

***Aagaardia*, a New Holarctic Orthoclad Genus (Diptera: Chironomidae)**

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ABSTRACT

Diagnoses of all stages of the new genus *Aagaardia* are given. The genus includes *A. sivertseni* (Aagaard), originally described in *Eukiefferiella* Thienemann, from Norway and Finland and described in all stages; *A. protensa* sp. n. from Finland and *A. triangulata* sp. n. from Turkey described as male imagines; and *A. longicalcis* sp.n. from Canada described in both sexes. The male imagines share bare eyes, strong punctation on wings, bare squama, extended costa, triangular gonostylus and two groups of extremely strong and sclerotized virga. The pupa and the female genitalia show relationship with *Paratrissocladius* Zavřel, while the larva is very similar to the larvae of *Psilometriocnemus* Sæther and *Platysmittia* Sæther. Parsimony analyses suggest that *Aagaardia* forms the plesiomorphic sister genus to the rest of the *Heterotrissocladius* group combined.

KEYWORDS: *Aagaardia*, *sivertseni*, *protensa*, *triangulata*, *longicalcis*, Orthocladiinae, Chironomidae.

INTRODUCTION

Aagaard (1979) described a new species, *sivertseni*, from Lake Målsjøen, South Trøndelag, Norway, which he placed tentatively in *Eukiefferiella* Thienemann. The species had a remarkable virga consisting of two groups of extremely strong spines, whereas the hypopygium resembled certain *Zalutschia* Lipina. Cranston and Oliver (1988) found males and females of what they considered to be the same species and on the base of the female genitalia transferred the species to *Zalutschia*. Tuiskunen and Lindeberg (1986) reported the species from Northern Finland. Later a male reared from pupa was found in Northern Norway, and Tuiskunen found the larva in Finland. The immatures show that the placements in *Eukiefferiella* and *Zalutschia* both are erroneous and that the species deserves a separate genus. Further examination of material available shows that there are four separate species within the genus.

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METHODS AND TERMINOLOGY

The general terminology follows Sæther (1980). In the figures of the male genitalia the dorsal view is shown to the left, the ventral aspect and apodeme to the right. The measurements are given as ranges followed by a mean when 4 or more measurements are made, followed by the number measured in parentheses (n). The holotypes of the new species are deposited at the Museum of Zoology (ZMH), University of Helsinki, Finland, and at Zoologisches Staatssammlung (ZSM), Munich, Germany.

Aagaardia gen. n.

Type species: Aagaardia sivertseni (Aagaard) by present designation.

Diagnostic characters: The male imagines are separable from other Orthocladinae by the combination of having bare eyes without dorsomedian elongation, bare squama, no setae on wing membrane but distinct punctation, acrostichals starting in front, pseudospurs and pulvilli absent, anal point present, and extremely strong and sclerotized virga. The pupa differs from that of other genera with thoracic horn by having simple shagreen on tergites, three macrosetae, anal lobe fringe and taeniate L-setae on segment VIII, and from all except *Paratrissocladius* Zavřel, by lacking caudal hooklets on tergite II. Furthermore the pupa differs from *Paratrissocladius* by having the anterior shagreen spinules stronger than the posterior, lacking pedes spurii A, and having more sparse fringe of anal lobe taeniae. The larva differs from other genera except *Psilometriocnemus* Sæther and *Platysmittia* Sæther by having the ventromental plate conspicuous and double with a second plate lying inside main plate, S I with apical teeth, and six-segmented antenna with ultimate segment vestigial. It differs from both *Psilometriocnemus* and *Platysmittia* by having the basal antennal segment slightly longer than half the length of the flagellum, and mentum with the fourth lateral tooth lower and smaller than or at most subequal to the fifth lateral tooth.

Etymology: Named in honour of Kaare Aagaard, who first described *A. sivertseni*.

Male imago

Small species, wing length less than 1.5 mm.

Eye bare, reniform, without dorsomedian elongation. Antenna with 13 flagellomeres in male, 5 in female; fully plumed; groove beginning on flagellomere 4; sensilla chaetica present on flagellomere 2, 3 and 13; apex without straight apical seta; AR lower than 1.0. Palpomeres normal; palpomere 3 with 1–2 short lanceolate sensilla clavata. Temporals reduced in number, frontals usually replacing inner verticals. Tentorium and stipes normally developed. Cibarial pump with anterior margin deeply concave, cornua strongly developed. Clypeus with few setae.

Anteprenotal lobes not reduced medially, with few and weak lateral anteprenotals. Acrostichals starting close to anteprenotum, often weak in front, distinct in centre of scutum; dorsocentrals few and uniserial to numerous and in up to 4

rows anterior and posterior; few prealars; supraalars absent. Scutellum with setae transversely uniserial or in 3–4 transverse rows. All setae on thorax weak.

Wing membrane with distinct punctuation visible at 100 X; anal lobe reduced; costa moderately extended; R_{2+3} running in the middle between R_1 and R_{4+5} , ending close to R_{4+5} ; R_{4+5} ending above or distal to end of M_{3+4} , costa ending distal to end of M_{3+4} ; VR moderately high; Cu_1 slightly sinuous; postcubitus ending far distal to cubital fork, anal vein ending below or slightly distal to cubital fork. Brachiolum with 1 seta, R with a few setae, costal extension occasionally with 1 non-marginal seta, other veins bare. Squama bare. Sensilla campaniformia about 10–12 basally on brachiolum, about 8–10 apically on brachiolum, 3 below setae on brachiolum; 1 present basally on subcosta, and 1 basally on R_1 .

Front leg ratio about 0.5. Tibial spurs and hind tibial comb normal. Tarsal pseudospurs and pulvilli absent. None or 1–2 sensilla chaeticae present on ta_1 of mid leg of male, about 6–7 at 0.3–0.9 of ta_1 of each middle and hind tibia in female.

Tergites and sternites sparsely haired with a transverse band of few setae, a few median setae and few lateral setae.

Male anal point short, triangular with bare, rounded apex and setae lateral of base; no further setae on tergite IX; laterosternite IX with several setae and more or less distinct anterior tooth-like projection. Sternapodeme slightly curved, oral projections weak. Phallapodeme and aedeagal lobe normally developed. Virga consisting of two groups of very strong, darkly sclerotized spines, each group consisting of 3 long and 2 shorter spines. Gonocoxite well developed; inferior volsella a relatively low projection, no superior volsella. Gonostylus with outer corner which is smoothly rounded to pointed or carries a pointed projection, inner margin concave or straight, megaseta normal.

Female genitalia with evenly curved gonocoxapodemes meeting anterior of vagina. Gonocoxite well developed with few setae. Tergite IX strongly divided with several setae. Segment X normal. Postgenital plate weak, indistinct, bluntly triangular. Cercus small. Gonapophysis VIII divided into parallel-sided, slightly brush-like, long ventrolateral lobe and narrow dorsomesal lobe; both lobes covered by a posterior extension of sternite IX. Apodeme lobe large and distinct. Coxosternapodeme with anterior right-angled bend. Seminal capsules much larger than cerci, ovoid, darkly sclerotized for most of their length; with broad, triangular neck. Spermathecal ducts with long anterior loop and separate openings. Labia large and bare.

Pupa

Small pupae, 2.2–2.6 mm long. Exuviae transparent except some specimens with dark spot posterior on tergites I–IV or on the conjunctive following.

Cephalic tubercles and frontal warts absent. Frontal setae well developed, on frontal apotome, not on tubercles. Frontal apotome smooth or very slightly wrinkled anteriomedially. Thoracic horn with pointed apical tooth and some spines along inner margin, otherwise with few spinules. Wing sheath smooth, without

pearls or nose. Three precorneals, 4 anteprenotals, at least one postorbital, and 4 dorsocentrals present.

Tergite I bare; II–VIII with shagreen, extensive on III–VI, less extensive on VII and VIII; 3-4 anterior transverse rows of spinules coarse, particularly on III–VI, posterior rows of spinules slightly stronger than median; tergite IX with a few anteriomedian spinules. Conjunctives IV/V or V/VI to VII/VIII with a few weak spinules. Sternites I-V bare; VI and VII with distinct posteriomedian and very weak anteriomedian shagreen; VIII with a few anteriomedian spinules; IX bare. Tergite II without caudal hooklets, but a slight hump with shagreen spinules present. Pedes spurii A absent. Pedes spurii B absent or vestigial.

Segment I with 1 L seta, II–VI each with 3 hair-like L setae; VII with 4 taeniate LS seta; VIII with 5 taeniate LS setae. Tergites and sternites with 1 pair of O setae in C5 pattern, i.e., ventral O setae laterad of dorsal O setae.

Anal lobe well developed with complete fringe of few (10–12) long taeniae, dorsal taenia absent; macrosetae long and subequal. Genital sac of male with long lateral projection.

Larva

Small larvae, up to 4 mm long.

Antenna with 6 segments, basal segment shorter than flagellum; antennal segment 2 long, 3 shorter than 2 and 4; segment 4 slightly shorter to slightly longer than segment 2; segment 5 about as long as segment 3; ultimate segment minute, not hair-like. Basal antennal segment with ring organ situated in middle of basal segment. Lauterborn organs weak, style well developed. Blade shorter than flagellum.

S I with apical teeth. Other S setae simple. Weakly sclerotised labral lamellae present between S I. Chaetae apparently simple, about 6; 2 spinulae. Pecten epipharyngis of 3 simple, short spines. Seta premandibularis simple. Chaetulae laterales about 7 pairs, chaetulae basales apically bifid. Premandible bifid, without brush.

Mandible with apical tooth slightly shorter than combined width of 3 inner teeth. Seta interna of 7 branches, apparently plumose on inner side.

Mentum with two large median teeth and 5 pairs of gradually smaller lateral teeth. Ventromental plates double, distinctly connected to outer margin of first lateral teeth, anterior plate about half as wide as posterior plate. Setae submenti situated slightly below base of outer lateral tooth of mentum.

Maxillae with weak pecten galearis. Anterior lacinial chaeta shorter and broader than other lacinial chaetae.

Shorter claws of anterior parapods with teeth, longer claws apparently smooth. Procerus higher than wide, with about 7 anal setae. Supraanal setae about 1/3 as long as anal setae. Anal tubules shorter than posterior parapods. No distinct body setae.

SYSTEMATICS

In the key to Holarctic male Orthoclaadiinae (Cranston et al., 1989) *Aagaardia* is included as '*Zalutschia*' *sivertseni* and keyed out in the same couplet as *Boreosmittia* Tuiskunen. However, *Boreosmittia* apparently is related to *Pseudosmittia* Goetghebuer having among other the base of the anal point in the middle of the anal tergite, and shows few similarities with *Aagaardia*. The few species of *Eukiefferiella* Thienemann with bare squama mentioned in the diagnosis of that genus are not keyed out by Cranston et al. and would have keyed out together with *Boreosmittia* and *Aagaardia* if included in the key.

If the bare squama is disregarded the male imago keys to *Paratrissocladius* Zavřel. However, *Paratrissocladius* (Sæther, 1976), has dorsomedial eye extension, fully fringed squama, setae on R_1 and R_{4+5} , costal extension very short or absent, relatively long anal point, virga absent or consisting of minute spines, digitiform or weakly developed inferior volsella, gonostylus without outer heel, and differs also in other details. The female genitalia of *Aagaardia* shows some similarities to those of *Paratrissocladius* for instance in the divided tergite IX and in the parallel-sided ventrolateral lobe. *Paratrissocladius* is placed in the *Heterotrissocladius* group of genera by Sæther (1975, 1976).

The pupa of *Aagaardia* keys to *Paratrissocladius* in Coffman et al. (1986). It differs from that genus by having the anterior shagreen spinules slightly stronger than the posterior ones, while the opposite is true for *Paratrissocladius*. *Paratrissocladius* also has well developed pedes spurii A which appear to be absent in *Aagaardia*, and dense fringe of taeniae on the anal lobe while the number is reduced in *Aagaardia*.

The larva of *Aagaardia* is nearly identical to those of *Psilometriocnemus* and *Platysmittia* Sæther. It differs primarily in not having the fourth lateral tooth of the mentum smaller than the outer fifth tooth, and the basal antennal segment only about half as long as the flagellum. Both these features may not hold up when the larvae of more species are known. In *Platysmittia* the antenna is much longer than the flagellum (Jacobsen, 1998). The double ventromental plates are found among chironomids only in *Aagaardia*, *Psilometriocnemus*, *Paraphaenocladus*, *Platysmittia* and some *Parametriocnemus*, all belonging to the *Heterotrissocladius* group of genera. However, this feature is probably not a synapomorphy since not all *Parametriocnemus* have such ventromental plates and a number of other characteristics indicate that *Parametriocnemus*, *Paraphaenocladus*, *Heterotrissocladius* Spärck and *Paratrissocladius* may form a monophyletic group (Sæther, 1975; Sæther & Wang, 1995).

The lack of consistent synapomorphies within the group and several underlying synapomorphies in the form of unique inside parallelisms appear to be characteristic for the *Heterotrissocladius* group of genera (Sæther, 1983). Other characters such as equal-sized lobes of gonapophysis VIII of the female genitalia, shape and setae on the male anal point, wing sheath of pupa with pearl row, sexual dimorphism on segment VIII of pupa, larval antenna with more than 5 segments,

characteristically thin ultimate larval antennal segment etc. are nearly unique for the group but far from shared by all members.

Aagaardia partly possesses two of the three synapomorphies used for separating *Paratrissocladius* plus *Heterotrissocladius* from *Paraphaenocladius* plus *Parametriocnemus* in Sæther (1975), i.e., equal-sized lobes of gonapophysis VIII and vestigial Lauterborn organs in the larvae. However, three of the four species also possess unreliable synapomorphies used for separating the two last genera from the two first, i.e., that R_{4+5} ends above end of M_{3+4} and that costa is extended. Also *Platysmittia* has similar wing venation whereas in *Psilometriocnemus* R_{4+5} ends distal to end of M_{3+4} (Sæther, 1969, 1982). A bare squama is otherwise found in the group only in *Psilometriocnemus cristatus* Sæther, although *P. trianulatus* Sæther has 2 setae on squama.

Because of the prevalence of underlying synapomorphies, parsimony analysis may help sort out which phylogeny is the most likely. Also since all stages and both sexes are known for all included genera with only one question mark in the whole data matrix (for the female pupa of *Aagaardia*) one might expect a consistent result.

Interpretation of parsimony analyses are strongly influenced by the choice of outgroups (Sæther, 1983, 1986, 1990a, b). It may be incorrect to use the sister group as the sole outgroup if that group is aberrant or includes several aberrant subtaxa. Since *A. sivertseni* has been placed both in *Eukiefferiella* Thienemann and in *Zalutschia* Lipina, and *Parakiefferiella* Thienemann has been proposed to be related to at least some of the included genera, these three genera combined are used here as the outgroup. Most details of the other genera are according to Cranston et al. (1983, 1989), Coffman et al. (1986), Sæther (1969, 1975, 1977, 1982, 1983), Sæther and Wang (1995), and Jacobsen (1998).

The following 40 trends were used (0, 1 carry no implication of polarity although the 0 is used for what is regarded generally as the more plesiomorphous alternative):

Imagines

- T 1. AR 0.8 or higher (0), between 0.8 and 0.5 (1), lower than 0.5 (2).
- T 2. Eyes with strong dorsomedial extension (0), without (1).
- T 3. Acrostichals long, starting in front at antepronotum (0); acrostichals shorter, but well developed (1); very weak or absent (2).
- T 4. Wing membrane with setae (0); with no setae, but with strong microtrichiae or coarse punctation (1); bare, with fine punctation (2).
- T 5. Anal lobe well developed, distinctly protruding (0); weak, at most very slightly produced (1); absent, wing nearly cuneiform (2).
- T 6. Squama with 10 or more setae (0), with 1-9 setae (1), bare (2).
- T 7. R_{4+5} ending distinctly distal to apex of M_{3+4} (0), ending opposite to or slightly proximal or distal to apex of M_{3+4} (1), ending well proximal of M_{3+4} (2).
- T 8. Pulvilli present (0), absent or vestigial (1).
- T 9. Pseudospurs present (0), absent (1).
- T 10. Anal point with microtrichiae and setae to apex or absent (0), anal point with microtrichiae-free apex (1).
- T 11. Anal point when present with apex not spatulate (0), spatulate (1).

- T 12. Anal point when present without median swelling (0), with (1).
 T 13. Setae of anal point when present well developed, at least some straight and stiff (0); setae weak (1).
 T 14. Virga present, consisting of tightly clustered spines (0); virga absent or consisting of narrow field of short spinules (1).
 T 15. Spines of virga absent or moderately long (0); spines very long, and sometimes very stout (1).
 T 16. Gonostylus without outer corner or heel (0), with (1).
 T 17. Ventrolateral lobe of gonapophysis VIII of female much larger than dorsomesal lobe (0), of similar size or smaller (1).
 T 18. Spermathecal ducts straight or with bends (0), with loop (1).
- PUPAE
- T 19. Frontal apotome smooth (0), rugose (1).
 T 20. Frontal setae present (0), absent (1)
 T 21. Wing sheath without pearls (0), with (1).
 T 22. Caudal hooklets on tergite II well developed (0), absent or vestigial (1).
 T 23. Tergites with weak to strong shagreen, but no posterior spines (0); tergites VI or VII to VIII with posterior rows of spines (1), at least tergites V-VIII with posterior spines (2).
 T 24. Sternite VIII of male without posterior spines (0); sternite VIII of male with posterior spines (1).
 T 25. Sternite VIII of female without triangular projections or medial incision (0); sternite VIII medially incised, occasionally with spines but without imbedded spines (1); with imbedded spines (2).
 T 26. Pedes spurii A present (0), absent (1).
 T 27. Lateral setae at least of segment VIII taeniate (0), hair-like (1)
 T 28. Anal lobe fringe with more than 15 taeniae (0), with 2-15 taeniae (1), absent (2).
 T 29. Macrosetae well developed, subequal (0); reduced in size or numbers (1).
- LARVA
- T 30. Antenna with 5 segments (0), with 6 segments of which ultimate vestigial (1), with 7 of which ultimate vestigial (2).
 T 31. Antenna without hair-like vestigial ultimate segment (0), with (1).
 T 32. Antennal ratio higher than 0.8 (0), lower (1).
 T 33. Antennal blade shorter than flagellum (0), longer (1).
 T 34. Lauterborn organs well developed (0), absent or vestigial (1).
 T 35. S I plumose or with apical and lateral teeth (0), with more than 5 apical teeth (1), simple, bifid or with less than 5 apical teeth (2).
 T 36. Premandible with 1 apical tooth (0), with 2-6 apical teeth (1).
 T 37. Mentum with 2 (-3) well separated median teeth (0), with single median tooth or with 2 partly fused median teeth (1).
 T 38. Mentum with 5-6 pairs of lateral teeth (0), with 4 (1).
 T 39. Outer lateral teeth of mentum smaller than second most lateral tooth (0), larger (1).
 T 40. Ventromental plates not double (0), double (1).
 T 41. Pecten galearis present (0), absent (1).

Table 1 gives the data matrix for the parsimony analysis based on the above trends (T 1-41). The analysis used PAUP version 3.1.1 and McClade on a Macintosh IIsi. All searches were exhaustive.

It was not possible to make the in-group monophyletic with unweighted trends and *Eukiefferiella*, *Zalutschia* and *Parakiefferiella* combined used as outgroup. Also with Lundberg rooting, i.e., using a theoretical ancestor with all character states zero as outgroup, the in-group is not monophyletic. Both with ordered and unordered trends or with some multistate trends ordered others unordered using *Eukiefferiella*, *Zalutschia* and *Parakiefferiella* combined as outgroup, *Eukiefferiella* formed the sister group of the remaining genera with *Zalutschia* and *Parakiefferiella* in the same group as *Heterotrissocladius*, *Paratrissocladius* and *Aagaardia*. With Lundberg rooting *Parakiefferiella* or *Aagaardia* formed the basal

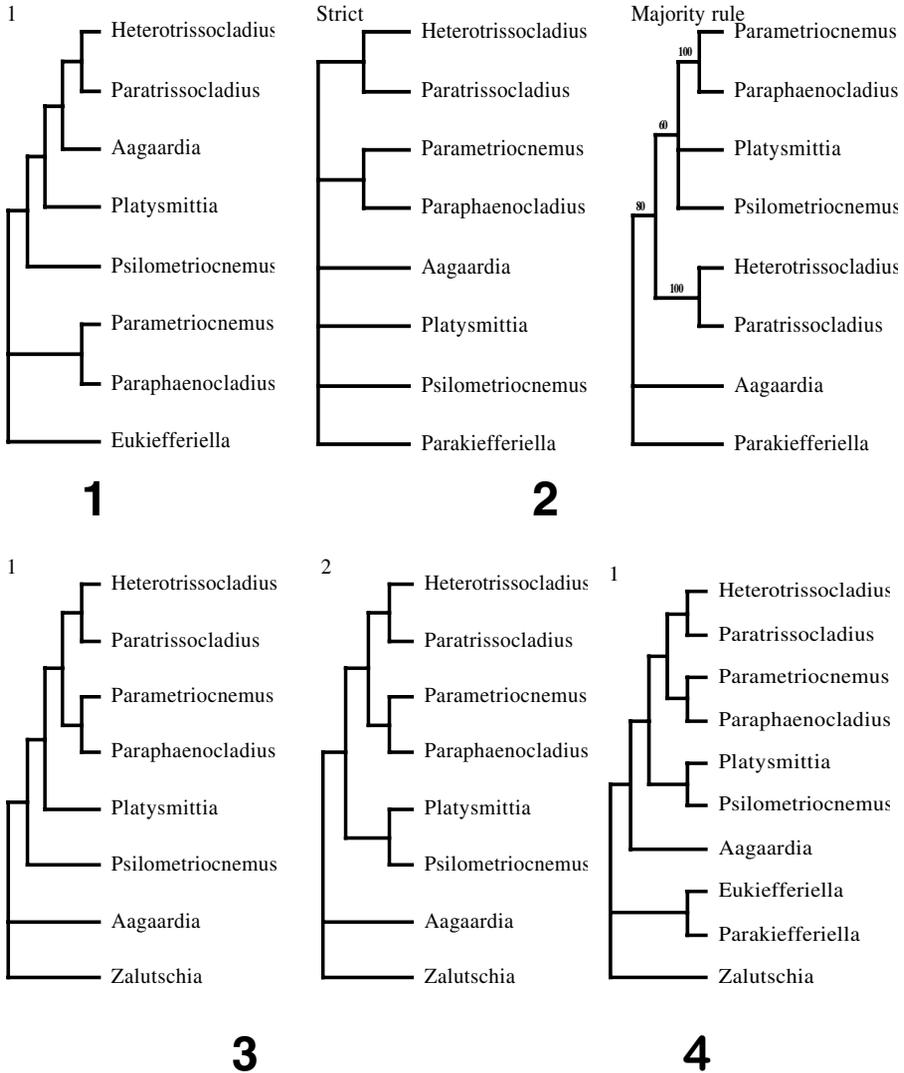


Fig. 1. The single cladogram obtained with *Eukiefferiella* Thienemann as outgroup.

Fig. 2. Strict and majority rule trees obtained with *Parakiefferiella* Thienemann as outgroup.

Fig. 3. The two trees obtained with *Zalutschia* Lipina as outgroup.

Fig. 4. The single cladogram obtained with weighting and ordering as specified in the text and using *Eukiefferiella*, *Zalutschia* and *Parakiefferiella* combined as outgroup.

genera with *Eukiefferiella* the sister genus of *Parametriocnemus* plus *Paraphaenocladus* and *Zalutschia* the sister group of *Heterotrissocladus* plus *Paratrissocladus*. The lengths and fit measurements range from a length of 157 steps for all trends unordered to 161 steps for all ordered, consistency index (CI)

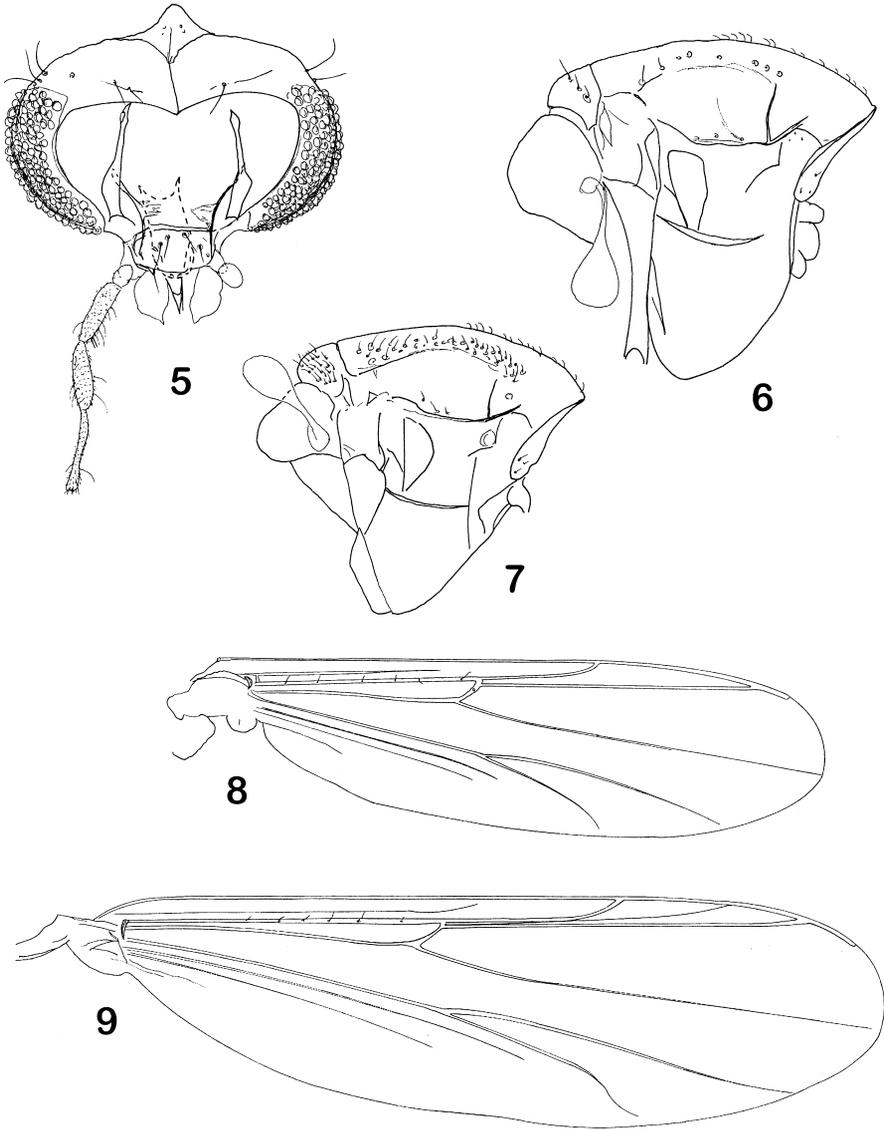
0.75–0.76, retention index (RI) 0.53–0.54 and rescaled consistency index (RC) 0.39–0.41.

Using *Eukiefferiella*, *Zalutschia* and *Parakiefferiella* sequentially as single outgroups gave the results shown in Figs. 1–3. The differences mostly consist in whether *Platysmittia* and *Psilometriocnemus* are closer to *Heterotrissocladius* plus *Paratrissocladius*, to *Parametriocnemus* plus *Paraphaenocladus*, or basal to both pairs, and whether *Aagaardia* is the most plesiomorphic genus or the sister group of *Heterotrissocladius* plus *Paratrissocladius*. Using *Zalutschia* alone as the sister group gives the result expected from previous studies, i.e., the internal relationship of the *Heterotrissocladius* group is as in Sæther (1975) with *Platysmittia* plus *Psilometriocnemus* as the sistergroup as suggested by Jacobsen (1998). With *Eukiefferiella* as outgroup the single tree obtained has 131 steps, CI of 0.79, RI of 0.54, and RC of 0.43. With *Parakiefferiella* as outgroup there are 5 trees each with 121 steps, and with *Zalutschia* as outgroup 2 trees each of 122 steps. For both the measurements of fit are about the same as for *Eukiefferiella* as outgroup even though the lengths are appreciably shorter.

The different character alternatives for several of the trends probably are parts of morphoclines and these trends thus should be ordered. Trends 1, 5, 25 and 35, however should be unordered. As mentioned above some character alternatives are unique for the group. Others occur only among some clearly unrelated groups, and others are unusual among the orthoclads. Weighting the trends differently thus is desired. Trends 2, 4, 11–13, 21, 31, and 40 are given a weight of 20; trends 3, 15, 24, 25, 29, 30, and 39 a weight of 10; and trends 7, 17, 22, 27, 32, and 33 a weight of 5. Using *Eukiefferiella*, *Zalutschia* and *Parakiefferiella* combined as outgroup the result with this weighting and ordering is shown in Figure 4. The single tree obtained has 162 steps, i.e., the tree is only one step longer than when the trends all are ordered. It thus seems reasonably to regard *Aagaardia* as the sister group of the rest of the *Heterotrissocladius* group.

Key to male imagines of *Aagaardia* gen. n.

1. Dorsocentrals 34–46, bi-multiserial (Fig. 7); heel of gonostylus mostly smoothly rounded (Figs 11, 13) 2
- Dorsocentral 7–23, uni-biserial (Fig. 6); heel of gonostylus mostly pointed to narrow and elongate (Figs 10, 12) 3
2. Scutellum with 26–40 setae in several transverse rows (Fig. 7); R_{4+5} ends above or slightly distal to end of M_{3+4} ; costal extension 56–83 μm long (Fig. 9); inner margin of gonostylus strongly concave, HR 2.0–2.3 (Fig. 11); Finland *A. protensa* sp. n.
- Scutellum with about 12 setae; R_{4+5} ends distinctly distal to end of M_{3+4} ; costal extension 30–49 μm long (Fig. 8); inner margin of gonostylus straight or slightly concave, HR 1.4–2.0 (Fig. 13); Turkey *A. triangulata* sp. n.
3. Dorsocentrals 7–11 (Fig. 6), heel of gonostylus mostly pointed (Fig. 10); Norway and Finland ... *A. sivertseni* (Aagaard)
- Dorsocentrals 18–23; heel of gonostylus with long, narrow apical point (Fig. 12); Canada *A. longicalcis* sp. n.



Figs. 5–9. *Aagaardia* gen. n., male imagines: 5: head of *A. protensa* sp. n., 6: thorax of *A. sivertseni* (Aagaard), 7: thorax of *A. protensa* sp. n., 8: wing of *A. triangulata* sp. n., 9: wing of *A. protensa* sp. n.

Aagaardia sivertseni (Aagaard) (Figs. 10, 14–26)

Eukiefferiella sivertseni Aagaard, 1979: 95; Tuiskunen & Lindeberg, 1986: 367.
not *Zalutschia sivertseni*, Cranston & Oliver, 1988: 453 (= *A. longicalcis* sp. n.).
not *Eukiefferiella sivertseni*, Caspers & Reiss, 1989: 113 (= *A. triangulata* sp. n.).

Material examined. FINLAND: Lappi Inari, Inari, Karigasniemi, 4 ♂, 1973, E. Jaakola; Lappi Inari, Inari, Lake Peltojärvi, 1 ♂, 14 VII 1982; Lappi Inari, Inari, River Peltojokki, 1 ♂, 16 VII 1982, J. Tuiskunen; Tavastland, Kangasala, Ponsa, Lake Vuorijärvi, 1 ♂ reared from pupa, 6 ♂, 2 mature ♂ pupae, 2 larvae, 4 larval exuviae, 6 VI, 20 V & 2 VII 1982, 11 V & 14 VI 1986, J. Tuiskunen; P. Sodankylä Lokka, 1 ♂, 19 VI 1984, J. Tuiskunen; Vehkalahti, Lake Paijärvi Pieni Mäntjärvi, 1 ♂, 5 VI 1985, J. Tuiskunen (all ZMH). NORWAY: Finnmark, Finnmarksvidda, stream in bog near Nappadjökul, 1 mature ♂ pupa, 4 VII 1987, J. Moldsvor and T. Larsen (ZMBN).

Diagnostic characters. The male imago is separable from the other species of the genus by having 7–11 uniserial dorsocentral, few uniserial scutellars, R_{4+5} ending above end of M_{3+4} , costal extension of about 50–85 μm , gonostylus usually with pointed outer corner and concave inner margin, and HR of about 2.0.

Male imago (n = 16–18)

The male is well described by Aagaard (1979). A few measurements are given here in order to show the variation:

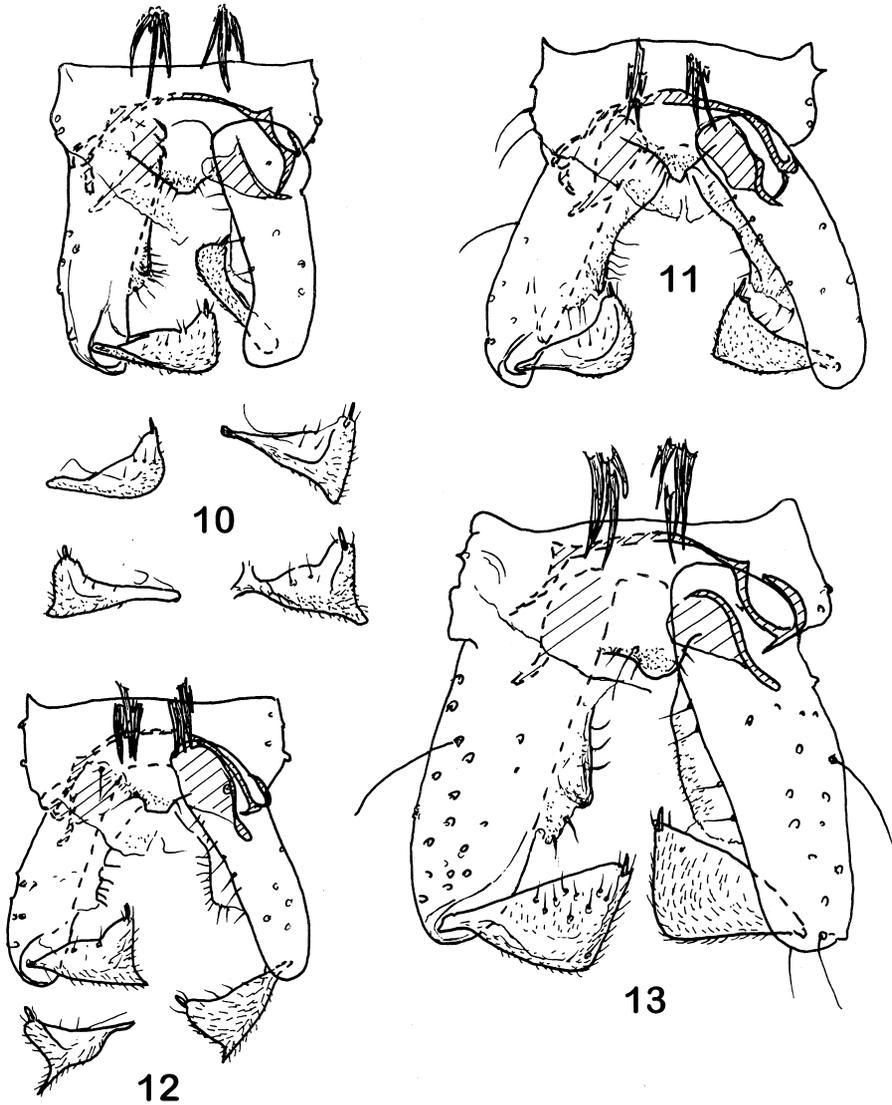
Wing length 1.10–1.41, 1.22 mm. AR 0.51–0.73, 0.64; ultimate flagellomere 206–311, 253 mm long. Dorsocentral 7–11, 9 uniserial, acrostichals about 16–24 (Fig. 6). R_{4+5} ending above end of M_{3+4} ; costal extension 53–83, 65 μm long. Sensilla chaetica 0–2, 0, present in 5 of 18 specimens at 0.29–0.41, 0.36 of τ_1 of mid leg. LR_1 0.49–0.52, 0.51. Longest spine of virga 34–60, 53 μm long. Gonostylus (Fig. 10) variable, usually with right-angled outer corner often with a pointed projection, often with smoothly rounded outer corner; nearly always with concave inner margin, but occasionally inner margin nearly straight.

Pupa

Total length 2.17–2.60, 2.41 mm (4).

Cephalothorax: Frontal setae (Fig. 15) taeniate 75 μm (1) long. Thoracic horn (Fig. 16) 135–140 μm (3) long, 28–36 μm (3) wide, 3.75–5.36 (3) times as long as wide, 0.90–1.00 (3) times as long as anal lobe. Anterior precorneal (Pc_1) 38–56 μm (2) long; Pc_2 and Pc_3 56–94 μm (2) long; distance Pc_1 – Pc_2 2–4 μm (2), Pc_2 – Pc_3 0–2 μm (2), Pc_3 to thoracic horn 34–35 μm (2), all 2–7, 5 μm . Postorbital seta 38 μm (1) long. Anteprenotals 56–94 μm (2) long. Anterior dorsocentral (Dc_1) 38 μm (1) long; Dc_2 to Dc_4 all about 56 μm (1) long. Distances (in μm , n = 1): Dc_1 – Dc_2 38, Dc_2 – Dc_3 19, Dc_3 – Dc_4 38.

Abdomen (Fig. 14). Shagreen and chaetotaxy as in generic diagnosis. Anal lobe 143–173, 159 μm (4) long, with 10–12, 11 (4) taeniae. Anal macrosetae 128–158, 143 μm (4) long. Genital sac of male overreaching anal lobe by 45–60 μm (3), in female 75 μm (1) short of apex of anal lobe.



Figs. 10–13. *Aagaardia* gen. n., male imagines, hypopygium: 10: *A. sivertseni* (Aagaard), with variations in gonostylus; 11: *A. protensa* sp. n.; 12: *A. longicalcis* sp. n, with variation in gonostylus; 13: *A. triangulata* sp. n.

Fourth instar larva (n = 5–6 except when otherwise stated)

Total length 2.36–3.54 mm (3). Head 0.22–0.25, 0.24 mm long. Postmentum 98–101, 99 μ m long.

Head. Antenna as in Figure 17. Length of antennal segments (in μm): 19–21, 20; 12–14, 13; 5–7, 6; 9–12, 10; 5–7, 5; 2. AR 0.49–0.57, 0.54. Basal antennal segment 11–12, 12 μm wide; blade 17–26 μm (3) long; accessory blade about 9 μm (2) long; Second antennal segment with 5–6 μm (2) long preapical style. Labrum and epipharyngeal area as in Figure 18. Premandible 47–52, 50 μm long. Mandible (Fig. 19) 73–87, 77 μm long. Mentum (Fig. 20) 64–71, 68 μm wide; combined width of median teeth 24–26, 25 μm . Anterior ventromental plate 7 μm wide; posterior plate 13–25, 17 μm wide.

Abdomen (Fig. 21). Procercus 19–24 μm (3) long; 19–23, 21 μm (3) high; each with 7 anal setae, 150–225, 190 μm (4) long. Supraanal seta 60–68 μm (3) long; 0.27–0.35 (3) times as long as anal setae. Anal tubules about 49 μm (1) long.

Ecology and Distribution

The species has been collected by from lakes, rivers and bog streams in Norway and Finland.

Aagaardia protensa sp. n. (Figs. 5, 7, 9, 11)

Type locality: FINLAND: Kaakkoissuomi, Vehkalahti, Lake Pieni Mäntjärvi.

Type material. Holotype δ , FINLAND: Kaakkoissuomi, Vehkalahti, Pieni, Lake Pieni Mäntjärvi, 5 VI 1985, Jari Tuiskunen (ZMH). Paratypes: FINLAND: Ruskeasuo, 3 δ , 2 VI 1983, Jari Tuiskunen; Vantaa, Lake Kumsijärvi, 1 δ , 20 V 1975, Jari Tuiskunen, (all ZMH).

Etymology. From the Latin *protensus*, stretched forth, extended, referring to the shape of the apex of the gonostylus.

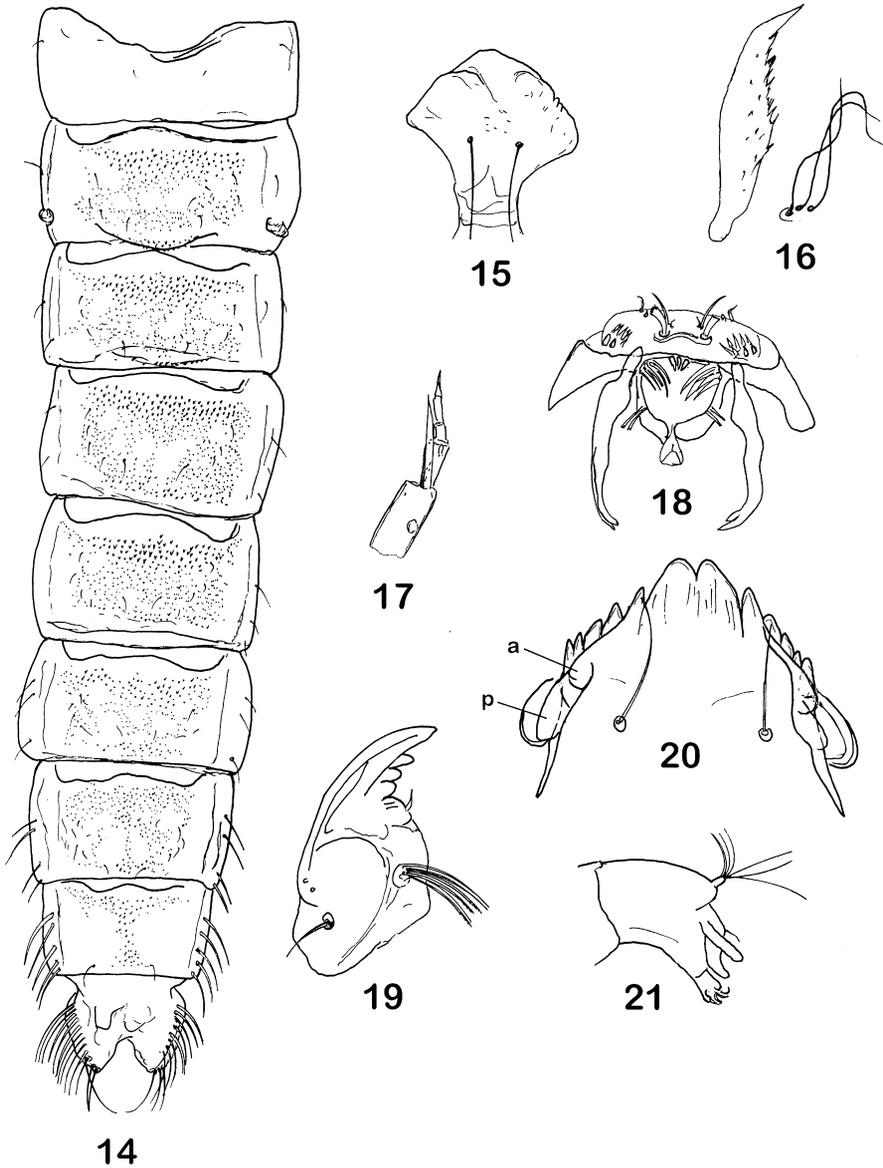
Diagnostic characters. The male imago is separable from the other species of the genus by having 34–46 bi-triserial dorsocentrals, about 26–40 multiserial scutellars, R_{4+5} ending above or very slightly distal to end of M_{3+4} , costal extension 56–83 μm long, gonostylus usually with smoothly rounded outer corner and strongly concave inner margin, and HR of 2.0–2.3.

Male imago (n = 4–5 except when otherwise stated)

Total length 1.96–2.52, 2.29 mm. Wing length 1.10–1.46, 1.31 mm. Total length/wing length 1.73–1.87, 1.78. Wing length/length of profemur 2.41–2.77, 2.65. Coloration blackish brown.

Head (Fig. 5). AR 0.63–0.73, 0.68. Ultimate flagellomere 251–345, 302 μm long. Temporal setae 5–7, 6; including 2–4, 3 frontal setae; 2–3, 2 outer verticals and 1–2, 1 postorbital. Clypeus with 4–6, 6 setae. Tentorium 94–135, 119 μm long; 23–30, 26 μm wide. Stipes 115–120 μm (2) long, 30 μm (1) wide. Palpomere lengths (in μm): 23–30, 27; 30–41, 36; 68–90, 77; 68–75, 71; 83–143, 106. Third palpomere with 1 sensilla clavata, 15 μm (1) long.

Thorax (Fig. 7). Antepronotum with 3–4 (2) setae. Dorsocentrals 34–46, 38; in 3–4 rows in front, biserial medially, and triserial posteriorly, setae weak; acrostichals about 19–20 (3); prealars 3–4 (2). Scutellum with about 26–40 weak setae, in 3–4 transverse rows.



Figs. 14–21. *Aagaardia sivertseni* (Aagaard), immature stages: 14–16: pupa, 14: tergites, 15 = frontal apotome, 16 = thoracic horn and precorneal setae. 17–21: larva, 17 = antenna, 18: labrum and epipharyngeal area, 19: mandible, 20: mentum (a = anterior ventromental plate, p = posterior ventromental plate), 21: posterior end of abdomen.

Wing (Fig. 9). VR 1.11–1.29, 1.20. R_{4+5} ending above or very slightly distal to end of M_{3+4} . Costal extension 56–83, 70 μm long. R with 3–7, 5 setae.

Legs. Spur of front tibia 30–41, 35 μm long; spurs of middle tibia 15–23, 19 and 15–19, 16 μm long; of hind tibia 39–45, 42 and 15–19, 17 μm long. Width at apex of front tibia 26–38, 32; of middle tibia 28–38, 32 μm ; of hind tibia 36–45, 40 μm . Length (in μm) and proportions of legs:

	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄
p ₁	416–548,492	529–680,612	215–359,309	170–232,200	123–170,147	76–113,97
p ₂	454–572,510	436–576,517	208–265,235	123–161,138	85–118,101	57–76,67
p ₃	491–605,542	570–662,586	255–350,303	142–203,169	104–175,139	61–95,77
	ta ₅	LR	BV	SV	BR	
p ₁	61–66,63	0.49–0.53,0.50	2.59–2.92,2.78	3.42–3.75,3.58	2.2–2.6,2.4	
p ₂	47–66,56	0.43–0.48,0.46	3.31–3.61,3.47	4.23–4.52,4.36	2.2–2.9,2.5	
p ₃	57–76,65	0.50–0.53,0.51	2.93–3.67,3.22	3.59–3.83,3.76	3.6–4.0,3.2	

Hypopygium (Fig. 11). Tergite IX with 14–17, 15 setae; laterosternite IX with 6–9 (3) setae. Phallapodeme 64 mm (1) long; transverse sternapodeme 71–86, 76 μm long. Gonocoxite 139–176, 158 μm long. Gonostylus 69–86, 75 μm long; megaseta 11 μm long. Longest spine of virga 38–56, 48 μm long. HR 2.00–2.31, 2.09; HV 2.75–3.19, 3.00.

Ecology and distribution

The species is known from Finnish lakes.

Aagaardia triangulata sp. n. (Figs. 8, 13)

Zalutschia sivertseni, Caspers & Reiss, 1989: 113, not Aagaard.

Type locality: TURKEY: Kars, Soganli at Sarikamis.

Type material. Holotype ♂, TURKEY: Kars, Soganli at Sarikamis, railway station, drift, 2100 m. a. s. l., 5 VII 1985, W. Schacht (ZSM). Paratype ♂, as holotype except 29 V1983.

Etymology. From the Latin *triangulum*, triangle, and the suffix *-ata*, equipped with, referring to the shape of the gonostylus.

Diagnostic characters. The male imago is separable from the other species of the genus by having about 38 dorsocentrals in several rows, at least 12 biserial scutellars, R_{4+5} ending distinctly distal to end of M_{3+4} , costal extension of about 30 μm , gonostylus with straight inner margin and smoothly rounded outer corner, and HR of about 1.4.

Male imago (n = 2 except when otherwise stated)

Total length 2.08–2.22 mm. Wing length 1.11–1.19 mm. Total length/wing length 1.86–1.87. Wing length/length of profemur 2.55–2.63. Coloration blackish brown.

Head. AR 0.56–0.60. Ultimate flagellomere 214–232 μm long. Temporal setae 4 including 1 frontal, 2 outer verticals, and 1 postorbital. Clypeus with 7–8 setae. Tentorium 90–109 μm long, 19–23 μm wide. Stipes 94–105 μm long, 34–38 μm wide. Palpomere lengths (in μm): 30, 36–38, 71–73, 64–69, 79–90. Third palpomere with 2 sensilla clavata, 9 μm long.

Thorax. Antepronotum apparently with 1 seta. Dorsocentrals about 36–38, triserial in front, than biserial, and partly triserial posteriorly; prealars about 6. Scutellum with about 12 setae, transversely biserial.

Wing (Fig. 8). VR 1.16. C extension 30–49 μm long. R with 6–11 setae.

Legs. Spur of front tibia 34–36 μm long, spurs of middle tibia 19 and 15 μm (1) long, of hind tibia 38–41 and 15 μm long. Width at apex of front tibia 28–34 μm , of mid tibia 30–34 μm , of hind tibia 36–39 μm . Length (in μm) and proportions of legs:

	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅
p ₁	435–454	506–529	255–265	170–175	123–128	80–90	61–66
p ₂	430–439	435–454	194–198	109–113	80–90	57–61	57
p ₃	463–482	510–520	236–246	132–137	113–123	61–66	61–66
	LR	BV	SV	BR			
p ₁	0.50	2.72–2.75	3.69–3.76	2.0–2.4			
p ₂	0.44–0.45	3.40–3.50	4.46–4.50	2.4–2.6			
p ₃	0.46–0.47	3.18–3.28	4.08–4.12	2.2–2.8			

Hypopygium (Fig. 13). Tergite IX with 12 weak setae, lateral of base of anal point; laterosternite IX with 6 setae. Phallapodeme 75–83 μm long; transverse sternapodeme 83–101 μm long. Gonocoxite 146–206 μm long. Gonostylus 101–105 μm long, with smoothly rounded outer corner and straight to slightly concave inner margin. Longest spine of virga 49–53 μm long, shortest 19–34 μm long. HR 1.39–2.04, HV 1.98–2.20.

Ecology and Distribution

The species was collected in drift at 2100 m. a. s. l. in a river in Turkey (Caspers & Reiss 1989).

Aagaardia longicalcis sp. n. (Figs. 12, 22–26)

Zalutschia sivertseni, Cranston & Oliver, 1988: 453, not Aagaard.

Type locality: CANADA: New Brunswick, Kouchibouguac National Park.

Type material. Holotype \varnothing , CANADA: New Brunswick, Kouchibouguac National Park, 7. VII 1978, D.R. Oliver & M. Russell (CNC CH7219). Paratypes: 1 σ , 1 \varnothing , Nova Scotia, Cape Breton Highlands National Park, 8. VI. 1984, M. Dillon (CNC QG016844).

Etymology. From the Latin *longus*, long, and *calcis*, heel, referring to the long narrow heel of the gonostylus.

Diagnostic characters. The male imago is separable from the other species of the genus by having about 18–23 dorsocentrals in 1–2 rows, 6–11 biserial scutellars; R₄₊₅ in male ending above or slightly distal to end of M₃₊₄, distinctly distal in female; costal extension of about 60–83 μm ; gonostylus with slightly to strongly concave inner margin and pronounced elongated and narrow heel; and HR of about 1.9–2.0.

Male imago (n = 2 except when otherwise stated)

Total length 2.02–2.17 mm. Wing length 1.11 mm. Total length/wing length 1.83–1.95. Wing length/length of profemur 2.71–2.81. Coloration blackish brown.

Head (Fig. 1). AR 0.57–0.62. Ultimate flagellomere 236–244 μm long. Temporal setae 4–5 including 1 frontal, 1 outer vertical, both very weak, and 2–3 postorbital. Clypeus with 6–8 setae. Tentorium 90–128 μm long, 23 μm wide. Stipes 101–124 μm long, 26–34 μm wide. Palpomere lengths (in μm): 23, 34, 75–79, 64–71, 90–94. Third palpomere with 1 sensilla clavata, 8 μm long.

Thorax (Fig. 2). Anteprepronotum with 1 seta. Dorsocentrals 22–23, partly biserial; prealars 3. Scutellum with 6–8 setae, transversely biserial.

Wing (Fig. 3). VR 1.14–1.15. C extension 60–68 μm long. R with 2–4 setae.

Legs. Spur of front tibia 30 μm long, spurs of middle tibia 17–19 and 15 μm long, of hind tibia 38–41 and 17–19 μm long. Width at apex of front tibia 26–28 μm , of mid tibia 26–30 μm , of hind tibia 32–38 μm . Length (in μm) and proportions of legs:

	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄
p ₁	397	506–510	265	165–175	118–128	76–80
p ₂	416–425	425	208–213	113–123	80(1)	57(1)
p ₃	454	496–501	269–284	1146–151	123–128	61–66
	ta ₅	LR	BV	SV	BR	
p ₁	61–71	0.52	2.21–2.27	3.41–3.43	2.4(1)	
p ₂	52(1)	0.49–0.50	3.36(1)	4.00–4.05	–	
p ₃	57	0.54–0.57	3.07–3.16	3.35–3.55	2.8–3.3	

Hypopygium (Fig. 7). Tergite IX with 10–12 weak setae, lateral of base of anal point; laterosternite IX with 3–5 setae. Phallapodeme 68–79 μm long; transverse sternapodeme 60 μm (1) long. Gonocoxite 131–136 μm long. Gonostylus 68 μm long, with pronounced slender 15–19 μm long outer heel and straight or slightly to strongly concave inner margin. Longest spine of virga 49–58 μm long, shortest 15 μm long. HR 1.94–2.00, HV 2.98–3.20.

Female imago (n = 1 except when otherwise stated)

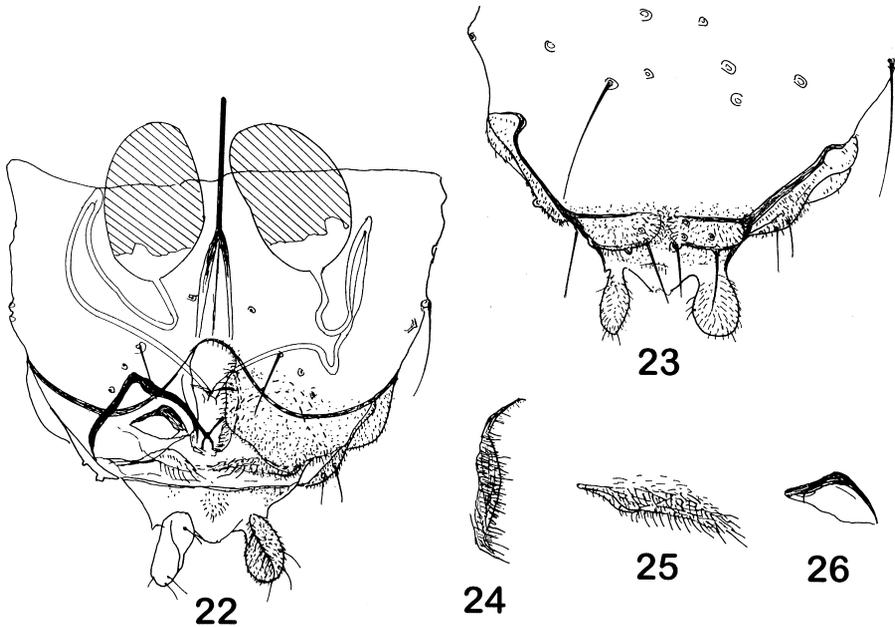
Total length 1.61 mm. Wing length 1.18 mm. Total length/wing length 1.44. Wing length/length of profemur 3.11. Coloration as in male.

Head. Antenna (Fig. 8) with 5 flagellomeres. AR 0.34. Temporal setae 5 including 2 frontals, 2 outer verticals, and 1 postorbital. Clypeus with 9 setae. Flagellomeres lengths (in μm): 60, 39, 38, 38, 56. Palpomere lengths (in μm): 23, 30, 64, 64, 68.

Wing. VR 1.12. Costal extension 83 μm long. Brachiolum with 2 setae, R with 8, R₄₊₅ with 6, C extension with 6 non-marginal setae.

Thorax (Fig. 2). Anteprepronotum with 5 setae. Dorsocentrals 18, biserial posteriorly; prealars 2. Scutellum with 11 setae, transversely biserial.

Legs. Spur of front tibia 24 mm long, spurs of middle tibia 15 μm long, of hind tibia 39 and 15 μm long. Width at apex of front tibia 24 μm , of middle tibia 26 μm ,



Figs. 22–26. *Aagaardia longicalcis* gen. n., sp. n., female genitalia: 22: ventral view, 23: dorsal view, 24: dorsomesal lobe of gonapophysis VIII, 25: ventrolateral lobe of gonapophysis VIII, 26: apodeme lobe of gonapophysis IX.

of hind tibia 34 μm . Sensilla chaetica 7 at 0.28–0.90 on ta_1 of midleg, 6 at 0.32–0.88 on ta_1 of hind leg. Length (in μm) and proportions of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
p_1	359	435	208	132	90	61	52	0.48	2.99	3.82	2.3
p_2	387	387	161	95	66	47	47	0.41	3.67	4.82	2.0
p_3	411	435	236	123	113	52	52	0.54	3.18	3.58	2.5

Abdomen. Number of setae on each of tergites I–III 6, on each of IV–VIII 8–10. Sternites I–IV bare, V with 3 setae, VI with 4, VII with 6, VIII with 6 central plus 1 far lateral to each side

Genitalia (Fig. 9). Gonocoxite with 2 setae. Tergite IX clearly divided, with altogether 12 setae. Cercus 41 μm long. Seminal capsules 83 μm long, 56 μm wide; sclerotized in anterior 64 μm . Notum 71 μm long.

Ecology and Distribution

The species is known from two national parks in New Brunswick and Nova Scotia, Canada.

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REFERENCES

- Caspers N, Reiss F (1989): Die Chironomidae der Türkei. Teil I: Podonominae, Diamesinae, Prodiamesinae, Orthocladiinae (Diptera, Nematocera, Chironomidae). *Entomofauna* 10: 105–160.
- Coffman WP, Cranston PS, Oliver DR, Sæther OA (1986): The pupae of Orthocladiinae (Diptera: Chironomidae) of the Holarctic region - Keys and diagnoses. In: Wiederholm T, ed., *Chironomidae of the Holarctic region. Part 2. Pupae. Ent scand Suppl* 28: 147–296.
- Cranston PS, Oliver DR (1988): Additions and corrections to the Nearctic Orthocladiinae (Diptera: Chironomidae). *Can Ent* 120: 425–462.
- Cranston PS, Oliver DR, Sæther OA (1983): The larvae of Orthocladiinae (Diptera: Chironomidae) of the Holarctic region - Keys and diagnoses. In: Wiederholm T, ed., *Chironomidae of the Holarctic region. Part 1. Larvae. Ent scand Suppl* 19: 149–291.
- Cranston PS, Oliver DR, Sæther OA (1989): The adult males of Orthocladiinae (Diptera: Chironomidae) of the Holarctic region - Keys and diagnoses. In: Wiederholm T, ed., *Chironomidae of the Holarctic region. Keys and diagnoses. Part 3. Adult males. Ent scand Suppl* 34: 165–352.
- Jacobsen RE (1998): Taxonomy of the genus *Platysmittia* Sæther (Diptera: Chironomidae), with comments on its ecology and phylogenetic position. *Aquatic Insects* 20: 239–256.
- Oliver DR, Dillon ME, Cranston PS (1990): *A catalog of Nearctic Diptera. Res Br Agric Canada Publ* 1857/B, 89 pp.
- Sæther OA (1969): Some Nearctic Podonominae, Diamesinae and Orthocladiinae (Diptera: Chironomidae). *Bull Fish Res Bd Canada* 170: 154 pp.
- Sæther OA (1975): Nearctic and Palaearctic *Heterotrissocladius* (Diptera: Chironomidae). *Bull Fish Res Bd Canada* 193: 67 pp.
- Sæther OA (1976): Revision of *Hydrobaenus*, *Trissocladius*, *Zalutschia*, *Paratrissocladius*, and some related genera (Diptera: Chironomidae). *Bull Fish Res Bd Canada* 195: 287 pp.
- Sæther OA (1977): Female genitalia in Chironomidae and other Nematocera: morphology, phylogenies, keys. *Bull Fish Res Bd Can* 197: 211 pp.
- Sæther OA (1980): Glossary of chironomid morphology terminology (Chironomidae: Diptera). *Ent scand Suppl* 15: 51 pp.
- Sæther OA (1982): Orthocladiinae (Diptera: Chironomidae) from S.E. USA, with descriptions of *Pludsonia*, *Unniella*, *Platysmittia* n. genera and *Atelopodella* n. subgen. *Ent scand* 13: 465–510.
- Sæther OA (1983): The canalized evolutionary potential: inconsistencies in phylogenetic reasoning. *Syst Zool* 32: 343–359.
- Sæther OA (1986): The myth of objectivity – post-Hennigian deviations. *Cladistics* 2: 1–13.
- Sæther OA. (1990 a): Midges and the electronic Ouija board. The phylogeny of the *Hydrobaenus* group revised (Chironomidae, Diptera). *Zool Syst Evolut-forsch* 28: 107–136.
- Sæther OA (1990 b): Phylogenetic trends and their evaluation in chironomids with special reference to orthoclads. *Acta biol Debr oecol Hung* 2: 53–75.
- Sæther OA, Wang X (1995): *Revision of the genus Paraphaenocladus Thienemann, 1924 (Diptera: Chironomidae). Ent scand Suppl* 48: 69 pp.
- Tuiskunen J, Lindeberg B (1986): Chironomidae (Diptera) from Fennoscandia north of 68°N, with a description of ten new species and two new genera. *Ann zool fenn* 23: 361–393.