

DESCRIPTION OF THE ORIENTAL *STRATIOMYS REDUCTA*, NEW SPECIES, AND ITS LARVA AND PUPARIUM (DIPTERA: STRATIOMYIDAE)

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ABSTRACT. – The male, female, larva and puparium of *Stratiomys reducta*, new species, from North Thailand are described. The larvae live in micro-pools of seepage areas in the forest. They are compared with other known *Stratiomys* larvae. This is the first record of the genus *Stratiomys* from Thailand and the first description of a *Stratiomys* larva from the Oriental Region. An identification key to the adults of the Oriental *Stratiomys* species is included.

KEY WORDS. – Stratiomyidae, *Stratiomys reducta*, new species, Thailand, taxonomy, morphology.

INTRODUCTION

The majority of the 92 species belonging to *Stratiomys* Geoffroy, 1762, are known from the Palaearctic (45 species) and Nearctic Regions (30 species), with only 11 species described from the Neotropical Region, one species from the Afrotropical Region and five species from the Oriental Region (Woodley, 2001). All the Oriental species have already been treated by Brunetti (1920, 1923). Recently we reared two males and eight females of an interesting new species with aquatic larvae. The larvae were found in micro-pools of a seepage area in the province of Mae Hong Son in north Thailand.

The genus *Stratiomys* includes mostly fairly large flies with elongate antennae and a broad and flattened abdomen. The head is usually elliptical in frontal view and suboval in lateral view. The long antenna consists of a rod-like scape, being 2.5–6.0 times longer than the pedicel. The flagellum has 5–6 flagellomeres and is, as a rule, even longer than the scape, and is more or less triangular in cross-section, with a dorsal ridge. The scutellum is armed with a pair of strong spines. Vein R_{2+3} arises far distal to the anterior crossvein, R_4 is present, three medial veins originate at the discal cell and the posterior crossvein is usually distinct. All medial veins are bent anteriorly in their apical portions and end before the wing margin. The lower calypter has a pubescent fan-like process.

The abdomen is broader than the thorax, somewhat flattened dorsoventrally and narrowly margined laterally, usually with pale markings at the posterolateral corners of tergites 2–4 and/or with pale posterior margins on some tergites. The dorsal part of the male genitalia is of the basic type, with triangular, sub-oblong or even bilobate and transversely dilated cerci. The massive genital capsule has a conspicuous medial process at the posterior margin, the gonostyli are more or less pointed on their inner apices. The phallic complex is tripartite, smooth or with small spines.

Descriptions of *Stratiomys* larvae are rare. An aquatic way of life has been shown for only four Palaearctic species (Rozkošný, 1982), seven Nearctic (McFadden, 1967) and one Neotropical species (Lindner, 1928). Distinguishing larval characters are known for only five species altogether. The long anal segment is usually interpreted as a breathing tube and is considered to be the main diagnostic character distinguishing this genus from the related *Odontomyia* Meigen, 1803. Moreover, *Stratiomys* larvae never possess strong ventral hooks and/or scales on some body segments as found in some *Odontomyia*. Nevertheless, the larval differences between the two genera need further investigation, because some *Stratiomys* spp. possess a shortened anal segment and have scales (transformed hairs) at least on the thoracic segments, while some *Odontomyia* spp. lack ventral hooks on their abdominal segments. In contrast, the

adults can be easily assigned to either genus on the basis of the antennal structure. In *Stratiomys*, the first antennal segment is more than twice as long as the second and the flagellum has a distinct dorsal or dorsolateral longitudinal ridge. In *Odontomyia* the first antennal segment is shorter and the longitudinal ridge on the flagellum is lacking (see Rozkošný, 1982).

TAXONOMY

STRATIOMYIDAE Latreille, 1802

Stratiomys reducta, new species

(Figs. 1–7)

Material examined. – Holotype: male, north Thailand, Mae Hong Son Province, Pangmapa District: near Muang Phaem, 18 Apr.2002, 1 male ex puparium of larva found in spring, A87/02, coll. D. Kovac, deposited in the Senckenberg Forschungsinstitut, Frankfurt am Main (SMF).

Paratypes: 1 female, same data as holotype, A87/02, (SMF); 1 female, same locality, 07 Apr.2002, resting on grass, A74/02 (SMF); 1 female, same locality, 7 Apr.2002, ex puparium, A84/02 (SMF); 1 female, same locality, 17 Apr.2002, ex puparium, A85/02 (SMF); 1 female, same locality, 18 Apr.2002, ex puparium, A86/02 (SMF); 4 females, same locality, 20 Apr.2002, ex puparia, A88/02 (1 specimen in SMF, 1 specimen in Faculty of Science, Masaryk University (FSMU), 2 specimens in the Department of Entomology,

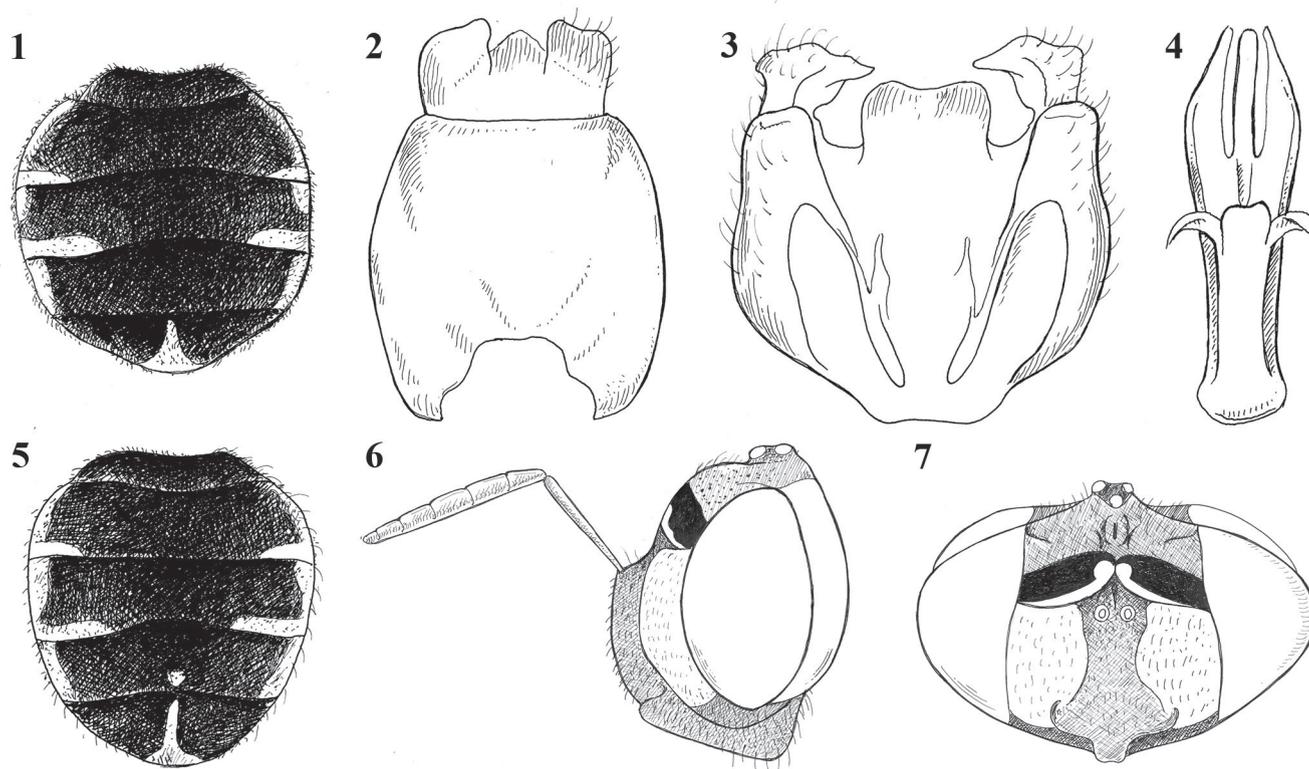
Kasetsart University, Bangkok); 1 male, same locality, 22 Apr.2002, ex puparium, A96/02 (FSMU).

Larvae: 66 larvae, same locality as holotype, 7 Apr.2002, A75/02–A81/02 (SMF); 7 larvae, same locality and date (FSMU); 2 larvae, near Ban Huai Pong, 15 Oct.2005 (SMF). All specimens collected by D. Kovac.

Etymology. – The proposed name refers to the reduction of lateral abdominal markings in both sexes compared to related species.

Description. – Holotype male: Head suboval in lateral view, tapered towards prominent ocellar tubercle. Face somewhat convex but narrowly produced in lateral view, postocular rim swollen in lower third. Eyes bare, medially contiguous for a long distance, facets markedly smaller in lower third. Lower frons above antennae subshiny black, face also entirely black but more punctuate and finely wrinkled. Antenna long, flagellum with 5 flagellomeres, apical flagellomere dull, relative lengths of scape: pedicel: flagellum are 2.6 : 1 : 4. Head pilosity whitish-yellow, erect and fairly long especially on swollen area of postocular rim but very short and appressed on occiput behind eyes.

Thorax black, only scutellar spines and narrow space between them yellow. Thoracic pile woolly, longer and dense along notopleura and on pleura. Wing hyaline, with brownish veins and slightly bronze tinge. Wing venation as in other species



Figs. 1–7. *Stratiomys reducta*, new species. Characters of adults: 1, male abdomen, dorsal view; 2–4, male genitalia: cerci, proctiger and epandrium (2), genital capsule (3), phallic complex (4); 5, female abdomen, dorsal view; 6, female head, lateral view; 7, female head, frontal view, antennae removed.

of genus, all M veins ending far before wing margin, Cu₁A somewhat longer, postcubitus hyaline but distinct. Lower calypter haired, with usual fan-like process.

Legs predominantly black, only fore- and mid-knees yellowish; basal third of hind tibia contrastingly yellow. Mid and hind basitarsi pale brown to yellow. Pile on legs inconspicuous, pale and mostly appressed, longer and more reddish on inner surface of fore tibia.

Abdomen (Fig. 1) rounded, broader than thorax, predominantly black. Yellow pattern consisting of narrow markings at posterior corners of tergite 3 and narrow lateral margin of tergite 4. Similar spots at posterior corners of tergite 2 barely visible and lateral margin of tergite 3 very narrowly yellow only at anterior corner. Posterolateral spots on tergite 4 mostly absent but a small subtriangular medial spot visible near posterior margin. A narrow longitudinal medial stripe on tergite 5 not reaching its anterior margin and partly extended along posterior margin. Venter predominantly black, sternites with yellow posterior and lateral margins; sternite 1 yellow medially; yellow pattern on sternite 2 extending almost to its anterior margin and occupying more than medial third. Abdominal pile black, short and appressed on dark parts of tergites. Pale hairs nearly erect at anterolateral corners of abdomen, short and denser on lateral margin of two last tergites. Ventral abdominal pile entirely pale, inconspicuous.

Male genitalia (Figs. 2–4): Epandrium convex, posterior margin transverse, emarginate anteriorly. Proctiger resembling a low triangle, cerci subquadrate, posterior margin slightly obliquely transverse with slightly produced posteromedial lobe. Genital capsule (Fig. 3) massive, with a well-developed medial process with a slightly bilobed posterior margin, gonostyli sharply pointed medially and gonocoxal apodemes not reaching anterior margin of genital capsule. Aedeagal complex (Fig. 4) only slightly longer than genital capsule at midline, smooth and tripartite; lateral lobes dilated in distal third.

Measurements. – Length: body (without antennae) 7.5 mm, wing 6.6 mm.

Female. – Eyes bare, head with a broad frons occupying more than 1/3 of head width, ocellar tubercle prominent in lateral view (Fig. 6). Frons slightly widened towards antennae, predominantly black and densely punctate but punctuation somewhat reduced on vertex. Two distinct, transversely oval, shiny frontal calli present above supra-antennal depression, both predominantly black but each with a narrow and medially-widened yellow spot (Fig. 7). Area around bases of antennae black and black pattern narrowly extending along frontal depression and continuing as broad medial stripe on face. Scape and flagellum of antenna relatively longer than in male, relative lengths of scape : pedicel : flagellum are 3.5 : 1 : 4.6. Oral margin broadly black with black colouration continuing on gena below eye. Postocular rim band-shaped, almost as broad as length of pedicel, parallel sided, contrasting yellow and continuing on posteroventral

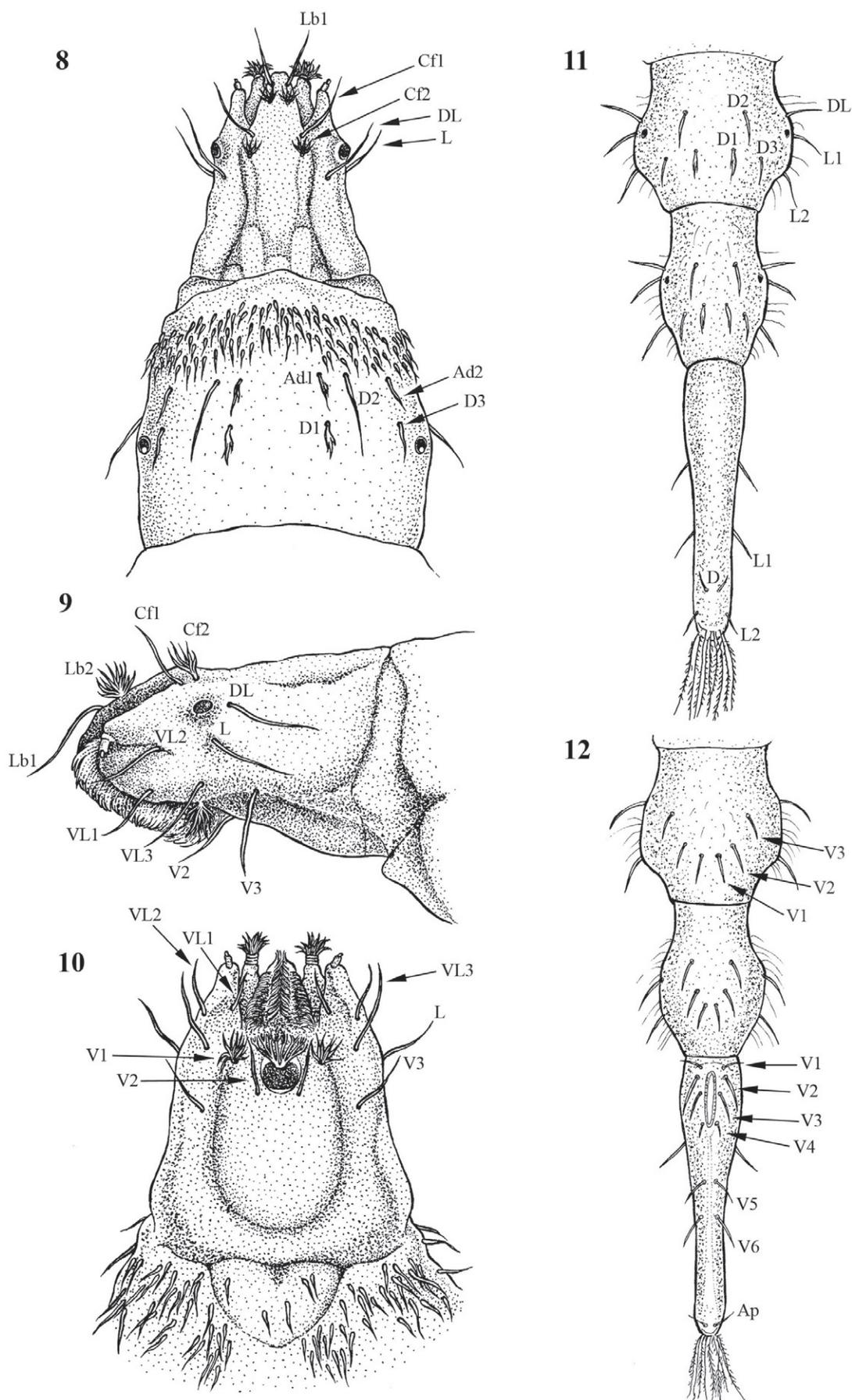
margin of eye. Median occipital sclerite with a pair of large yellow spots, upper margin of occipital cavity yellow, remainder black. Head pile rather short, semi-erect to erect, pale but more brownish on upper frons, very short, dense and appressed especially on postocular rim.

Thorax, wings and legs as in male but nearly the entire posterior half of scutellum pale and basal thirds of all tibiae yellow. Abdominal spots on tergite 3 slightly narrower than in male, yellow lateral margins on tergites 3 and 4 slightly more extensive and yellow medial stripe on tergite 5 longer (Fig. 5). Venter more extensively yellow: posterior margin of sternite 1 entirely yellow and yellow posterior margins of sternites 3 and 4 broadened medially. Female genitalia not examined.

Measurements. – Length: body (without antennae) 8.62 – 10.53 mm, wing 5.92 – 8.16 mm. 9 females examined.

Larva (mature). – Elongate, only slightly dorsoventrally flattened, caudal end distinctly tapering, anal segment modified into an elongate breathing tube. Head mostly dark brown. Dorsomedian sclerite separated by a clypeofrontal suture on either side, dark brown with paler proximal third. Lateral sclerites (genae, ocular plates) predominantly medium brown. Ventral sclerites uniformly dark brown with black margins. Oral opening and antennae black, at least basally. Dorsum of body segments mainly brown in ground colour, with dark brown and yellowish pattern. Thoracic segment 1 uniformly brown on anterior half; posterior half with yellow pattern consisting of small circular, partly confluent yellow spots. Central area yellow with a dark longitudinal midline. Also, extensive lateral areas around anterior spiracles yellow. Thoracic segments 2 and 3 more yellow than preceding, with three pairs of subquadrate yellow patches in a transverse row at anterior margin. Area on about posterior 2/3 of segment with yellow circular spots which are, however, more confluent than on thoracic segment 1, thus a dark medial line is visible along entire length. Abdominal segment 1 with six well developed yellow patches along anterior margin, posterior part of this segment with a similar pattern as on thoracic segment 3, although apparently darker. The following abdominal segments with six (= three pairs) subtriangular yellow patches along posterior margin, middle pair larger than others. Lateral areas of abdominal segments with extensively confluent yellow spots creating a brownish pattern with more or less distinct longitudinal stripes. Venter of body segments yellowish-brown in ground colour. Thoracic segments with several small brownish spots arranged into posteromedial and lateral symmetrical groups. Brownish spots on abdominal segments not very distinct, more confluent ventrolaterally, forming two more or less distinct longitudinal stripes on each side.

Head (Figs. 8–10; 13–17): only slightly retracted into thoracic segment 1, about as long as broad in dorsal view, head index 1.0–1.2. Labrum somewhat longer than anterolateral corners of head capsule. Eyes distinct but small, darker than surrounding areas. Two-segmented antennae situated at the anterolateral angles of the head capsule (a, in Fig. 13). Basal



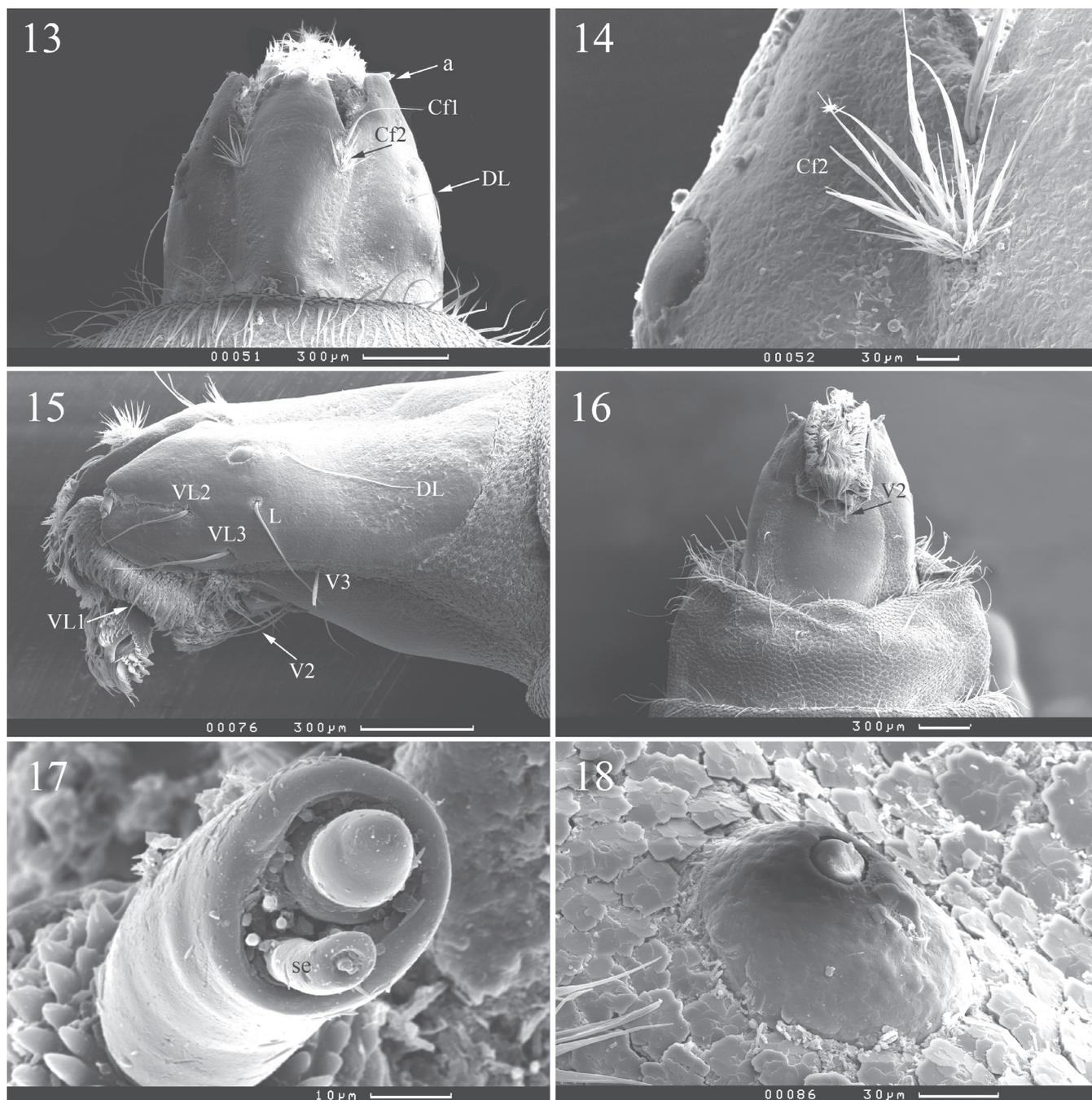
Figs. 8–12. *Stratiomys reducta*, new species. Mature larva: 8, head and thoracic segment 1, dorsal view; 9, head, lateral view; 10, head, ventral view; 11, last three abdominal segments, dorsal view; 12, last three abdominal segments, ventral view. Ad1, Ad2, Ap, Cf1, Cf2, D, D1, D2, D3, DL, L, L1, L2, Lb1, Lb2, V1, V2, V3, V4, V5, V6, VL1, VL2, VL3 = constant setae.

segment of antenna about twice as long as wide, apical segment short, semiglobular. One relatively small dark brown subcylindrical sensilla visible beside apical segment (se, in Fig. 17). Ventral margin of genal lobes bordered by dense hair fringe. Mandibular-maxillary complexes located on the sides of labrum densely haired, transverse rows of flat setae arranged in characteristic combs in apical part. Fingerlike maxillary palpus relatively long. Ventral opening of head capsule well-developed, covered with fine membrane.

Body segments: Larval body consists of three thoracic and eight abdominal segments. Thoracic segments almost as long as wide. Abdominal segments gradually tapering and

elongated toward distal end: segments 1–3 more than twice as wide as long, segment 5 subquadrate, segment 7 almost 1.5 (1.4) times as long as wide and anal segment about four times as long as wide (index of mature larvae 3.6–4.3). Oval anal slit located near base of anal segment occupying less than one-third of segment length (Figs. 12, 22). No ventral hooks and intersegmental projections visible; sternal patch not present.

Respiratory system: Dark brown anterior spiracles on sides of thoracic segment 1 relatively small, oval (Fig. 18). Very small and indistinct, circular, dark brown dorsolateral spiracles found on thoracic segment 3 and abdominal segments 1–7



Figs. 13–18. *Stratiomys reducta*, new species. Mature larva: 13, head, dorsal view; 14, clypeofrontal setae (Cf₂) on dorsal side of the head; 15, head, lateral view; 16, head, ventral view; 17, antenna with sensilla; 18, anterior spiracles on sides of thoracic segment 1. a = antenna; se = sensilla; Cf₁, Cf₂, DL, L, V₂, V₃, VL₁, VL₂, VL₃ = constant setae.

that are very probably non-functional. Transverse spiracular opening at distal end of anal segment surrounded by pinnate float hairs arising from dorsal and ventral lips (Figs. 12, 22).

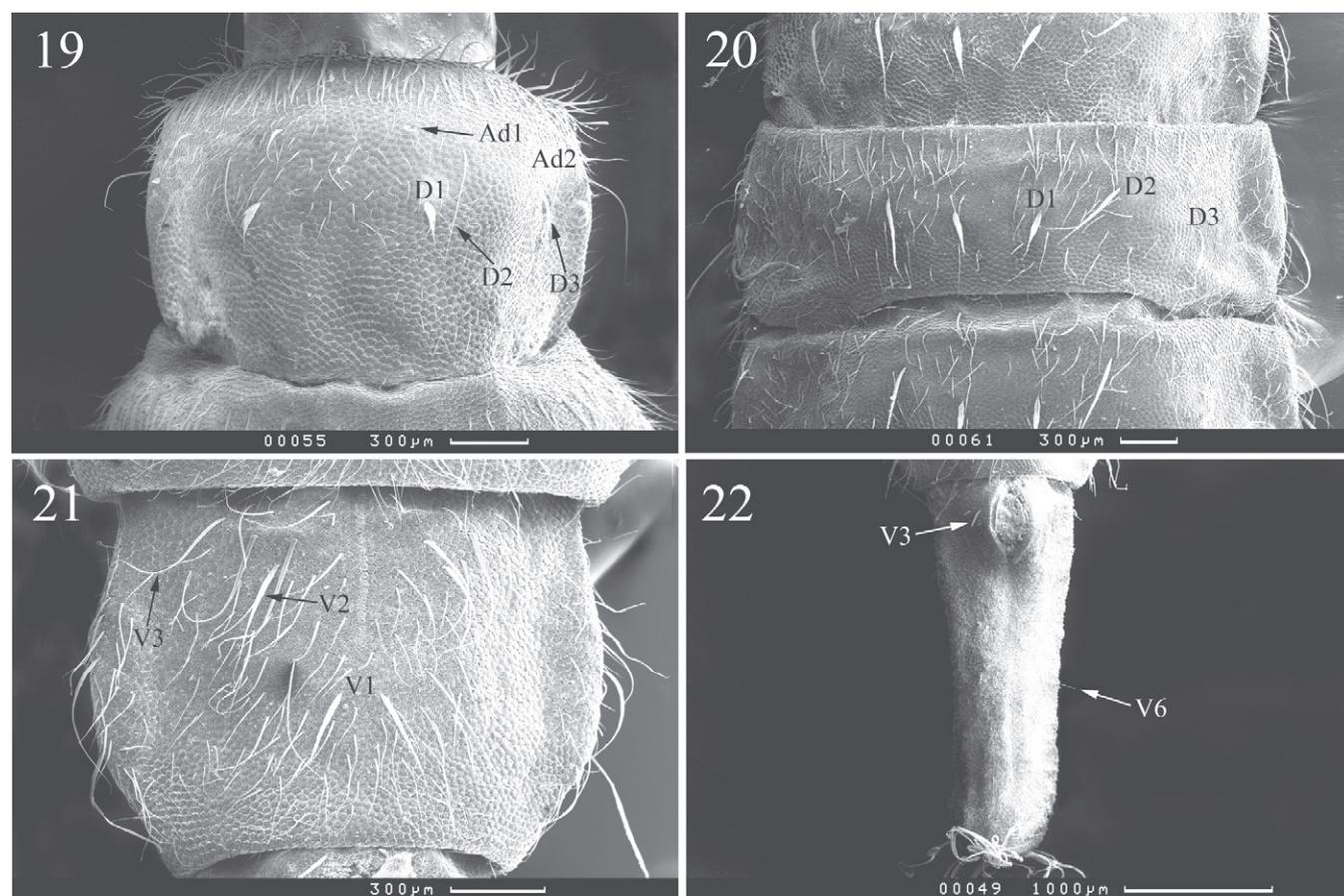
Chaetotaxy (for definitions of terminology see Rozkošný, 1982): Configuration and number of major setae same as in other species of the genus *Stratiomys*. Head capsule virtually without surface hairs (except for conspicuously haired genal lobes on ventral side and anterior margin of ventral opening), major setae clearly visible. Labral setae (Lb_1) relatively long and simple, posterior labral setae (Lb_2) broadly bushlike (Figs. 8, 9). Anterior clypeofrontal setae (Cf_1) on level of posterior eye margin, simple and slender, posterior clypeofrontal setae (Cf_2) fanlike with numerous branches (Figs. 8, 9, 13). Long and slender dorsolateral seta (DL) beyond eye and lateral seta (L) just below it (Figs. 8, 9, 15). Three pairs of ventral setae well-developed. Seta V_1 close to ventral opening, largely fanlike and transverse with numerous branches but often almost invisible among marginal hairs of genal lobes, setae V_2 relatively long and simple, V_3 setae simple, flattened in basal half (Figs. 9, 10, 15). Ventrolateral setae arranged into elongate triangle: VL_1 in middle of genal lobe, VL_2 between lateral seta (L) and antenna, and VL_3 in front of V_3 (Figs. 9, 10, 15).

Major setae on body segments often barely visible among long pale hairs that are especially dense on anterior half and dorsolateral parts of segments.

Thoracic segment 1 bears all characteristic setae including 2 pairs of anterodorsal (Ad) and 3 pairs of dorsal (D). All setae simple, at most with short pubescence, Ad1 and D_1 setae partly flattened. Slender and long D_2 setae shifted to anterior margin of segment (Figs. 8, 19). Dorsolateral (DL) and ventrolateral (VL) setae hardly visible between bunches of numerous, long setae forming lateral fringe. Ventral side with only short two-branched outer ventral setae (V_2) and simple, short inner ventral setae (V_1) inserted more medially and slightly anterad. Dense pale short hairs present on almost entire anterior half of segment. Remaining pubescence sparse, hyaline, denser only along lateral margins.

Setae on dorsal and ventral side of thoracic segments 2 and 3 in same position as on segment 1, but without anterodorsals. Dorsal setae D_1 and D_3 in a transverse line, D_2 setae again shifted anteriorly.

Configuration of dorsal setae on abdominal segments 1–7 very similar to thoracic segments 2 and 3; dorsal D_1 setae pubescent, D_2 setae again shifted anteriorly at



Figs. 19–22. *Stratiomys reducta*, new species. Mature larva: 19, thoracic segment 1, dorsal view; 20, abdominal segment 1, dorsal view; 21, abdominal segment 7, ventral view; 22, abdominal segment 8 (anal segment), ventral view. Ad1, Ad2, D_1 , D_2 , D_3 , V_1 , V_2 , V_3 , V_6 = constant setae.

boundary of anterior third of segments, D_3 inserted at same level as D_1 (Figs. 11, 20, 21). Relatively short dorsolateral seta (DL) inserted above spiracle on each side. Two major lateral setae (L_1 , L_2) often barely distinct among hairs on lateral margin but L_2 usually longer (Fig. 11). Three pairs of ventral setae arranged semicircularly: (V_1) located closest to posterior margin, V_2 being somewhat above and more lateral and V_3 above them, near anterior margin (Fig. 12). On dorsal side of anal segment (= abdominal segment 8) one pair of short dorsal setae present at distal third and two pairs of relatively long lateral setae: L_1 above middle of segment and L_2 at each posterolateral corner (Fig. 11). Ventral side with 6 pairs of setae being more or less distinct (V_1 above anal slit, V_2 more lateral at level of proximal end of anal slit, V_3 at sides of anal slit, V_4 at level of distal end of anal slit, V_5 and V_6 approximately at the middle of segment (Figs. 12, 22). Pair of apical setae (Ap) distinct on ventral side just above apical coronet. Subapical setae were not found (Fig. 12).

Measurements. – Length 9.0–27.3 mm; maximum width 1.3–4.0 mm. Seven larvae examined.

Puparium. – The pupa is formed within the skin of the last larval instar. All morphological structures characteristic for the last instar larvae including mouthparts, cuticular structures and surface pubescence remain unmodified. In full agreement with the other known larvae of the *Stratiomyini* no pupal structures (elongation of anterior spiracles or pupal respiratory tubes on abdominal segments) were present on the surface of the puparium. The length and maximum width of the puparium is the same as in mature larvae.

Measurements. – Length 25.6–27.1 mm; maximum width 3.6–4.1 mm. Two puparia examined.

Biology. – *Stratiomys reducta* larvae were found at two different localities, near the settlements of Muang Phaem and Ban Huai Pong. Both collection sites were situated in an open area of the forest with water diffusely seeping out of the ground (Fig. 23). In the depressions of the wet



Fig. 23. Habitat of *Stratiomys reducta*, new species, in north Thailand (Muang Phaem site, April 2003).

ground there were small puddles. Most larvae stayed in the puddles, but some were also creeping around on the wet ground between them. The larvae were most abundant in March–April (dry season). There were hundreds of larvae at the Muang Phaem site, while at the Huai Pong site there were only a few. The reason for the high abundance of *S. reducta* larvae at the Muang Phaem site is probably the regular occurrence of water buffaloes (Fig. 23). The water buffaloes create depressions in the ground when walking around and their dung provides additional nutrients for the organisms living in the puddles.

DISCUSSION

Stratiomys reducta is apparently related to *S. approximata* Brunetti, 1923 from India, but differs in the size, the shape and yellow patterning of the female head, the colouration of legs and the form of abdominal spots. *Stratiomys approximata* is apparently larger (10.0–12.0 mm) and resembles *S. barca* Walker, 1849 from China. It may be characterised as follows: the frontal calli above the antennae are yellow, the female postocular rim is dilated and yellow only on the lower half, the hind tibia is pale brown with a narrow ring at the middle and at the tip, and the yellow abdominal markings are also distinct on tergite 4. The new species is included in the identification key below which is slightly modified from Brunetti's (1923).

Until now, no Oriental *Stratiomys* larva has been described. In the following, characters of the larva of *S. reducta* are compared with four Palaearctic species: *S. chamaeleon* (Linnaeus, 1758), *S. longicornis* (Scopoli, 1763), *S. potamida* Meigen, 1822 and *S. singularior* (Harris, 1776), the Nearctic *Stratiomys discaloides* Curran, 1922, and the Neotropical *S. convexa* (Wulp, 1881). Larvae of *S. longicornis* and *S. singularior* are characterized by conspicuous lateral projections on basal abdominal segments 1–4 or 2–3, respectively, which are completely absent in *S. reducta*. The main differences between *S. potamida* and *S. reducta* larvae lie in the length of the last abdominal (anal) segment. *Stratiomys potamida* has an anal segment 9–10 times as long as wide (Dušek & Rozkošný, 1965), but in *S. reducta* it is only about 4 times as long as wide. The larva of *S. discaloides* differs from all other described *Stratiomys* larvae by having an unusually short anal segment, being only about twice as long as broad at the base. The larva of *S. convexa* is extremely slender and long, its anal segment is longer than the two preceding abdominal segments combined (Lindner, 1928). *Stratiomys chamaeleon* mainly differs from *S. reducta* in the chaetotaxy of the head. In larvae of *S. chamaeleon* the Cf2 setae are simple, whereas in *S. reducta* (and *S. potamida*) these setae are fanlike (with numerous branches).

Larvae of the genus *Stratiomys* inhabit different types of standing water. Apparently some species prefer more muddy water like some springs and marshes. *Stratiomys reducta* has a relatively short anal segment that is only four times longer than broad at the base and resembles in this respect the larva of the Nearctic *S. discaloides*, which has an even

shorter anal segment. The relatively short anal segment probably represents an adaptation to rather semi-aquatic habitats because the known European *Stratiomys* larvae living in deeper water (pools, edges of ponds, etc.) has, as a rule, a long and more slender anal segment.

**Key to adults of the Oriental species of
Stratiomys Geoffroy, 1762**

1. Legs predominantly yellow (Indonesia: Java)
..... *S. flaviscutellata* Wulp, 1885
- Legs predominantly black 2

2. Male abdominal tergites 3–5 reddish brown, female tergites
2–4 broadly yellow laterally (Myanmar)
..... *S. dissimilis* Brunetti, 1923
- Abdomen in both sexes mainly black, tergites 2–4 at most
narrowly yellow 3

3. Posterior margins of abdominal tergites 3–4 with uninterrupted
yellow bands (Pakistan) *S. fulvescens* Brunetti, 1920
- Posterior margins of abdominal tergites 3–4 with well separated
lateral markings 4

4. Thoracic pile extremely short and sparse, scutellum yellow,
female median occipital sclerite without yellow spots
(Myanmar) *S. micropilosa* Brunetti, 1920
- Thoracic pile moderately long and dense at least on notopleura
and pleura, scutellum black at least in basal half, female median
occipital sclerite with a pair of yellow spots 5

5. Yellow lateral markings developed on abdominal tergites 2–4, the
first largest; hind tibia pale brown, with narrow rings at middle
and tip; female frons with two large yellow calli (India)
..... *S. approximata* Brunetti, 1923
- Yellow lateral markings developed on abdominal tergites 2–3,
the second larger (Figs. 1, 5); hind tibia black with basal third
yellow; female frontal calli predominantly shiny black (north
Thailand) *S. reducta*, new species

ACKNOWLEDGEMENTS

This study was supported by the Ministry of Education of the Czech Republic (Grant MSM0021622416) and the field work by the Deutsche Forschungsgemeinschaft (DFG; Ko1367/2-1).

LITERATURE CITED

- Brunetti, E., 1920. *The fauna of British India, including Ceylon and Burma*. Diptera Brachycera. Vol. 1. In Shipley, A. E. (ed.). Taylor & Francis, London, ix + 401 pp.
- Brunetti, E., 1923. Second revision of the Oriental Stratiomyidae. *Records of the Indian Museum*, **25**(1): 45–180.
- McFadden, M. W., 1967. Soldier fly larvae in America north of Mexico. *Proceedings of the United States National Museum*, **121**(3569): 1–72.
- Dušek, J. & R. Rozkošný, 1965. Revision mitteleuropäischer Arten der Familie Stratiomyidae (Diptera) mit besonderer Berücksichtigung der Fauna der ČSSR III. *Acta Entomologica Bohemoslovaca*, **62**: 24–60.
- Lindner, E., 1928. Dr. L. Zürchers Dipteren-Ausbeute aus Paraguay: Stratiomyiiden. *Archiv für Naturgeschichte*, Abteilung A, **92**(12): 94–103.
- Rozkošný, R., 1982. *A biosystematic study of the European Stratiomyidae (Diptera)*. Vol.1. Introduction, Beridinae, Sarginae, Stratiomyinae. Ser. Ent. 21. Dr Junk Publishers, Hague-Boston-London, 401 pp.
- Woodley, N. E., 2001. *A World Catalog of the Stratiomyidae (Insecta: Diptera)*. Backhuys Publishers, Leiden, 473 pp.