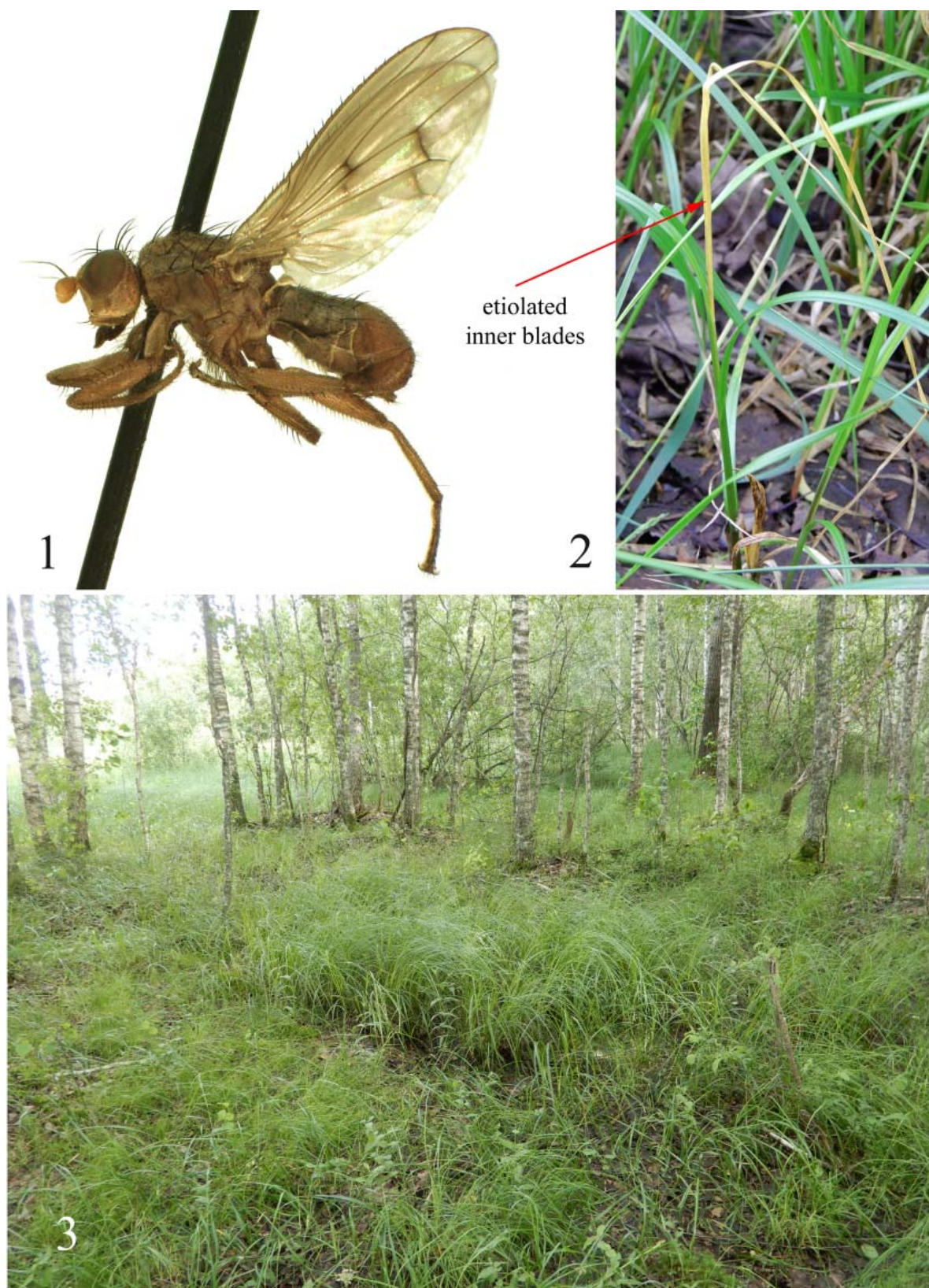
The family Heleomyzidae is subdivided in three subfamilies: Suillinae (with tribe Suilliini with a single

genus *Suillia* Robineau-Desvoidy, 1830 in the Palaearctic Region), Heteromyzinae (which includes a tribe Heteromyzini with three genera in the Palaearctic Region) and Heleomyzinae (with 3 tribes and 12 genera in the Palaearctic Region) [Papp, 1998].

The genus *Suillia* is the genus with the greatest number of species within the family Heleomyzidae. Hitherto 129 species have been described especially in the Palaearctic [Woźnica, 2013]. 19 species have been recorded in european part of Russia [Gorodkov, 1970]. *Suillia flavifrons* is a widespread species in Europe, also recorded in Siberia and the Russian Far East [Gorodkov, 1984; Woźnica, 2013].

Palaearctic genera and species are characterized by the combination of next characters: postpedicel rounded, oral vibrissae present, postocellar setae convergent, costa has a subcostal break and with spines (except *Borboropsis* Czerny, 1902). Species of the genus *Suillia* have only one orbital seta.

The larvae of most Heleomyzidae develop in all kinds of decomposing animal or vegetable matter [Papp, 1998]. Larvae of the genus *Suillia* usually occur in various mushroom species, but there are several species developing in plants. Uffen and Chandler (1978) recorded *Suillia ustulata* (Meigen, 1830) in association with stems of *Sambucus* (fam. Sambucaceae) and roots of *Aster* (fam. Asteraceae) respectively; both species are also known from fungi. Larvae of *Suillia laevifrons* (Loew, 1862) live in *Luzula pilosa* (L.)



Figs 1–3. 1 — male of *Suillia flavifrons* (Zetterstedt) (collection specimen), lateral view; 2 — infected stem of *Carex vesicaria* Linnaeus, with etiolated inner blades; 3 — larval collection point of *S. flavifrons*.

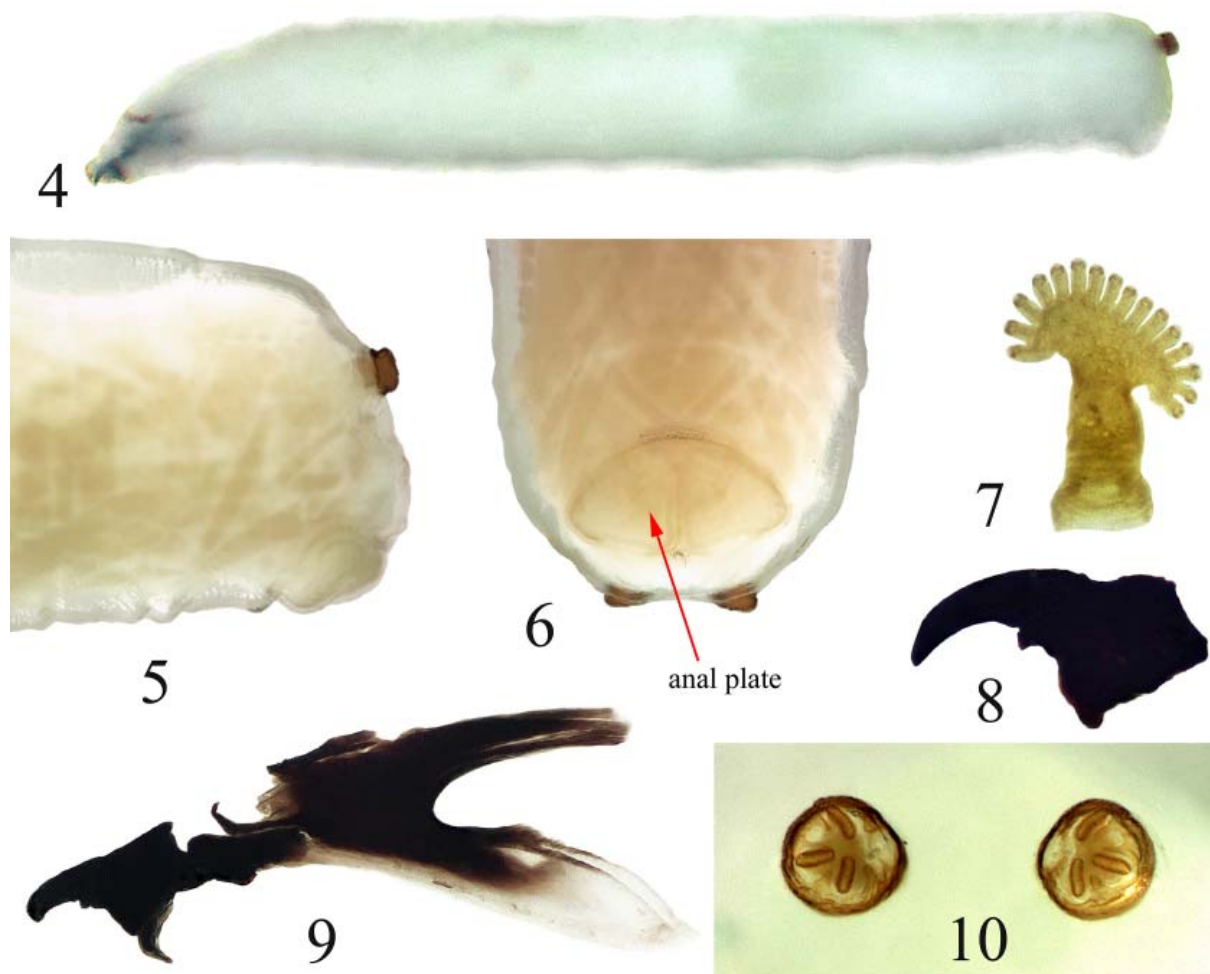
Рис. 1–3. 1 — самец *Suillia flavifrons* (Zetterstedt) (коллекционный экземпляр), сбоку; 2 — зараженный стебель *Carex vesicaria* Linnaeus, с этиолированными внутренними листьями; 3 — место сбора личинок *S. flavifrons*.

Willd. (fam. Juncaceae) [Bland, Rotheray, 1996], larvae of *Suillia cepelaki* Martinek, 1985 develop in the underground parts of *Allium ursinum* Linnaeus (fam. Amaryllidaceae) [Preisler, Roháček, 2012], larvae of *Suillia univittata* (von Roser, 1840) of the spring generation develop in the bulbs of *Allium sativum* Linnaeus (fam. Amaryllidaceae), while larvae of the second generation live in truffles (*Tuber magnatum pico*) (fam. Tuberaceae) [Ciampolini, Süs, 1983]. In addition, *Suillia lurida* Meigen, 1830, known as the garlic fly, is a pest of winter garlic (*Allium sativum*) and onion in Western Europe. The larvae mainly inhibit the growth of the main shoot as they feed on the innermost, freshest leaves, which produces notches around the edges of the leaves that result in their growth becoming stunted or twisted (Kahrer, 1986; Szwejda, 1988). No species of *Suillia* has been registered in *Carex*. Nothing is known of biology of *Suillia flavifrons*.

Our study is related to the description of the three instar larva and the puparium of *Suillia flavifrons* (Zetterstedt, 1838), which is done for the first time for the species. Terminology follows Zimin [1948] and Teskey [1981].

Material and Methods

The collection of the preimaginal material (mature larvae and puparium) took place in the Moscow region (Shakhovskaya district, outskirts of Yakshino village (55.9374°N, 35.5611°E) into stems of *Carex vesicaria* Linnaeus (Figs 2, 3) on the 8th and 14th June 2024. In total, 14 mature larvae and 1 pupa were collected in this place. Of these, 6 larvae after scalding with boiling water were placed for storage in 70° alcohol, and the puparia and other larvae were left to hatch as adults. All stems with larvae and puparia were placed in separate test tubes with moistened sand at the bottom and a portion of sphagnum moss above the sand. After 6 days, all



Figs 4–10. *Suillia flavifrons* (Zetterstedt), three instar larva: 4 — general view, laterally; 5 — posterior end, laterally; 6 — same, ventrally; 7 — anterior spiracle; 8 — mandible; 9 — cephalopharyngeal skeleton; 10 — posterior spiracles.

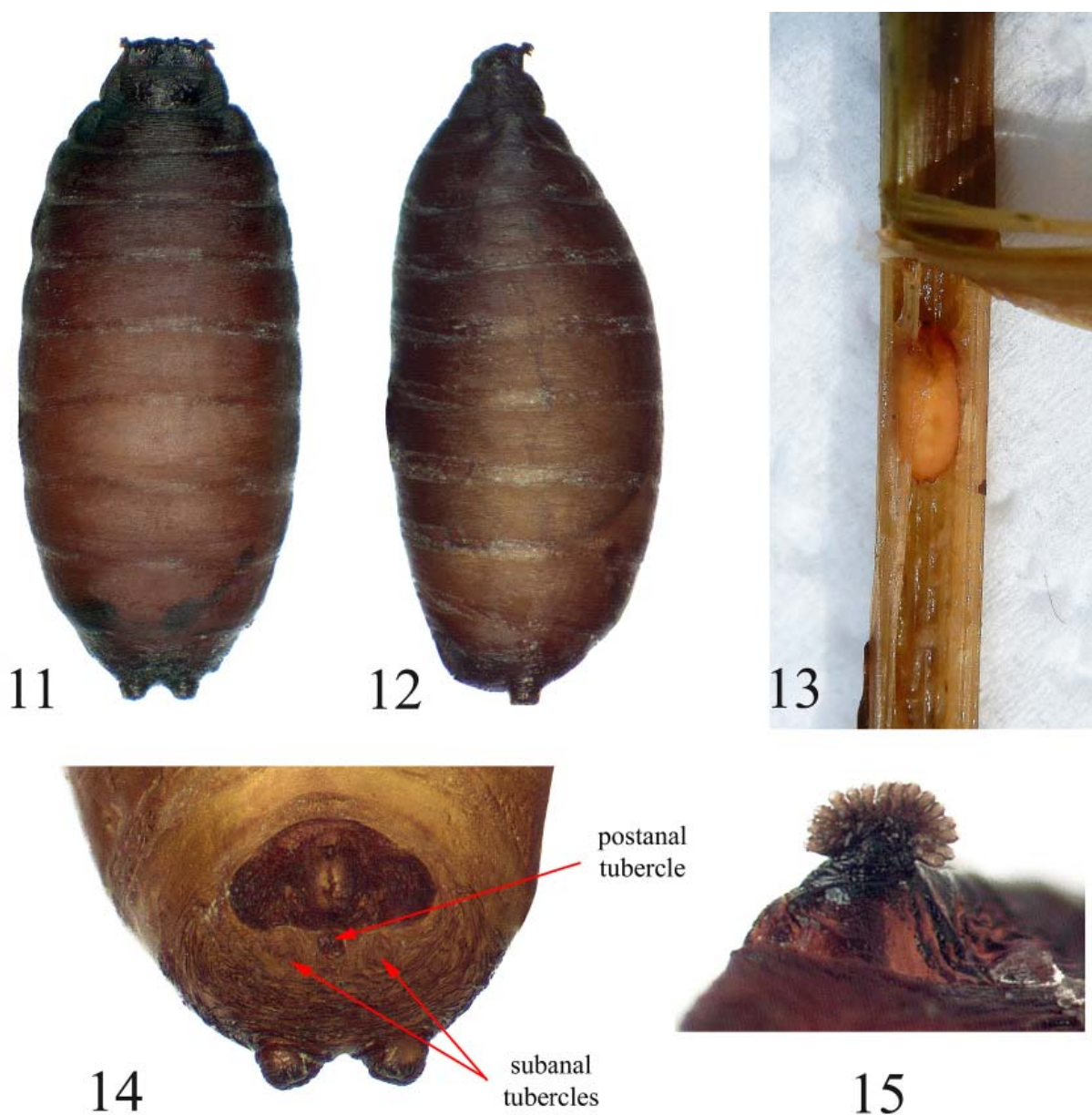
Рис. 8–12. *Suillia flavifrons* (Zetterstedt), личинка 3-го возраста: 4 — общий вид, сбоку; 5 — задний конец, сбоку; 6 — то же, снизу; 7 — переднее дыхальце; 8 — ротовой крючок; 9 — ротоглоточный скелет; 10 — задние дыхальца.

the larvae collected on June 8 pupated. To pupate, the larvae left the stem and buried themselves in the sand. On July 2 and 3, adult flies emerged from the puparia. After adult flies were hatched from 4 puparia (2 ♂♂ and 2 ♀♀), the empty puparia were each glued to a pin or stored in 70° alcohol. The larva collected on June 14 pupated on June 18, and the adult flew out of the puparium on July 5. All bred adults of both sexes were determined as *Suillia flavifrons* (Zetterstedt, 1838). Also two larvae inside the stems of *Carex vesicaria* were collected in the environs of Sizenevo (~56.0180342°N, 35.5699219°E)

on June 15, 2024, they were stored in 70° alcohol. All collected material is stored in the collection of the Zoological Museum of Moscow State University (ZMUM).

Results

DESCRIPTION OF IMMATURE STAGES. Three instar larva. Body white, body length 8 mm, maximal width 0.9 mm. Body shape cylindrical, tapering anteriorly, truncate posteriorly with 2 posterior spiracles on short spiracular tubes (Figs



Figs 11–15. *Suillia flavifrons* (Zetterstedt), puparium: 11 — general view, dorsally; 12 — same, laterally; 13 — puparium in the stem of *Carex vesicaria* Linnaeus; 14 — posterior end, ventrally; 15 — anterior spiracle.

Рис. 11–15. *Suillia flavifrons* (Zetterstedt), пупарий: 11 — общий вид, сверху; 12 — то же, сбоку; 13 — пупарий в стебле *Carex vesicaria* Linnaeus; 14 — задний конец, снизу; 15 — переднее дыхальце.

4–6). Creeping welts are weakly developed with transparent spinules.

Anterior spiracles fan-like with 15–16 papillae (Fig. 7). Cephalopharyngeal skeleton strongly sclerotized (Fig. 9). Mandibles massive with long hook and small tooth basally (Fig. 8). Dentate sclerite curved. Parastomal bar narrow. Hypopharynx 3 times as long as wide. Tentorial phragma broad, dorsal cornua of pharyngeal sclerite shorter than the ventral. Dorsal cornua of pharyngeal sclerite relatively narrow with very long and slit-like dorsal window. Ventral cornua with small triangular window.

Body integument white, smooth. Abdominal creeping welts weakly developed and consist of transparent spinules except those in front of perianal pad — there are 4 irregular rows of spinules each is formed by 22–28 black spinules.

Terminal segment of the body with two white short respiratory tubes, distance between the posterior spiracles is equal to 0.75–1.0 of the width of the spiracle (Figs 5, 6). Spiracular plates brownish, each with three identical radial spiracular openings (Fig. 10). Anal plate transverse, oval, 0.5 times as long as wide. Anus is situated in a longitudinal cleft.

Puparium. Brown, body length 5.0–5.5 mm, maximal width 1.8–2.0 mm. Body shape cylindrical, slightly more convex on the dorsal side, tapering and bilobed anteriorly (Figs 11, 12). Brown, integument in minute folds on the dorsal side and a few rows of spinules on the ventral side of abdominal segments.

Anterior spiracles fan-like with 15–16 papillae (Fig. 15). Cephalopharyngeal skeleton as in three instar larva (Fig. 9).

Body integument brown. Abdominal creeping welts weakly developed and consist of 3–4 rows of minute spinules.

Terminal segment of the body with weakly developed tubercles, subanal pair and unpaired postanal tubercle are the longest, with two short respiratory tubes, distance between them 0.75 as wide as the tube (Fig. 14). Spiracular plates brownish, each with three identical radial spiracular openings (Fig. 10). Anal plate brown, transverse, oval, 0.5 times as long as wide. Anus is situated in a longitudinal cleft (Fig. 14).

Discussion

Due to the fact that the material on *Suillia flavifrons* was collected by chance, the data which we received about the life history of this species is not complete and can be summarized as follows: adults emerge probably during May and lay eggs into stems of *Carex vesicaria* in the end of May. Only one larva of *S. flavifrons* was found in each infested stem, suggesting that the female probably lays only one egg per plant, as *Cordilura* females do [Wallace, Neff, 1971]. Apparently, the process of larval development after hatching from the egg occurs in the same way as in *Cordilura*. This is how Wallace & Neff [1971] described it in *Cordilura*: “After hatching, the larva makes a small entry hole into the culm, burrows to the center, and makes a spiral cut clown to the culm base. This cut severs the vascular bundles and causes the leaves in the middle of the culm to wither and die. The outer portion of the culm and the outer leaf blades are unaffected. Culm as well as the inner shoots of the upper part of the culm shows a characteristic etiolation and are easily recognized. The 2nd- and 3rd-stage larvae feed on the decaying plant material in the center portion of the culm”.

Mature (three instar) larvae of *S. flavifrons* leave the stem and form their puparia usually in wet soil, but can also pupate inside the stem (Fig. 13). Adult flies emerge from puparia until mid-July. It has not been established whether the second generation of *S. flavifrons* larvae develop in sedge. We collected damaged stems of sedges (Fig. 2) in a swamp in the vicinity of Yakshino (Fig. 3) periodically from May to mid-October. In June, stems infested with both *S. flavifrons* and *Cordilura* larvae were collected. In the autumn, in the same place, only *Cordilura* larvae were found in the sedges (the same species as in early summer), and no *S. flavifrons* larvae were found.

Ciampolini & Süs [1983] found that the larvae of *Suillia univittata* of the first (spring) generation develop in the bulbs of garlic, while the larvae of the second generation (autumn) live in truffles. Perhaps the larvae of the second generation *S. flavifrons* develop on another host, or colonize the sedge stems later (at the end of October).

The known larvae of *Suillia* are very similar and differ little in morphology from each other [Ciampolini, Süs, 1983; Papp, 1998; Bland, Rothery, 1996; Rothery, 2012]. The larvae of *Suillia flavifrons* are distinguished by the number of papillae of anterior spiracles (15–16). Cephalopharyngeal skeleton of *Suillia flavifrons* is close to *S. univittata* with relatively long cornua of pharyngeal sclerite and mandibles with basal tooth. Posterior spiracles of *Suillia flavifrons* are similar to those of *S. variegata* and *S. ustulata*. Distance between the posterior spiracles in *Suillia flavifrons* is equal to 0.75–1.0 of the width of the spiracle and in other species it is often larger.

Competing interests. The authors declare no competing interests.

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