

***Rheosmittia* (Diptera: Chironomidae): a generic validation and revision of the western Palaearctic species**

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The chironomid (Diptera) genus *Rheosmittia* gen. nov. is validated with the designation of a type-species by Brundin, in this paper. Generic diagnoses are given for larva, pupa, male and female imagines. The western Palaearctic species of *Rheosmittia* are revised, with lectotype designations for *R. spinicornis* Brundin and *R. languida* Brundin and the description and/or redescription of imagines of both these species and of *R. halvorseni* sp. nov. The larva and pupa of *R. spinicornis* are described and the possible confusion between the pupae of *R. halvorseni* and *R. languida*, both of which are described, is noted.

The systematic placement of *Rheosmittia* close to *Parakiefferiella* is confirmed, and a sister-group relationship with *Gynnidiocladius* and *Lopescladius* is suggested.

The ecology of the psammophilic (sand-dwelling) larvae of *Rheosmittia* is briefly discussed, and it is observed that the genus is Holarctic in distribution.

Introduction

The immature stages of non-biting midges (Chironomidae) have been generally well-studied during the past 75 years, but species inhabiting certain unusual aquatic habitats have received relatively little attention. Foremost amongst these habitats are sandy substrates—unstable benthic regions with distinctive, specialized (psammophilic) faunas. Psammophilic chironomid larvae are often very small and are rarely encountered by traditional sampling methods. It is only recently that the unexpected diversity and abundance of this community has been revealed (Peters and Söpnis 1983, D. Soluk 1983, personal communication).

Three groups of larval chironomids appear to be particularly associated with these sandy substrates. In sandy-bedded large rivers, probably throughout the world, larvae of some genera of the *Harnischia* complex are important members of the psammophilic community. In the New World, *Lopescladius* larvae are often associated with shifting sand substrates (Saether 1983), but throughout the Holarctic region the larvae found most abundantly in these habitats belong to *Rheosmittia*. This taxon of small midges contains species which are little-known and incompletely or fully undescribed in the larva, pupa and adult. Furthermore, as is so often the case in the Chironomidae, the nomenclature is confused and often erroneous.

In this paper, the name *Rheosmittia* is validated, we give generic diagnoses for larva, pupa, adult male and female, redescribe two western Palaearctic species and describe as new a third species. We conclude with a review of the scattered literature references on distribution and ecology of *Rheosmittia*.

Nomenclature

In 1950, Zvereva illustrated and described briefly an unusual psammophilic chironomid larva from the rivers Pechora and Vychegda in Komi A.S.S.R., northern U.S.S.R. Zvereva designated a new genus, *Tschernovskiella*, for these un-reared larvae, but, in failing to include any named species, did not satisfy the criteria of availability of the International Code of Zoological Nomenclature (I.C.Z.N. 13 b).

Six years later, Botnariuc and Cure (1956) found similar larvae in Romania and, although aware of Zvereva's description, described the larva as new and gave the name *delicatula*, but refrained from making a generic placement, thereby rendering the name unavailable (I.C.Z.N. 1 1g(ii)).

This distinctive larval type was found in the eastern U.S.A. by both W. Coffman and O. A. Saether, but the identity of the pupa and adult remained unknown until 1980, when P. Wiburg-Larsen and A. Sode, of Odense, Denmark, made a successful rearing. They correctly identified the adults and pupae as *Parakiefferiella* (*Rheosmittia*) *spinicornis* Brundin, while the larva can be recognized as the '*Tschernovskiella*'/'*delicatula*' type.

Rheosmittia was erected by Brundin (1956) as a subgenus of *Parakiefferiella* Thienemann, for the adult males and pupae of two species he described as new to science, *spinicornis* and *languida*. The genus-group name *Rheosmittia* is invalid since Brundin did not select a type-species (I.C.Z.N. 13 b) and, although elevated to generic rank in Cranston *et al.* (1983), has not been validated since. In order to validate the name and to retain his authorship of the taxon, Professor Brundin here selects *Parakiefferiella* (*Rheosmittia*) *spinicornis* Brundin, 1956 as the type-species of *Rheosmittia*, thus dating his authorship from the date of publication of our paper.

In our study we have checked the type-material of *spinicornis* and *languida*. The imagines were teneral when collected and are in a very poor state. Nevertheless, there was no difficulty in recognizing the conspecificity between the syntypes of *spinicornis* and the reared specimens from Denmark. A lectotype male of *spinicornis* has been selected.

The type-material of *languida* was collected from the high mountain river Leirungå at Gjendesheim, Jotunheim in Norway at an elevation of 1120 m. The material was preserved in a vial which contained imagines and pupal exuviae of several different species of Chironomidae, including females of *Rheosmittia halvorseni*, a new species described in this paper. Amongst the pupal exuviae were those which Brundin (1956) believed to be *languida* and others which he called '*Parakiefferiella* sp. c'. These latter are closer to *Rheosmittia* than to any other *Parakiefferiella*. The association of these two exuviae types with the two *Rheosmittia* adult species in the vial is uncertain and, until reared associations are made, we will refer to the pupal exuviae as *Rheosmittia* species *A* and *B*.

Methods and morphology

The mounting procedure is outlined in Saether (1969: 1) and the general terminology follows Saether (1980). The measurements are given as ranges followed by

a mean when three or more measurements are made, followed by the number measured (*N*) in parentheses.

Abbreviations of specimen repositories are as follows.

BMNH British Museum (Natural History), London, England;

SMNH Swedish Museum of Natural History), Stockholm, Sweden;

ZMBN Museum of Zoology, University of Bergen, Bergen, Norway.

Rheosmittia gen. nov.

Orthoclaadiinae gen. ? lv. *Tschernovskiella* Zvereva, 1950: 272 (invalid).

Parakiefferiella (*Rheosmittia*) Brundin, 1956 [May]: 150 (invalid).

Orthoclaadiinae gen. ? 1. *delicatula* Botnariuc and Cure, 1956 [December]: 265 (invalid).

Type-species. Parakiefferiella (*Rheosmittia*) *spinicornis* Brundin, 1956: 154, by designation of Brundin in the present paper. Other included species: *Parakiefferiella* (*Rheosmittia*) *languida* Brundin, 1956: 156; *Rheosmittia halvorseni* sp. nov.

Imago

Minute species, wing length about 0.7–1.2 mm.

Eyes not dorsally elongated, naked, but with short pubescence between nearly all ommatidia. Male antenna with 11–13 flagellomeres, normal setal plume, antennal groove reaching flagellomere 3, sensilla chaetica on flagellomeres 2, 3 and ultimate and antennal ratio much lower than 1. Female antenna with 5 flagellomeres with 2 sensilla chaetica on flagellomeres 1 and 2, about 8 on flagellomere 5. Temporals very few, inner verticals absent. Frontal tubercles occasionally well developed. Palp 5-segmented, with 1–2 lanceolate sensilla clavata on third segment.

Antepnotum strongly reduced to relatively well-developed with lobes either in contact or widely separated anteriorly, with 0–2 weak setae. Scutum extending hunch-like forward or with slight to distinct pre-apical concavity. Acrostichals absent, few dorsocentrals and prealars present. Scutal tubercle prominent to absent. Scutellum with 2–3 setae.

Wing membrane bare, microtrichia not visible at $\times 300$. Anal lobe barely indicated. Costa strongly extended; R_{2+3} visible at base, more or less fused with R_{4+5} apically; R veins and costa strongly thickened in female; R_{4+5} ending far proximal to end of M_{3+4} , approximately above Cu_1 , or between end of M_{3+4} and Cu_1 (see remarks); vannal fold ending distal to FCu; an ending distal to FCu (proximal in some males); Cu_1 strongly curved; VR very high. Branchiolum with 1 seta and 0–2 setae on R (males) or with a few setae on R, R_1 , R_{4+5} and costal extension (females). Squama bare. Sensilla capaniformia about 5 on base of brachiolum, 3 below seta and about 5 at apex of brachiolum; 1 at base of subcosta; 1 on FR_1 and 1 on R_1 .

Pulvilli small but distinct, less than half as long as claws. Pseudospurs absent or weak, sensilla chaetica absent. Comb and hind tibial spurs normal, outer spur on middle and hind tibia of female and on some middle tibiae of male absent.

Tergites and sternites with very few setae in single transverse rows.

Anal point short, broad, triangular with rounded apex or with apical blunt point, with weak setae at margin, with or without setae at base. Virga well developed, consisting of few long spines and lateral lamellae. Phallapodeme well developed; oral projections of lateral sternapodeme weak. Gonocoxite with superior volsella with mediolateral corner with fine microtrichia; inferior volsella distinct, triangular with mediolateral digitiform projection. Gonostylus with median bend (as in *Parakiefferiella*

Thienemann). Tergite IX of female divided into two setigerous protrusions each with 2–3 setae. Gonocoxite of female with few setae of differing length. Segment X normal. Gonapophyses VIII divided into relatively small, brush-like ventrolateral lobe and slightly larger dorsomesal lobe. Apodeme lobe visible between principal lobes. Postgenital plate small. Cerci relatively large. Seminal capsules pear-shaped to bulbous, apparently with weak microtrichia. Spermathecal ducts with loops or bends, with small to large bulbs before nearly separate openings.

Pupa

Small, no more than 2.5 mm long, translucent to weakly infusate.

Cephalothorax. Frontal setae apparently always absent. Cephalic area smooth, without warts or tubercles. Ocular area with 1 postorbital seta and 1 vertical seta. Antennal sheaths smooth without pearl row. Thoracic horn absent. Thorax with 1 or 2 median and 1 or 2 lateral anteprenotal setae; 3 precorneals in a line with Pc_2 longest; dorsocentrals arranged in 2 groups of 2 setae, or with Dc_4 apparently absent in *R. spinicornis*. Thorax smooth to weakly rugulose; wing sheaths smooth; leg sheath arrangement normal for Orthocladinae.

Abdomen. Tergite I and sternites I or I–IV and V–VIII or VII–VIII without shagreen. Tergites II–VII (or VIII) with posterior transverse band of posteriorly-directed spinules and an anteromedian area of smaller spinules which may extend posteriorly to contact posterior band. Tergites II–IV or III and IV with caudal, anteriorly directed spinules. Median spinule area weaker on posterior segments and very reduced on tergites VII and/or VIII. Sternites V and VI with or without posterior transverse area of weak, anteriorly directed spinules. Apophyses absent. Pedes spurii A absent, vestigial on IV or present on sternites IV–VI. Pedes spurii B absent.

Abdominal setation: segment I with 2(?) weak or 5 stronger D setae, 0–2 V setae and 1 L seta. Segments II–VII with 4 or 5 D setae, 4 or 5 V setae and 3 or 4 L setae. Segment VIII with 2 or 4 D setae, 1 V seta and 2 L setae. L_2 often more strongly developed than remaining L setae. On tergites II–IV or VI D_5 enlarged, often apically expanded and plumose, sometimes strong but simple; sometimes weakly expanded on tergite I.

Anal lobe very reduced with tergite IX postero-laterally expanded into spinose tails. Anal macrosetae present and weak or absent. Tergite IX medially with or without shagreen. Genital sacs of male large, nearly extending to apex of tails.

Larva (fourth instar)

Small, no more than 2.5 mm long; head capsule pale, no more than 125 μm long.

Antenna. About 0.75 length of head capsule, 5 segmented. Segment 2 subequal to segment 1 but unevenly and weakly sclerotized medially, sometimes giving the appearance of a divided segment. Segment 3 longer than 4, segment 5 narrow and elongate. Antennal ratio considerably less than 1. Weakly sclerotized and rather distended style present at apex of segment 2. Lauterborn organs absent, but extruded intersegmental membranes and/or style may be mistaken for these organs. Blade extending to apex of segment 2.

Labrum. SI slightly dentate, SII and SIII simple with SIII longer and arising from a distinct tubercle. SIV small or unrecognizable. Pecten epipharyngis and chaetulae laterales similarly developed as narrow, apically branched or perhaps sometimes as simple spines. Chaetulae basales similarly developed as chaetulae laterales although slightly broader. Premandible with 10–12 small, subequal teeth and distinct inner brush.

Mandible. Apical tooth no longer than any of the 5 inner teeth. Seta subdentalis placed further lateral than usual; simple and strong. Seta interna with 5 or 6 simple or weakly serrate branches.

Mentum. With 17, 19 or about 22 (Zvereva 1950, Botnariuc and Cure 1956) teeth with laterals either subequal or decreasing evenly in size. Either 3 median teeth may be delimited by their larger size or 9 median teeth are subequal in size. Ventromental plates weakly developed but may extend slightly beyond outermost mental teeth in flattened mentum. Setae submenti close to posterior level of ventromental plates. Median area of hypopharynx with 2 distinctive lobate scales.

Maxilla. Palp well developed, with distinct segmentation and reduced sensillae. Galea indistinct. Maxillary setae fine and apparently simple.

Abdomen. Parapods separate; anterior with serrate claws, posterior with simple claws. Procercus as long or longer than wide, bearing 5 or sometimes 6 anal setae and 1 weak lateral seta. Supra-anal seta weak. Anal tubules unconstricted, half as long as posterior parapods. No distinct body seta.

Systematics

The genitalia of both sexes of *Rheosmittia* species are practically indistinguishable from those of many *Parakiefferiella* species. Males in both genera have the characteristic superior volsella, bent gonostylus and long virga. However, the three described species of *Rheosmittia* appear to differ from those of *Parakiefferiella* in having a slightly different inferior volsella lacking the digitiform mediolateral projection. All three species have pubescent eyes, while those species of *Parakiefferiella* we have seen have bare eyes. However, in *P. scandica* Brundin there is pubescence between some marginal ommatidia, and the character may not be of generic significance. Brundin (1956: 148) stated that a scutal tubercle is present in all *Parakiefferiella*, but Saether (1969: 138) found the tubercle to be a tuft of microtrichia, sometimes with an indication of a hump beneath. The *Rheosmittia* species discussed in this paper either have a distinct tubercle or none at all, but never with a distinct microtrichial tuft. Thus this tuft could be an autapomorphy for *Parakiefferiella* in the restricted sense. However, *P. coronata* (Edwards) has a very distinctive tubercle rather similar to that of *R. spinicornis* and also resembles *Rheosmittia* in possessing only 12 flagellomeres, a low A.R., reduced anteprenotal lobes and R_{2+3} fused with R_{4+5} . The gonapophyses VIII of the female genitalia are also rather similar in *P. coronata* and *R. spinicornis* (Saether 1977: fig. 561-J; fig. 2), but the immature stages of *P. coronata*, if correctly associated, are typical of *Parakiefferiella* in the restricted sense. Judging by the genitalia alone, *Rheosmittia* does not deserve generic rank, but the immature stages, although closely related to *Parakiefferiella*, are so distinct that we prefer to give *Rheosmittia* full generic status. A complete review of the genus *Parakiefferiella* throughout its range and examination of the as yet unknown adults belonging to the Nearctic immature stages, may result in reappraisal of these groups.

Saether (1983) placed *Rheosmittia* as the sister group of *Gynnidiocladus* Sublette & Wirth and *Lopescladius* Oliviera combined, these three genera then forming the sister group of *Parakiefferiella*. *Gynnidiocladus* and *Lopescladius* are both well delineated genera and if this is correct, then *Rheosmittia* clearly needs generic status when using phyletic sequencing and subordination. The synapomorphies mentioned by Saether (1983) for these three genera consist of the high VR, absence of microtrichial tuft or acrostichals and fusion of R_{2+3} with R_{4+5} . There are several potential synapomorphies

in the immature stages of *Lopescladius* and *Rheosmittia*. However, the immature stages of *Gynnidiocladius* are still unknown, R_{2+3} is secondarily fused with R_{4+5} in some *Parakiefferiella* and the autapomorphies mentioned for *Rheosmittia* are partially incorrect since the scutum is not extended forward, hunch-like in all *Rheosmittia* species and the (presumed) pupa of *R. languida* has anal macrosetae and unsplit D_5 . This pupa, however, does show other autapomorphies such as the shape of the anal lobe, shagreen of the tergites and lack of a thoracic horn.

Key to the known male imagines of *Rheosmittia*

- | | | |
|---|--------------------|-------------------|
| 1 Scutal tubercle pronounced (fig. 2); antenna with 11 flagellomeres | <i>spinicornis</i> | 2 |
| - Scutal tubercle absent; antenna with 12-13 flagellomeres | | |
| 2 Scutal tubercle pronounced; bulbs of spermathecal ducts 14-19 μm in diameter on each side of anal point | <i>spinicornis</i> | |
| | <i>languida</i> | |
| - Anteprenotal lobe reduced (fig. 24); tergite IX with 6-9 additional setae to the 2-3 on each side of the anal point | | <i>halvorseni</i> |

Key to the known female imagines of *Rheosmittia*

- | | | |
|---|--------------------|-------------------|
| 1 Anteprenotal lobes well developed (fig. 22); bulbs of spermathecal ducts small (about 8 μm diameter) | <i>languida</i> | |
| - Anteprenotal lobes reduced (figs. 2, 24); bulbs of spermathecal ducts larger (greater than 14 μm diameter) | | 2 |
| 2 Scutal tubercle pronounced; bulbs of spermathecal ducts 14-19 μm in diameter | <i>spinicornis</i> | |
| - Scutal tubercle absent; bulbs of spermathecal ducts 20-30 μm in diameter | | <i>halvorseni</i> |

Key to the known pupae of *Rheosmittia*

- | | | |
|--|--------------------------|--------------------------|
| 1 Anal macrosetae present (figs. 18, 19) | <i>Rheosmittia</i> sp. A | 2 |
| - Anal macrosetae absent | | |
| 2 D_5 wider and more deeply split; exuviae pale, 1.3-1.7 mm long (Brundin, 1956: figs. 118-119; figs. 9-12) | <i>spinicornis</i> | |
| - D_5 narrower and less widely split; exuviae darker, 1.7-2.1 mm long (Brundin, 1956: figs. 120-121; figs. 20, 21) | | <i>Rheosmittia</i> sp. B |

***Rheosmittia spinicornis* (Brundin) comb. nov.**

Parakiefferiella (*Rheosmittia*) *spinicornis* Brundin, 1956: 154.

The imago is characterized by having 11 flagellomeres with an AR of 0.4-0.5 in the male, reduced anteprenotal lobes, pronounced scutal tubercle, digitiform projection of the inferior volsella directed posteriorly; female tergite IX with 4-5 setae; female gonocoxite with 1 long and 1-2 short setae and bulbs of spermathecal ducts 15-19 μm wide.

Male imago ($N=10$, except where otherwise stated)

Total length 1.29-1.49, 1.39 mm (12). Wing length 0.76-0.85, 0.82 mm (11). Total length/wing length 1.66-1.79, 1.72. Wing length/length of profemur 3.15-3.42, 3.30 (11). Thorax dark brown with scutellum slightly paler.

Head. AR 0.43-0.48, 0.45. Antenna with 11 flagellomeres, last flagellomere 139-169, 151 μm long. Temporal setae 2 including 1-2, 1 inner verticals; and 0.1, 1 postorbital. Clypeus with 2-3, 3 setae. Cibarial pump, tentorium and stipes as in fig. 1. Tentorium

60–77, 71 μm long; 8–9, 9 μm wide. Stipes 49–68, 58 μm long; 15–19, 16 μm wide. Palp lengths (μm): 11–17, 14; 23–30, 28; 30–38, 33; 30–38, 32; 45–56, 50.

Thorax. (fig. 2). Anteprenotum strongly reduced, without setae. Dorsocentrals 3–5, 4; prealars 2–3, 2·5; scutal tubercle pronounced. Scutellum with 2–3, 2 setae.

Wing. (fig. 3). VR 1·38–1·55, 1·43. Brachiolum with 1 seta, other veins bare. Extended part of costa 64–86, 69 μm long.

Legs. Spur of front tibia 23–26, 24 μm long; spurs of middle tibia 11–13, 11 μm and 0–8, 3 μm ; of hind tibia 23–30, 26 μm and 8–9, 9 μm long. Width at apex of front tibia 15–19, 17 μm ; of middle tibia 15–23, 17 μm ; of hind tibia 23–30, 25 μm . Comb of hind tibia with 8–10, 9 setae; longest setae 17–23, 20 μm long; shortest setae 11–15, 13 μm long. Tarsal pseudospurs absent. Lengths (μm) and proportions of legs:

	fe	ti	ta ₁	ta ₂
p ₁	233–255, 246 (13)	332–355, 345	150–158, 154	105–113, 108
p ₂	248–294, 284	251–270, 260	113–118, 115	60–68, 64
p ₃	240–268, 256	281–317, 302	131–148, 143	73–81, 77

	ta ₃	ta ₄	ta ₅	LR
p ₁	68–75, 70	34–41, 37	30–36, 33	0·44–0·46, 0·45
p ₂	45–60, 51	24–30, 26	26–32, 29	0·43–0·45, 0·44
p ₃	75–83, 80	32–36, 34	32–36, 34	0·44–0·48, 0·47

	BV	SV	BR
p ₁	2·90–3·17, 3·02	3·67–3·93, 3·84	2·7–3·2, 3·0
p ₂	3·54–4·06, 3·68	4·43–4·88, 4·74	2·5–4·3, 3·6
p ₃	3·02–3·22, 3·13	3·79–4·06, 3·91	3·3–4·3, 3·8

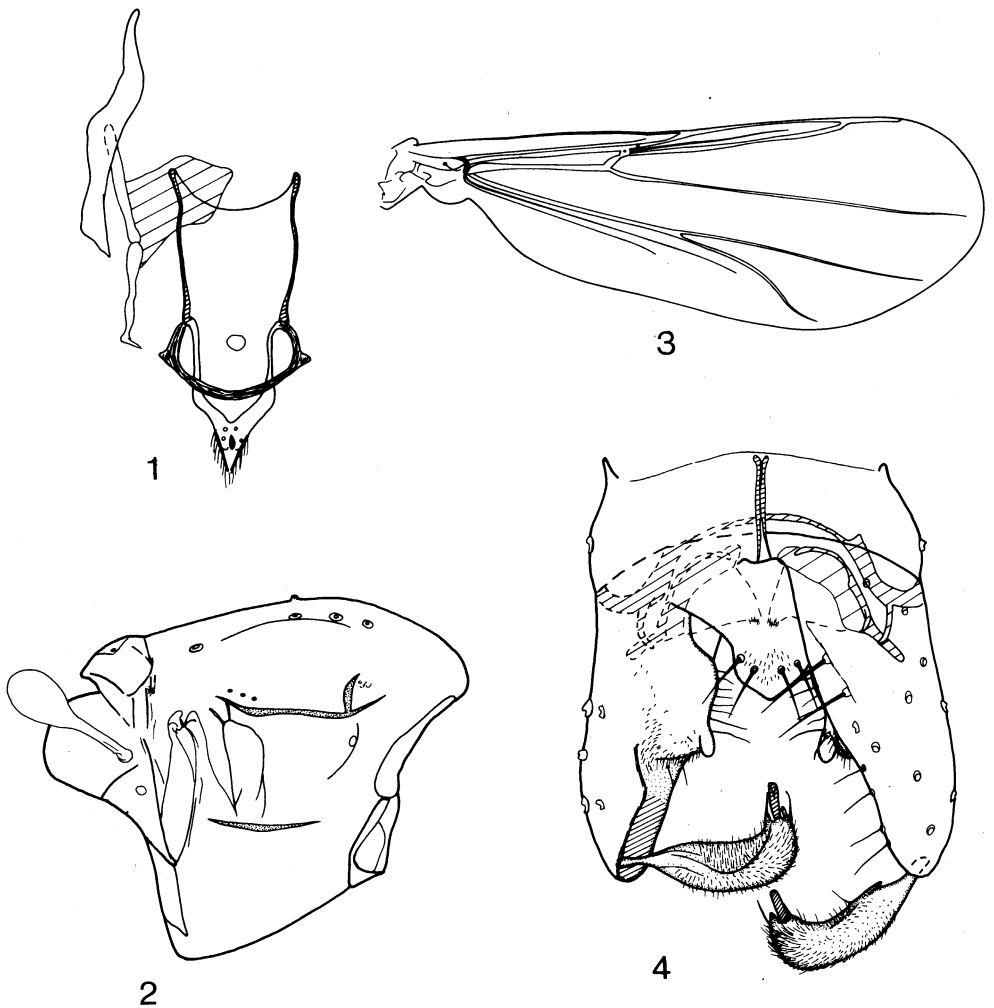
Abdomen. Tergites II–IV each with 2 lateral setae, tergites V–VIII each with 2 median and 2 lateral setae forming transverse row.

Hypopygium (fig. 4). Anal point 14–21, 18 μm long; 24–31, 25 μm wide at base; with 4–6, 4 setae; laterosternite IX with 2 setae. Phallapodeme 37–43, 40 μm long. Transverse sternapodeme 43–52, 48 μm long. Virga consisting of 6–9, 7 partly fused spines; longest spine 21–28, 25 μm long. Gonocoxite 88–101, 93 μm long, with well developed triangular superior volsella anteriorly and square inferior volsella with mediolateral digitiform, posteriorly directed projection. Gonostylus 45–49, 47 μm long, strongly bent; apical megaseta 11–12, 13 μm long. HR 1·92–2·08, 2·01; HV 2·83–3·08, 2·96.

Female imago (N=10)

Total length 1·00–1·25, 1·08 mm. Wing length 0·72–0·80, 0·77 mm. Total length/wing length 1·31–1·51, 1·41. Wing length/length of profemur 3·91–4·23, 4·09. Colour as in male.

Head. AR 0·43–0·51, 0·48. Flagellomere lengths (μm): 34–53, 40; 24–38, 28; 24–38, 29; 22–41, 31; 53–84, 58. Temporal setae 2, including 1 inner vertical and 1 postorbital. Clypeus with 2–4, 3 setae. Tentorium 45–71, 52 μm long; 4–8, 4 μm long. Stipes 38–64, 52 μm long; 9–19, 12 μm wide. Coronal suture absent in 7 specimens; 23–26, 24 μm long in 3 specimens. Palp lengths (μm): 3–13, 11; 19–26, 23; 24–32, 28; 26–34, 31; 38–49, 43.

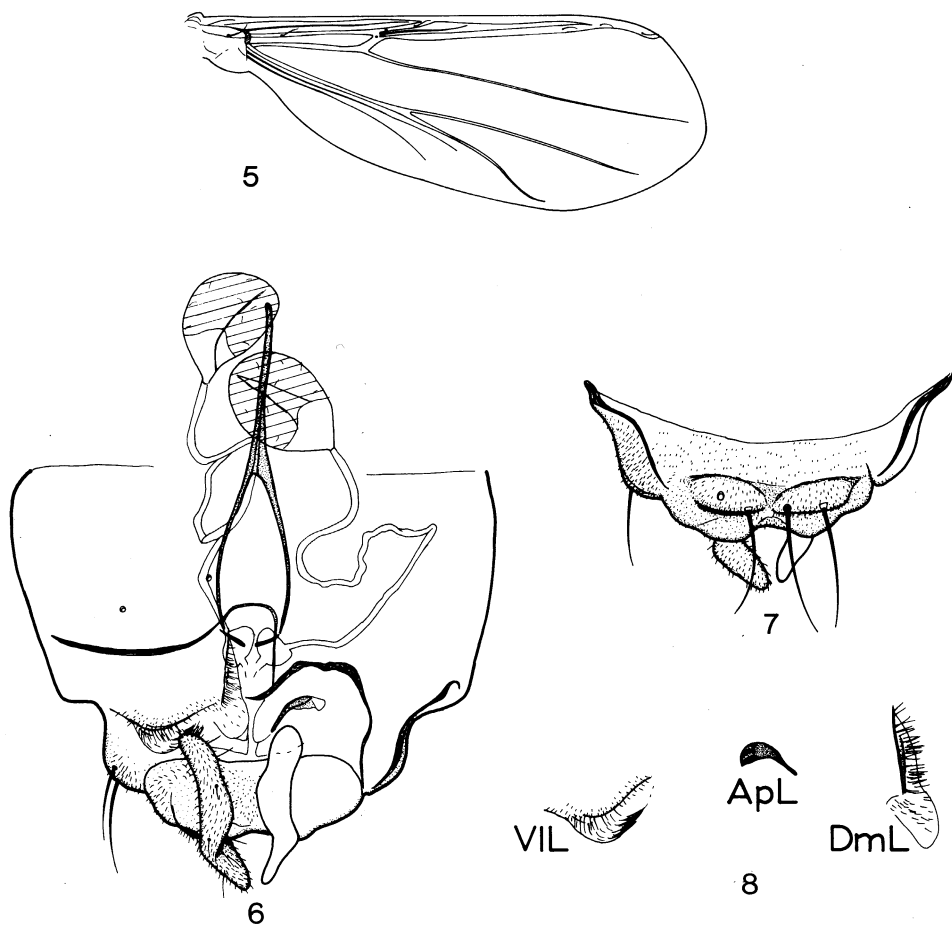


FIGS. 1-4. Male imago of *Rheosmittia spinicornis*. FIG. 1. Cibarial pump, tentorium and stipes. FIG. 2. Thorax. FIG. 3. Wing. FIG. 4. Hypopygium.

Thorax. Antepronotum without setae. Dorsocentrals 3-4, 4; prealars 3. Scutellum with 2 setae.

Wing (fig. 5). VR 1-43-1-52, 1-49. Brachiolum, R and R₁ each with 1 seta; R₄₊₅ with 1-3, 2 seta; extended part of costa with 1-2, 1 setae, in addition to marginal fringe.

Legs. Spur of front tibia 8-11, 10 μm long; spurs of middle tibia 8-11, 10 μm long and apparently absent; of hind tibia 23-31, 26 μm and absent. Width at apex of front tibia 15-21, 17 μm ; of middle tibia 17-23, 18 μm ; of hind tibia 21-26, 24 μm . Comb of



FIGS. 5-8. Female imago of *Rheosmittia spinicornis*. FIG. 5. Wing. FIG. 6. Genitalia, ventral view. FIG. 7. Same, dorsal view. FIG. 8. Lobes of gonapophysis VIII. ViL, ventrolateral lobe; ApL, apodeme lobe; DmL, dorsomesal lobe.

hind tibia with 7-9, 8 setae; longest seta 17-23, 20 μm long; shortest seta 11-15, 12 μm long. Tarsal pseudospiurs absent. Lengths (μm) and proportions of legs:

	fe	ti	ta ₁	ta ₂
p ₁	176-203, 190	240-274, 256	120-139, 130	60-73, 67
p ₂	227-251, 237	180-227, 208	90-113, 101	45-56, 50
p ₃	210-233, 220	240-270, 248	105-129, 120	53-66, 59
	ta ₃	ta ₄	ta ₅	LR
p ₁	41-49, 46	23-30, 27	28-32, 30	0.49-0.52, 0.51
p ₂	37-45, 43	23-26, 24	26-30, 28	0.46-0.54, 0.49
p ₃	64-75, 70	26-30, 28	28-34, 31	0.44-0.49, 0.47
	BV	SV	BR	
p ₁	3.26-3.63, 3.38	3.32-3.51, 3.42	2.3-3.0, 2.7	
p ₂	3.37-4.08, 3.82	4.23-4.63, 4.43	2.3-3.2, 2.9	
p ₃	3.05-3.32, 3.17	3.84-4.29, 3.96	2.6-3.7, 3.2	

Abdomen. Tergites I–IV each with 2 setae; tergite V with 2–4, 3 setae; VI–VII each with 4; VIII with 4–6, 4 setae. Sternite I without seta; II–III each with 2 setae; IV with 2–4, 2; V–VII each with 2–4, 3; VIII with 3–4, 4 setae.

Genitalia (figs. 6–8). Gonocoxite with 1 long and 1–2, 2 short setae. Tergite IX with 4–5, 4 setae. Cercus 49–81, 59 μm long. Seminal capsule including neck 32–41, 38 μm long; 28–34, 30 μm wide. Spermathecal duct with 15–19, 16 μm wide bulb before opening.

Pupa ($N=8$)

Length 1.3–1.7 mm, female shorter than male. Exuviae hyaline.

Cephalothorax. Frontal seta absent (fig. 9). Ocular and postorbital seta single and each about 40 μm long. Anterior precorneal seta 25–34 μm long, median 45–60 μm long, posterior 32–46 μm long. All dorsocentral setae about 40–52 μm long (fig. 10).

Abdomen (figs. 11, 12). Shagreen and chaetotaxy as in figures. Pedes spurii A absent. Anal lobe, including tails, 106–148, 132 μm long. Dc_5 on tergite III 45–56 μm long, 12–15 μm wide at apex.

Larva (4th instar) ($N=7$, except where otherwise stated)

Body length 1.9–2.4, 2.2 mm; head capsule length 111–137, 126 μm . Body colour after preservation, yellow. Head capsule pale yellow with mentum, mandibles and occipital margin slightly darker yellow.

Head. Antenna 5-segmented (fig. 14), segment 2 unevenly sclerotized; lengths (μm): 30–39, 36; 32–37, 35; 5–7, 6; 2–3, 2.5; 7–9, 8. AR 0.64–0.70, 0.68. Antennal blade 35–40 μm long; antennal style 6–8 μm long. Ring organ about 25 μm from base of first antennal segment.

Labrum (As in fig. 16). Premandible 16–21, 18 μm long, with 11 or 12 subequal teeth.

Mandible (fig. 15). 36–45, 42 μm long. Seta subdentalis about 5 μm long.

Mentum (fig. 13). Flattened mentum width 32–38, 36 μm (4), with 5 pairs of pointed lateral teeth and 9 rounded, subequal, median teeth. Ventromentum weakly developed.

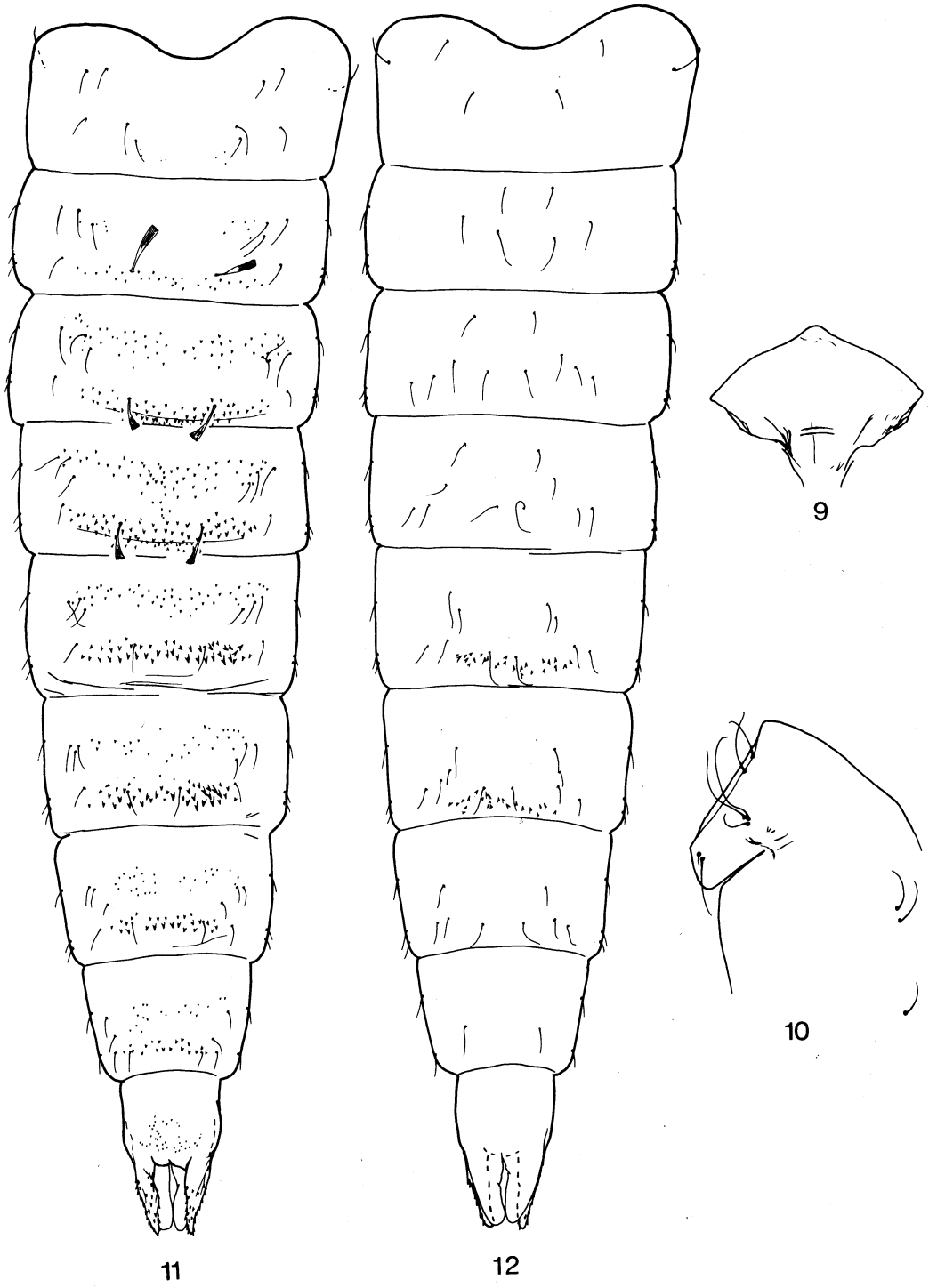
Abdomen (fig. 17). Anterior parapods with dark yellow serrate claws; posterior parapods 95–128, 110 μm long, bearing dark yellow simple claws. Procercus 15–19, 17 μm high, 14–16, 15 μm wide, bearing usually 5 anal setae of maximum length 153–212, 195 μm . Lateral procercal and supraanal setae fine and short. Anal tubules ovoid, uncontracted, 50–60 μm long, half the length of posterior parapods.

Material examined. LECTOTYPE; here designated: ♂, Sweden, Skåne, River Värke at Brösarp, 9.vi.55 (*Brundin*) (SMNH). PARALECTOTYPES: ALLOLECTOTYPE, 3 ♂, 4 ♀, same data as lectotype. 17 ♂, 15 ♀, 8 mature pupae, 1 pupal exuviae, 6 larvae, sandy bottom of small stream, Denmark, SW of Silkeborg, Skaer baek, 11.v.80, (*A. Sode* and *P. Wiberg-Larsen*) (BMNH, ZMBN).

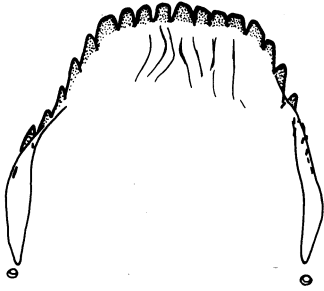
***Rheosmittia languida* (Brundin) comb. nov.**

Parakiefferiella (*Rheosmittia*) *languida* Brundin, 1956: 156 (male).

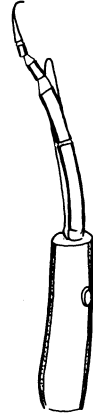
The imago is characterized by having 13(?) flagellomeres in the male with an AR of about 0.3, well developed anteprenotal lobes, lacking scutal tubercle, projection of inferior volsella directed posteriomediaally; female with weak bulbs, about 8 μm wide, at apex of spermathecal ducts.



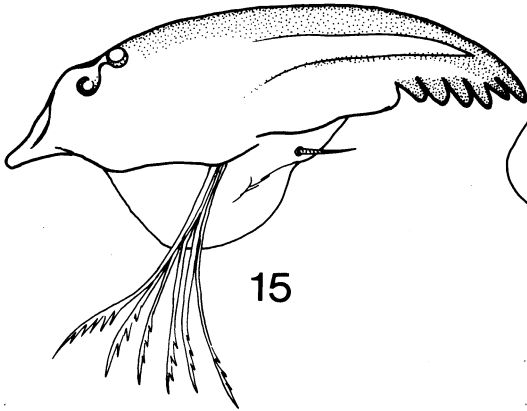
FIGS. 9-12. Pupa of *Rheosmittia spinicornis*. FIG. 9. Frontal apotome. FIG. 10. Thorax. FIG. 11. Tergites. FIG. 12. Sternites.



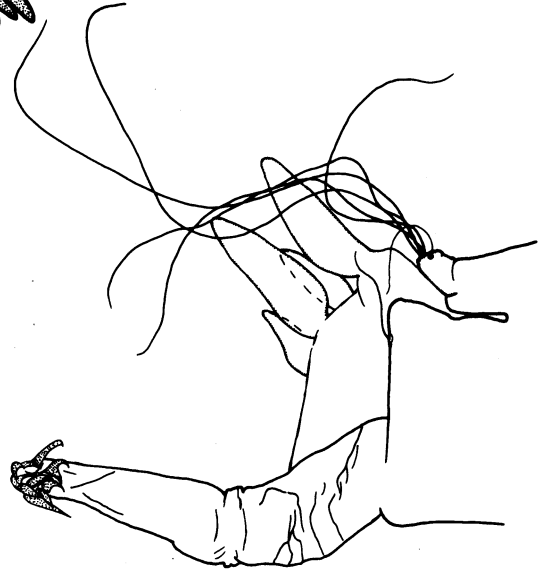
13



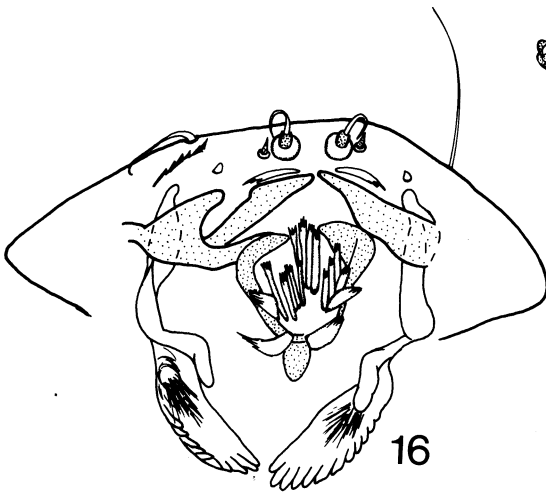
14



15



17



16

FIGS. 13-17. Larva of *Rheosmittia spinicornis*. FIG. 13. Mentum. FIG. 14. Antenna. FIG. 15. Mandible. FIG. 16. Labrum and epipharynx. FIG. 17. Posterior end of abdomen.

(The following redescrptions are based on the original type material which is in a very poor condition. It is, for instance, not possible to determine the number of flagellomeres (although there appear to be 13) and the chaetotaxy of thorax, head and abdomen is unclear.)

Male imago ($N=3-4$, except when otherwise stated)

Total length 1.95–2.00 mm (2). Wing length 1.19 mm (1). Total length/wing length 1.68 (1). Wing length/length of profemur 3.45–3.53 (2). Colour given by Brundin (1956: 156).

Head. AR 0.28–0.31, 0.29. Antenna apparently with 13 flagellomeres; last flagellomere 116–131, 124 μm long. Tentorium 90–98, 94 μm long; 10–11, 11 μm wide. Stipes 68–86, 78 μm (3) long. Palp lengths (μm): 17–23, 20; 23–30, 28; 38–49, 43; 49–53, 51; 56–71, 66.

Thorax (fig. 22). Anteprenotum well developed, lobes apparently in medial contact. Slight concavity present behind scutal projection, no scutal tubercle.

Wing ($N=1$). VR 1.21. Brachiolum with 1 seta, other veins bare. Extended part of costa 98 μm long.

Legs. Spur of front tibia 24–30, 27 μm long; spurs of middle tibia 11 μm (2) long and absent (2); of hind tibia 24–26 μm (2) and 8–9 μm (2) long. Width at apex of front tibia 19–23, 22 μm ; of middle tibia 17–23, 21 μm ; of hind tibia 26–30, 27 μm . Comb of hind tibia with 11–12 (2) setae; longest seta 23–24 μm (2 legs); shortest seta 15 μm (2) long. Tarsal pseudospurs absent. Lengths (μm) and proportions of legs:

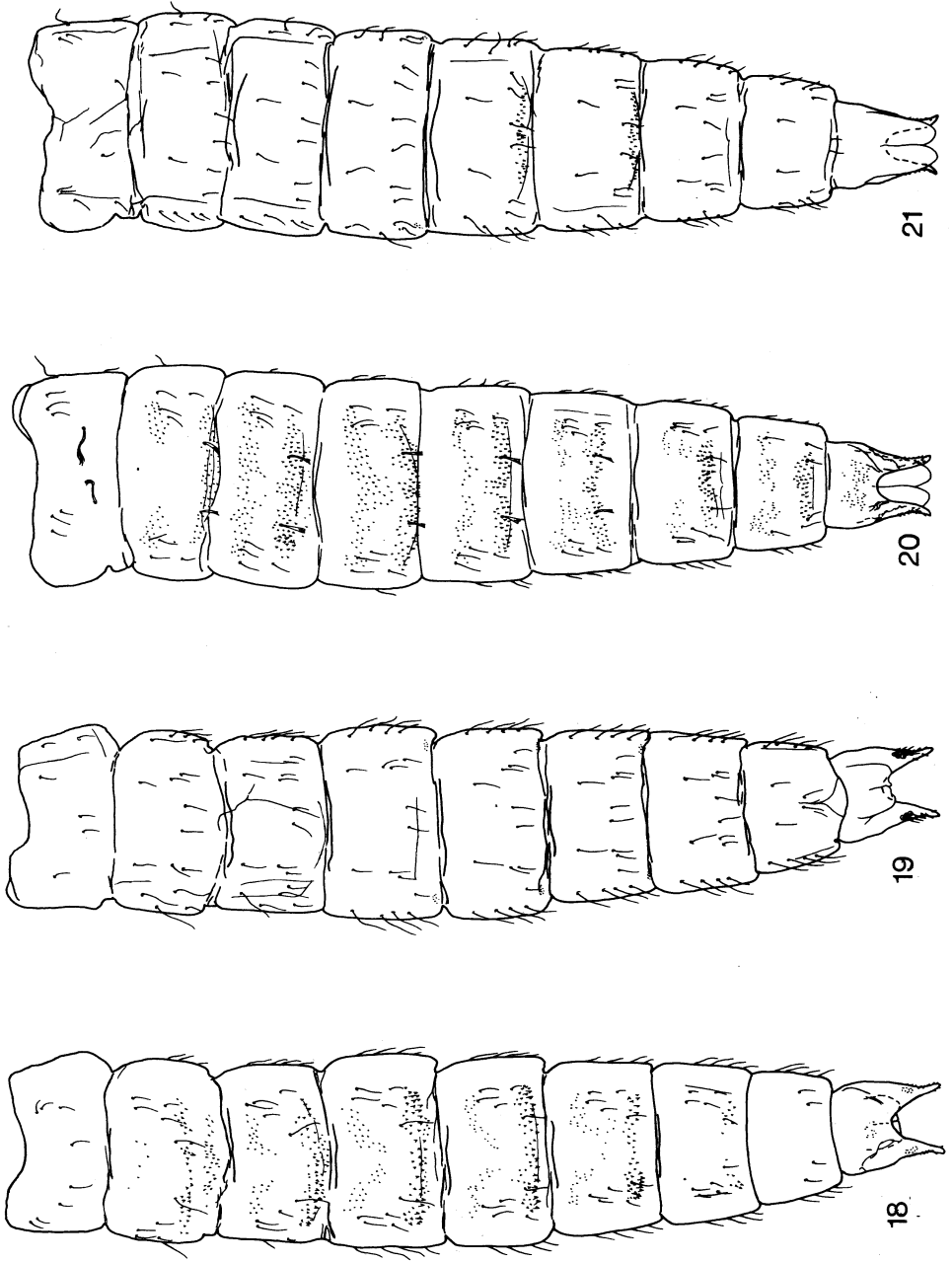
	fe	ti	ta ₁	ta ₂
p ₁	300–345, 319	394–473, 427	210–244, 223	135–180, 160
p ₂	338–390, 359	338–401, 362	144–176, 158	86–101, 92
p ₃	326–416, 372	409–454, 425	206–240, 219	116–135, 125
	ta ₃	ta ₄	ta ₅	LR
p ₁	86–113, 101	49–56, 52	45–53, 49	0.51–0.53, 0.52
p ₂	68–86, 76	34–45, 40	34–45, 39	0.40–0.44, 0.42
p ₃	98–113, 103	45–60, 51	41–53, 46	0.50–0.53, 0.51
	BV	SV		
p ₁	2.46–2.98, 2.76	3.30–3.36, 3.34		
p ₂	3.41–3.88, 3.59	4.45–4.81, 4.57		
p ₃	3.08–3.45, 3.12	3.56–3.75, 3.65		

Hypopygium (Brundin 1956: fig. 113). Phallapodeme 41–49 μm (2) long. Transverse sternapodeme 45–53 μm (2) long. Virga consisting of several fused spines 50–53 μm (2) long. Gonocoxite 94–116, 106 μm long; volsella apparently present and low and rounded, inferior volsella square with mediolateral, medioposteriorly directed projection. Gonostylus 49–58, 53 μm long, strongly bent; apical megaseta 7–8 μm long. HR 1.92–2.07, 2.00; HV 3.45–3.69 (2).

Female imago ($N=1-3$)

Total length 1.39 mm. Wing length 0.98 mm. Total length/wing length 1.42. Wing length/length of profemur 3.07.

Head. AR 0.50. Tentorium 79 μm long, 8–9 μm wide. Stipes 86 μm long. Palp lengths (μm): 19; 26; 45–56, 50; 49–60, 56; 71–90.



FIGS. 18-21. Pupae of *Rheosmittia* spp. FIG. 18. Tergites of sp. A. FIG. 19. Sternites of sp. A. FIG. 20. Tergites of sp. B. FIG. 21. Sternites of sp. B.

Wing. R with at least 2 setae, R_{4+5} with at least 1 seta.

Legs. Spur of front tibia 26 μm long, spurs of middle tibia 19 μm long and absent, of hind tibia 38 μm and 13 μm long. Width at apex of front tibia 23 μm , of middle tibia 26 μm , of hind tibia 32 μm . Comb of behind tibia with 10 setae, 19–34 μm long. Lengths (μm) and proportions of legs:

	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	BV	SV
p ₁	319	401	206	124	86	49	45	0.51	3.05	3.49
p ₂	349	375	169	83	60	34	34	0.45	4.25	4.29
p ₃	375	424	229	113	105	41	41	0.54	3.43	3.49

Genitalia (fig. 27). Cercus 45 μm long. Seminal capsule 39–49, 45 μm long excluding a 15–17 μm long neck; width 30–41 μm . Spermathecal ducts with 8 μm wide bulbs before opening. Notum 89–94, 91 μm .

Material examined. LECTOTYPE ♂ here designated, Norway, Jotunheimen, Gjendesheim, the river Leirungså, elevation 1120 m, 30.vii.1955, (*L. Brundin*) (SMNH). PARALECTOTYPES 3♂, 4♀, same data as LECTOTYPE (SMNH).

Rheosmittia halvorseni sp. nov.

Parakiefferiella (*Rheosmittia*) *languida* Halvorsen, Willassen & Saether 1982: 120, not Brundin 1956: 156 (male).

Diagnostic characters. The imago is characterized by having 12 flagellomeres in the male with an AR of 0.3–0.4; reduced anteprenotal lobes; no scutal tubercle; male with frontal tubercles; large, rounded projection of inferior volsella directed medially, female tergite IX with about 6 setae; female gonocoxite with 3 long and 3 short setae; bulbs of spermathecal ducts large, about 30 μm wide in diameter.

Etymology. Named in honour of G. A. Halvorsen, Museum of Zoology, University of Bergen, the collector of the holotype.

Male imago ($N=3$, except when otherwise stated)

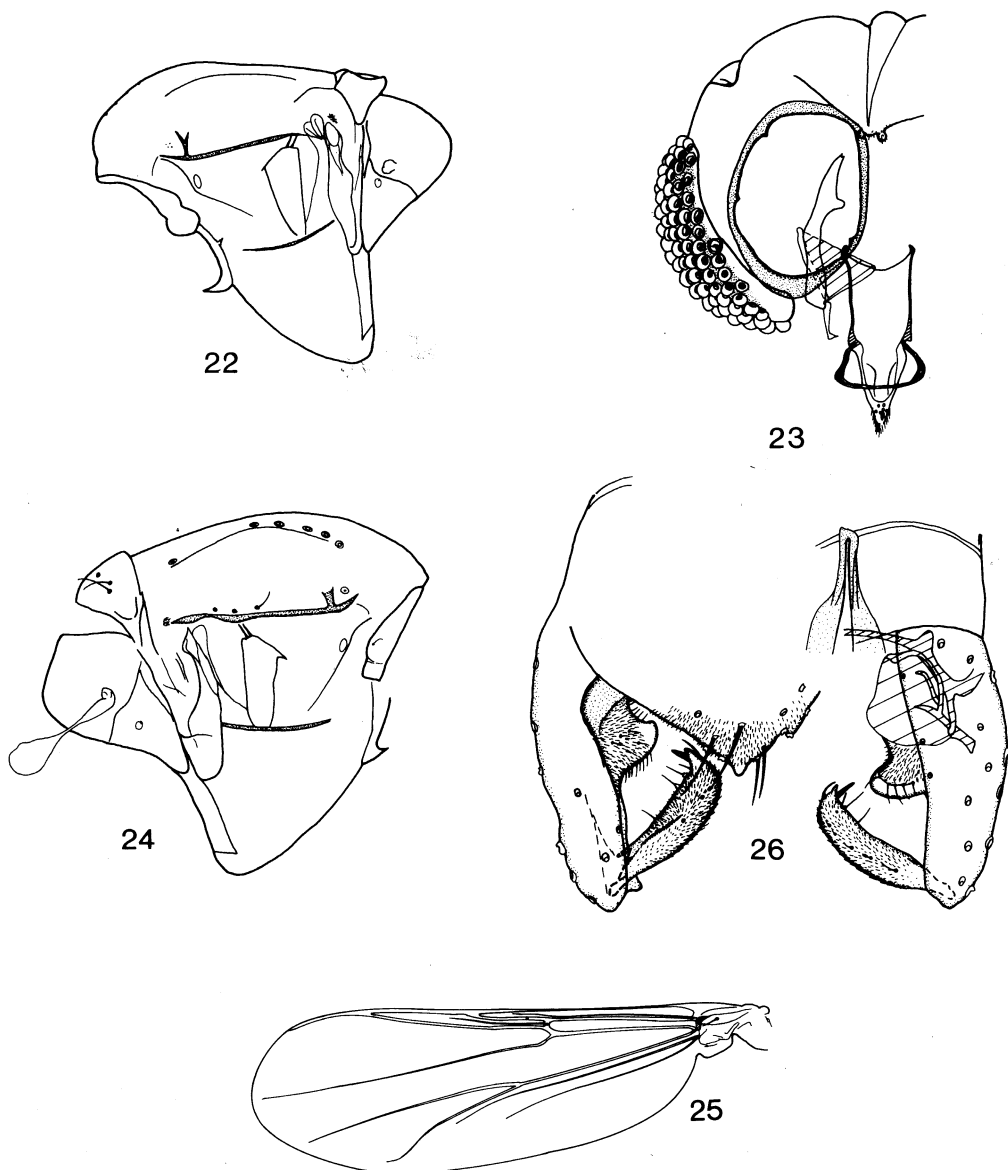
Total length 1.80–1.94, 1.89 mm. Wing length 1.17–1.22, 1.20 mm. Total length/wing length 1.54–1.61, 1.58. Wing length/length of profemur 3.60–3.75 (2). Pale with dark separate vittae, spot on anepisternum, preepisternum and margins of scutellum. Abdomen brown with setae situated in pale spots.

Head (fig. 23). AR 0.35–0.41, 0.38. Antenna with 12 flagellomeres; last flagellomere 156–184, 168 μm long. Temporal setae, 2–3, 2, all outer verticals. Frontal tubercles present and distinct 4–8, 7 μm high; 4 μm wide. Clypeus with 5–7, 6 setae. Cibarial pump, tentorium and stipes as in fig. 23. Tentorium 105–116, 112 μm long; 17–21 μm (2) wide. Stipes 79–86, 81 μm long. Palp lengths (μm): 19–23, 22; 30–34, 31; 53 (2); 62–68 (2); 79–84 (2).

Thorax (fig. 24). Anteprenotum reduced, with 1 lateral seta. Dorsocentrals 6; prealars 2–3, 3; no scutal tubercle. Scutellum with 4 setae.

Wing (fig. 25). VR 1.32–1.46, 1.41. Brachiolum with 1 seta; R with 0–2, 1 seta; other veins bare. Extended part of costa 208–246, 224 μm long.

Legs. Spur of front tibia 34–41 μm (2) long; spurs of middle tibia 11 μm (1) and 4 μm (1); of hind tibia 34–36, 35 μm and 15 μm . Width at apex of front tibia 21 μm (2); of middle tibia 23 μm (1); of hind tibia 30–32, 31 μm . Comb of hind tibia with 9 setae;



FIGS. 22-26. Male imagines of *Rheosmittia* spp. FIG. 22. Thorax of *languida* (chaetotaxy not shown). FIG. 23. Head of *halvorseni*. FIG. 24. Thorax of *halvorseni*. FIG. 25. Wing of *halvorseni*. FIG. 26. Hypopygium of *halvorseni*.

longest seta 28–34, 31 μm long; shortest seta 17–23, 20 μm long. Tarsal pseudosperms absent. Lengths (μm) and proportions of legs:

	fe	ti	ta ₁	ta ₂
p ₁	321–340(2)	421–435(2)	194(1)	104(1)
p ₂	416–444, 435	383–406, 394	175–189(2)	95(1)
p ₃	378–406, 387	406–449, 420	208–217, 211	104–118, 112

	ta ₃	ta ₄	ta ₅	LR
p ₁	76(1)	43(1)	47(1)	0.45(1)
p ₂	85(1)	43(1)	47(1)	0.46–0.47(2)
p ₃	104–113, 107	43–47, 44	38–47, 43	0.50–0.51, 0.51

	BV	SV	BR
p ₁	0.46–0.47(2)	0.50–0.51, 0.51	2.3(1)
p ₂	3.86(1)	4.50–4.57(2)	3.6(2)
p ₃	3.29–3.39, 3.33	3.71–3.87, 3.81	4.0(1)

Abdomen. Tergites with single or double transverse row of 4–6 setae.

Hypopygium (fig. 26). Tergite IX with 8–12, 10 setae including 2–3, 2 setae on each side of anal point; laterosternite IX with 2 setae. Phallapodeme 45–53, 49 μm long. Transverse sternapodeme 53–68, 63 μm long. Virga consisting of about 4 fused spines and lamellae; 32–45, 39 μm long. Gonocoxite 105–124, 114 μm long; with well developed rounded superior volsella anteriorly and inferior volsella with large, rounded, medially directed projection. Gonostylus 58–66, 63 μm long, only slightly bent; apical megaseta 7–9, 8 μm long. HR 1.79–1.89, 1.83; HV 2.93–3.10, 3.02.

Female imago (N = 1–2)

Total length 1.57–1.67 mm. Wing length 1.20 mm. Total length/wing length 1.40. Wing length/length of profemur 4.37. Colour as in male.

Head. AR 0.60. Flagellomere lengths (μm): 49, 38, 34, 34, 90. Temporal setae 2 outer verticals. Clypeus with 7 setae. Tentorium 81–84 μm long, 6–8 μm wide. Stipes 71 μm long. Coronal suture complete. Palp lengths (μm): 17–19, 26–30, 45, 56–60, 62.

Thorax. Anteprenotum with 1 seta. Dorsocentrals 6, prealars 3. Scutellum with 4 setae.

Wing. VR 1.59. Brachiolum with 1 seta, R with 4 setae, R₁ with 2, R₄₊₅ with 3, extended part of costa with 6 setae in addition to marginal fringe.

Legs. Spur of front tibia 26 μm long, spurs of middle tibia 8 μm and 4 μm long, of hind tibia 30 μm and 8 μm long. Width at apex of front tibia 19 μm , of middle tibia 23 μm , of hind tibia 30 μm . Comb of hind tibia with 9 setae, 15–23 μm long. Lengths (μm) and proportions of legs:

	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄
p ₁	246–274	293	151	76	52	28
p ₂	378	350	161	80	71	33
p ₃	326–340	350–369	151–180	76–85	85–95	28–38

	ta ₅	LR	BV	SV	BR
p ₁	38	0.52	3.56	3.56	—
p ₂	38	0.46	4.00	4.53	2.7
p ₃	28–38	0.43–0.49	3.48–3.80	3.95–4.47	2.2

Abdomen. Sternite I without seta, other tergites and sternites apparently each with 2–4 setae.

Genitalia (figs. 28–30). Gonocoxite with 2–3 long and 2–3 short setae. Tergite IX with about 6 setae. Cercus 83–86 μm long. Seminal capsule, including indistinct neck, 94–101 μm long, darker sclerotized in apical 71 μm , width 71–83 μm . Spermathecal duct with several loops and 30–32 μm wide bulb before opening.

Material examined. HOLOTYPE ♂, Norway, Hordaland, Vaksdal, Ekse, 26.vii.1979, netted in cop., (*Halvorsen*) (ZMBN No. 95). PARATYPES, 2 ♂, 1 ♀, same locality as HOLOTYPE, 20–27.vii.1976, light trap, (*Andersen*); 4 ♀, Norway, Jotunheimen, Gjendesheim, river Leirungså, 1120 m, 30.vii.1955, N.21 (*Brundin*) (SMNH, ZMBN).

***Rheosmittia* species A (? = *R. languida* (Brundin))**

Parakiefferiella sp., Thienemann, 1941: 184; Brundin, 1956: 153, figs. 116–117.

Pupa ($N = 10$)

Length 2.15–2.45, 2.25 mm. Exuviae hyaline.

Cephalothorax. Frontal setae absent. Ocular and postorbital setae, when visible, single and about 50 μm long. Precorneal and dorsocentral setae variably damaged and/or obscured, none longer than about 50 μm .

Abdomen (figs. 18, 19). Shagreen and chaetotaxy as in figures. Pedes spurii A present on sternites IV–VI. Anal lobe, including tails, 180–225, 200 μm long; longest of 3 macrosetae 37–54, 42 μm long. Dc₅ simple, up to 40 μm long on tergite III. L setae longer than usual, the longest between 60 and 90 μm long.

Material examined. 10 pupal exuviae, Norway, Jotunheimen, Gjendesheim, river Leirungså, 1120 m, 30.vii.1955 (*Brundin*) (SMNH).

Comments

The vial labelled 'N 21' contained, amongst others, 21 exuviae of the type Brundin figures as '*Parakiefferiella* (s. str.) sp. c Thien.' and 10 exuviae of '*Parakiefferiella* (*Rheosmittia*) *languida* n. sp.'. The vial contained adults of 8 (4 ♂, 4 ♀) *R. languida* and 4 ♀ *R. halvorseni* (newly described in this work). We are now recognizing '*Parakiefferiella* sp. c' as belonging to *Rheosmittia*, but we are unable to associate the two kinds of pupal exuviae with the two adult *Rheosmittia* species. The greater proportion of *Rheosmittia* species A ('*Parakiefferiella* sp. c') exuviae and adults of *R. languida* in Brundin's vial is the only indication of association. This contradicts Brundin's (*loc. cit.*) association, but confirmation awaits rearing or collection of pharate adults.

***Rheosmittia* species B (? = *R. halvorseni* sp. nov.)**

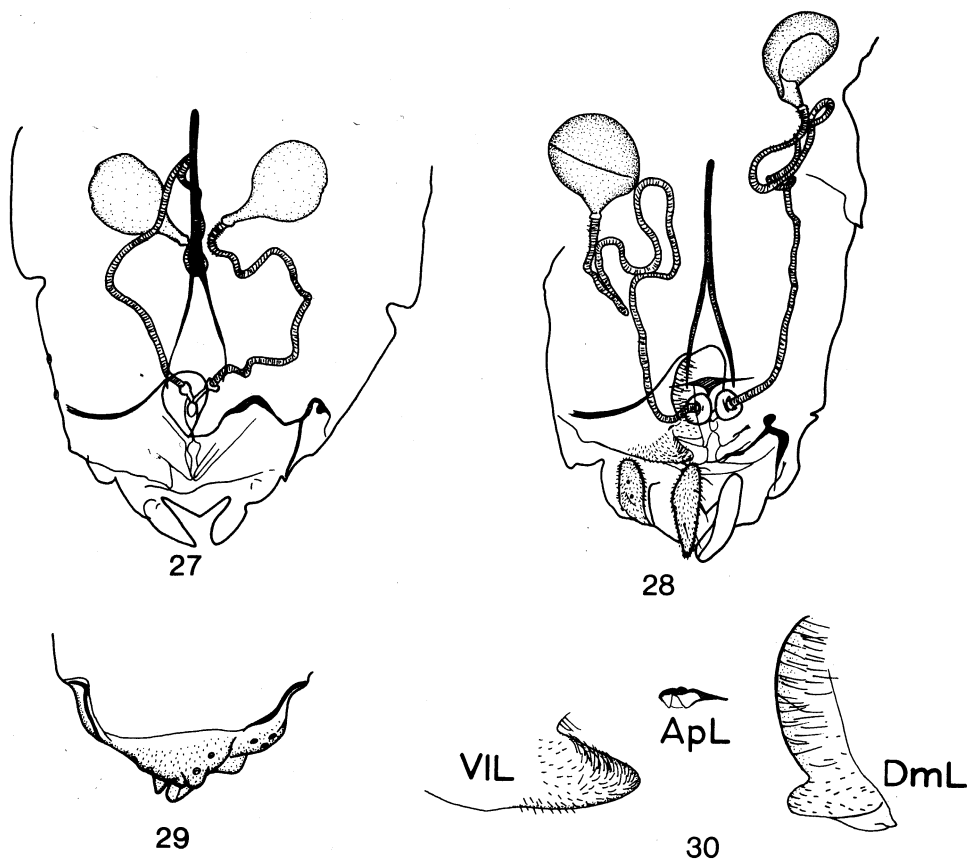
Parakiefferiella (*Rheosmittia*) *languida* Brundin 1956: 153, figs. 120–121 (pupa).

Pupa ($N = 10$)

Length 1.7–2.1, 1.9 mm. Exuviae weakly infusate.

Cephalothorax. Frontal setae absent. Ocular and postorbital setae, when visible, single and about 40 μm long. Precorneal and dorsocentral setae damaged and/or obscured, none longer than 45 μm .

Abdomen (Figs. 20, 21). Shagreen and chaetotaxy as in figures. Pedes spurii A indicated on tergite IV of some specimens. Anal lobe, including tails, 165–180, 172 μm



FIGS. 27–30. Female imagines of *Rheosmittia* spp. FIG. 27. Genitalia, ventral view, of *languida*. FIG. 28. Genitalia, ventral view, of *halvorseni*. FIG. 29. Genitalia, dorsal view, of *halvorseni*. FIG. 30. Lobes of gonapophysis VIII of *halvorseni*. ViL, ventrolateral lobe; ApL, apodeme lobe; DmL, dorsomesal lobe.

long, without macrosetae. Dc₃ on tergite III 32–54 μm long, 10–12 μm wide apically. L setae 20–32 μm long on segment III.

Material examined. 10 pupal exuviae, Norway, Jotunheimen, Gjendesheim, river Leirungså, 1120 m, 30.vii.1955 (Brundin) (SMNH).

Comments

As in the case of *Rheosmittia* species *A* (q.v.), there is no clear association of the pupal exuviae with an adult midge. In Brundin's vial 'N 21' the relative proportions of exuviae and adults suggest that *R.* species *B* might be the exuviae of *R. halvorseni*, but confirmation awaits rearing or collection of pharate adults.

Distribution and ecology

Adult *Rheosmittia* are rarely collected, perhaps because of their small size. The immature stages are collected more often, but species identifications are unreliable,

especially because of the uncertain association between the pupae and the adults of *R. languida* and *R. halvorseni*. Despite these problems, some general observations can be made.

In the western Palaearctic region, species of *Rheosmittia* are known from Norway and Sweden (Brundin 1956, and this study), U.S.S.R., Komi A.S.S.R. (Zvereva 1950), Denmark (this study), West Germany (Reiss 1982), Ireland (B. Hayes, 1984 personal communication), Italy (Rossaro 1977) and Romania (Botnariuc and Cure 1956, Albu 1966). We have seen an undescribed pupal type from China (Jilin Province, Erdaobaine, near Songjiang, May 1980) collected by Dr E. J. Fittkau.

In the Nearctic region the genus is represented by at least six pupal types. Several species, distinguished on larval and pupal morphology, are present in streams and rivers of the eastern U.S.A., and we have seen additional specimens from Yukon and Alberta in the north, Washington and Montana in the west and Florida and Kansas in the south.

The only locality outside the Holarctic region from which *Rheosmittia* has been collected is southern India (W. P. Coffman, 1983 personal communication).

Zvereva (1950) reported the larvae of *Rheosmittia* (as *Tschernovskiella*) to be psammophiles, dwelling in the sandy substrates of rivers. In recent years the importance of sandy river beds has been recognized and some of the sampling problems have been overcome. This has allowed confirmation of the abundance of *Rheosmittia* larvae in these biotopes (J. G. Peters, D. Solluk 1983, personal communications) but it is not clear if *Rheosmittia* larvae are restricted to unstable sandy beds, or if they may also occur on rocks and gravels.

Acknowledgments

We are indebted to Mrs Annette Sode, Institute of Biology, University of Odense and Mr Peter Wiberg-Larsen, Water and Environment department, Fyn amtskommune, both Odense, Denmark for the associated material of *Rheosmittia spinicornis*; to Prof. Emeritus Lars Brundin, Stockholm for the type-material of *R. spinicornis*, *R. languida*; the pupal material of *Rheosmittia* sp. *A* and *B* and paratype females of *R. halvorseni*; to G. A. Halvorsen for type material of *R. halvorseni*; and to Mrs Unni G. Saether for doing the illustrations and typing of the manuscript. Her assistance was made possible through a grant from the Norwegian Research Council.

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