

On the karyology and morphology of *Chironomus jonmartini* Lindeberg (Diptera, Chironomidae)

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A detailed description of the karyotype of *Chironomus jonmartini* Lindeberg as well as data for its polymorphism are presented. The polymorphism is realized by heterozygous inversions and a high percentage of additional "B" chromosomes. Males, females, pupae and larvae are also redescribed. *C. jonmartini* is compared morphologically with a karyologically unidentified species of the genus *Chironomus*, the males of which are to a certain extent similar to it.

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1. Introduction

Lindeberg (1960) described from the rockpools, on the shores of the Gulf of Finland, in the surroundings of the Tvärminne Zoological Station, S. W. Finland, the new species *Chironomus neglectus*. The karyotype of the Tvärminne population was first described by Wülker (1973 sub). Because the name *C. neglectus* was preoccupied by Kieffer (1917), the species was renamed and keyed as *C. jonmartini* Lindeberg in a paper by Lindeberg and Wiederholm (1979) on the European species of *Chironomus*. Later Wülker (1991b) also compared *C. jonmartini* morphologically with certain species, which he called the *aberratus* group and further stated that the karyotype of this species "was insufficiently known and needed additional descriptions". Langton (1991, 1995) has keyed the pupae of three species of the *aberratus* group with clear differences. Wülker (1991b: 106),

however, expressed the opinion that without karyotype investigation the species of the *aberratus* group cannot be convincingly distinguished.

The present paper gives a detailed description of the karyotype of *C. jonmartini* as well as data for its polymorphism. To continue the discussion about the possible holomorphological differences, *C. jonmartini* is here also compared morphologically with another, in the adult stage very similar species of the genus *Chironomus* from Lapland. The adult males of the latter species are, because of the relatively long hairs (BR) of the fore tarsus, very similar to *C. jonmartini* and might for instance be *C. fraternus* Wülker (Wülker 1991b) from the *aberratus* group. Unfortunately, we have no possibilities of obtaining live larvae for the study of the karyotype to make a firm identification. The biotope in question has been inundated and is today part of the large Lokka reservoir, where the species has up to the present time not been found.

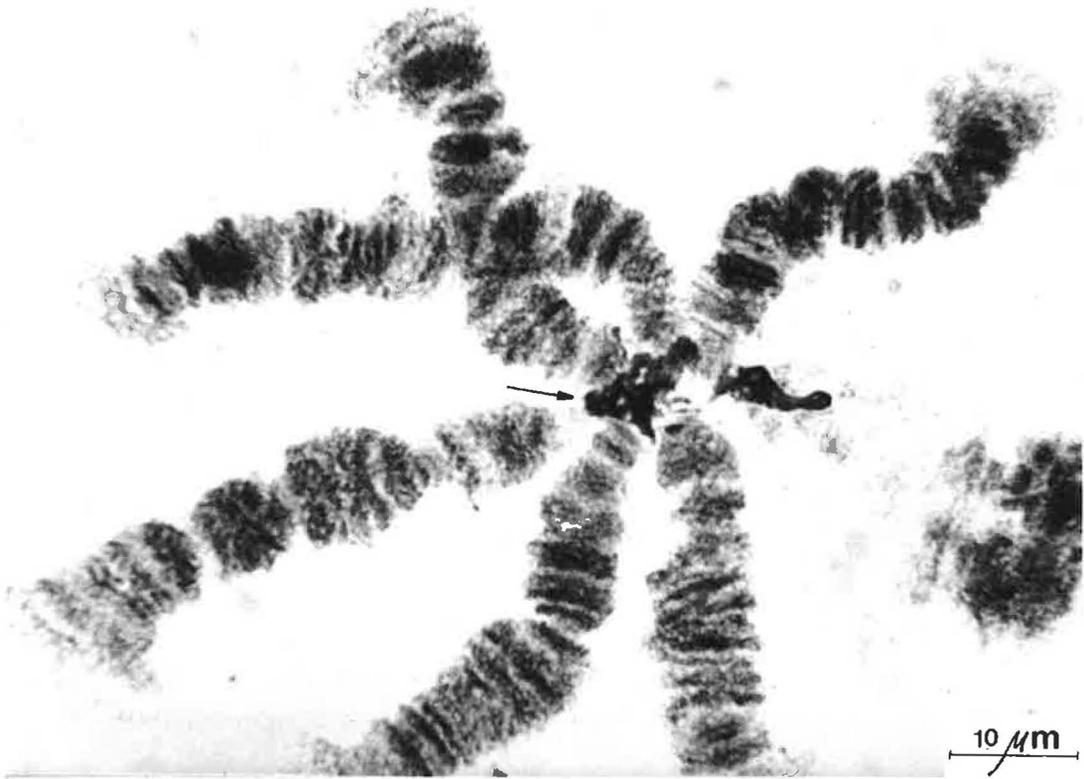


Fig. 1. *Chironomus jonmartini* Lindeberg. The combination of the centromeres in a chromocenter.

2. *Chironomus jonmartini* Lindeberg

2.1. Karyological notes

2.1.1. Material and methods

17 larvae (4th instar) from the rockpools (depth < 0.15 m) of the island Mellanskär about 3 km from the Tvärminne Biological Station, 30.VII.1992, V. I. Pajunen & M. Hirvenoja leg. They were fixed in alcohol-glacial acid (3:1) and used for the karyological preparations, which were made from salivary glands according to the aceto-orcein method.

2.1.2. Results

The identification of chromosome arms A B C D goes back to Wülker (1991b) and chromosome arm F goes back to Wülker (1973). Arm E is identified by comparison with *C. aberratus* Keyl and *C. sororius* Wülker.

2n = 8. Arm combination: AB, CD, EF and G (*thummi* complex); AB, CD are metacentric, EF

submetacentric and G telocentric. Centromeres are well heterochromatinized. Sometimes they are friable, very often combined in the chromocenter (Fig. 1). Arm G with a nucleolus and a Balbiani ring.

Arm A (Fig. 2) with band sequences: 1-2c, 10-12, 4-5-6-7-8-9, 2d-3, 13-19. There is a heterozygous inversion (29.41%; Fig. 4a) in 5 individuals.

Arm B (Fig. 2) with band sequences: 1-7, 8b-15, 22-28. There is an active region in section 15-13; there might be another Balbiani ring located in this region in arm B as in *C. plumosus* (cf. Kiknadze *et al.* 1991).

Arm C (Fig. 2) with band sequences: 1-6c, 10-7c, 15-12, 7b-6d, 16-22. Very often both homologues are unpaired, with heterozygous appearance of the centromere (Fig. 3a). In one individual there is a pericentric inversion (Fig. 3b).

Arm D (Fig. 2) with band sequences: 1-3, 11-18f, 7d-10-7e, 18g-24.

Arm E (Fig. 2) with band sequences: 1-2-3, 5-6-7-10b, 4-3f, 10c-11-12-13.

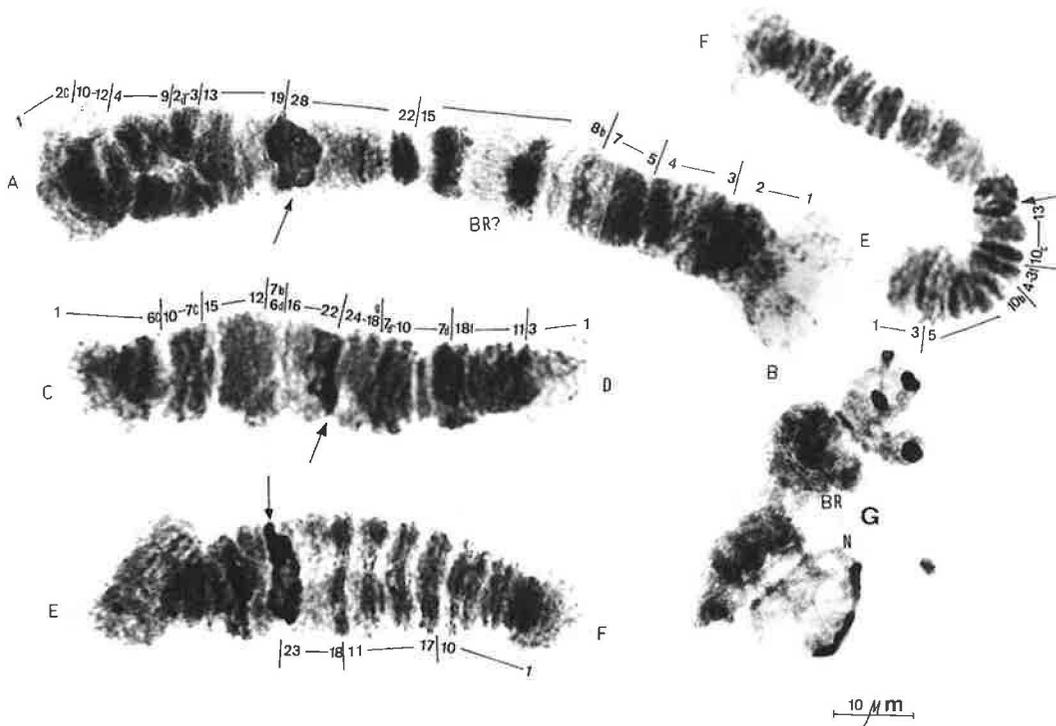


Fig. 2. *Chironomus jonmartini* Lindeberg. Chromosomes AB, CD, EF and G. BR = Balbiani ring, N = nucleolus, arrow = site of centromere.

Arm F (Fig. 2) with band sequences: 1-10, 17-11, 18-23.

Arm G: Both homologues are unpaired. Very often the centromere of one homologue has a granulate structure (Fig. 2). Arm G has a nucleolus at one end and a Balbiani ring near the other end. Sometimes this arm is connected to the centromere regions of other chromosomes (Fig. 4b).

We found "B" chromosomes (35.29%; Fig. 5) in 6 specimens within the studied population of *C. jonmartini*. Normally, in individuals with "B" chromosomes, there are 3-4 cells with "B" chromosomes. In some cells it looks like a strong heterochromatinized body (Fig. 5), however, in others it has a netlike structure. Very often the "B" is associated with arm G. It could be possible that the origin of this "B" chromosome was in this instance quite clearly traceable to a fragment derived from arm G. The frequency of the "B" chromosome is often closely correlated with environmental variables

(Jones & Rees 1982). On this basis, we could conclude with confidence that the frequency of "B" chromosomes within this species is at least dependent upon selection pressures imposed by the environment. So, there is the possibility that the specific unstable conditions of the rockpools itself could directly affect the accumulation of this additional chromosome.

2.2. Morphological notes

2.2.1. Material and methods

Larvae and reared pupae and adults (V. I. P. and/or M. H. leg.) from the rockpools of the islands Mellanskär (depth of the pools < 0.15 m) and Bränskäär (depth < 0.25 m), Tvärminne, S. W. Finland, June and September-October 1992, October 1995. The specimens were mounted for the measurements and drawings in Euparal (without cooking in KOH). Some details of the prepared 15 pupae and 6 larvae were infrequently possible to observe.

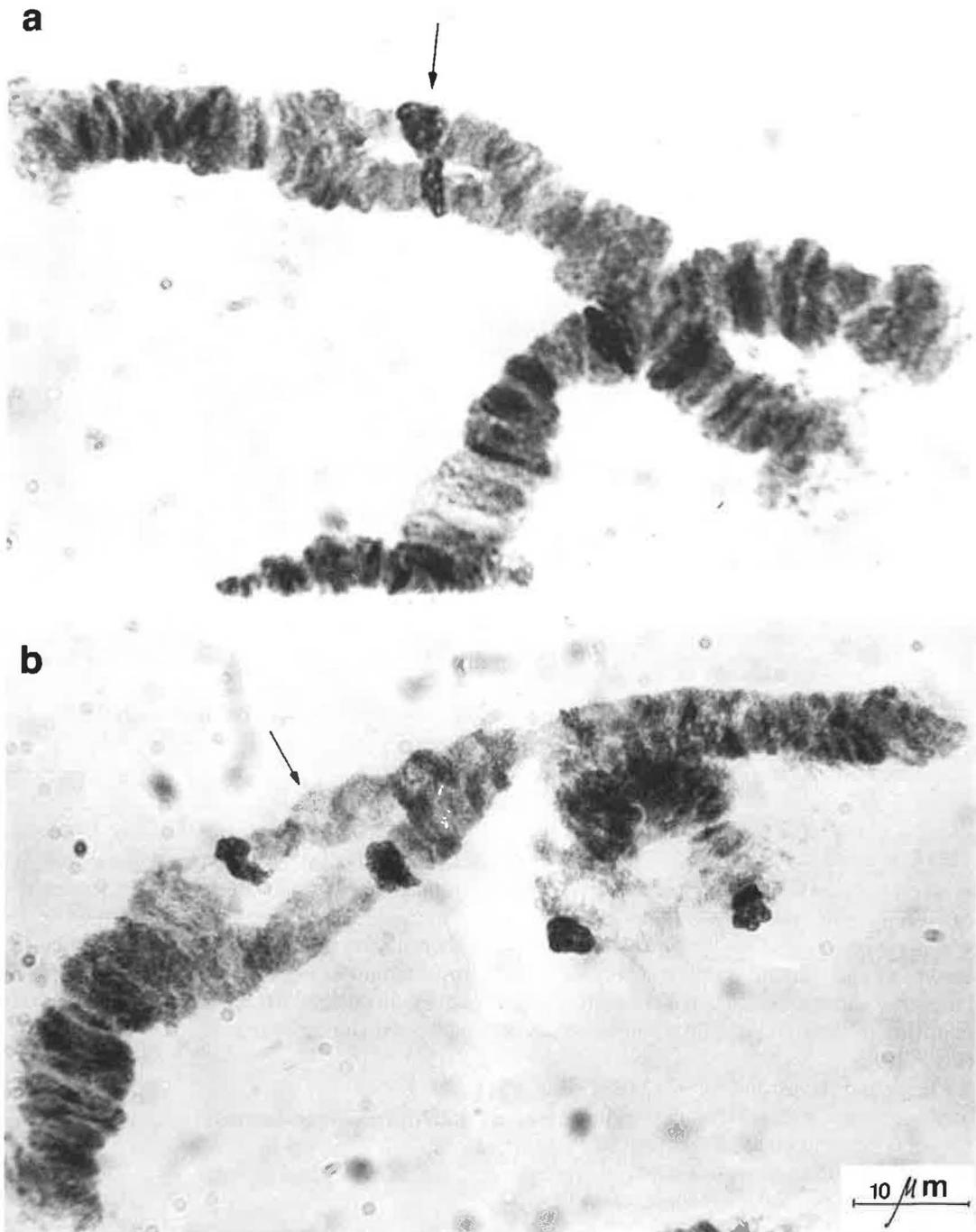
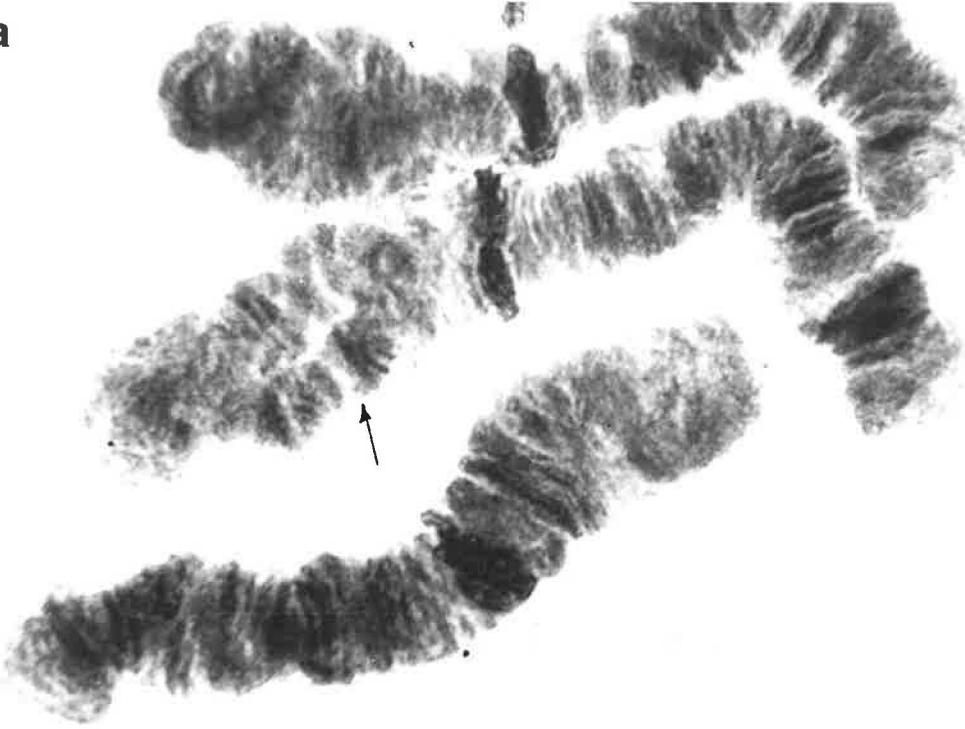


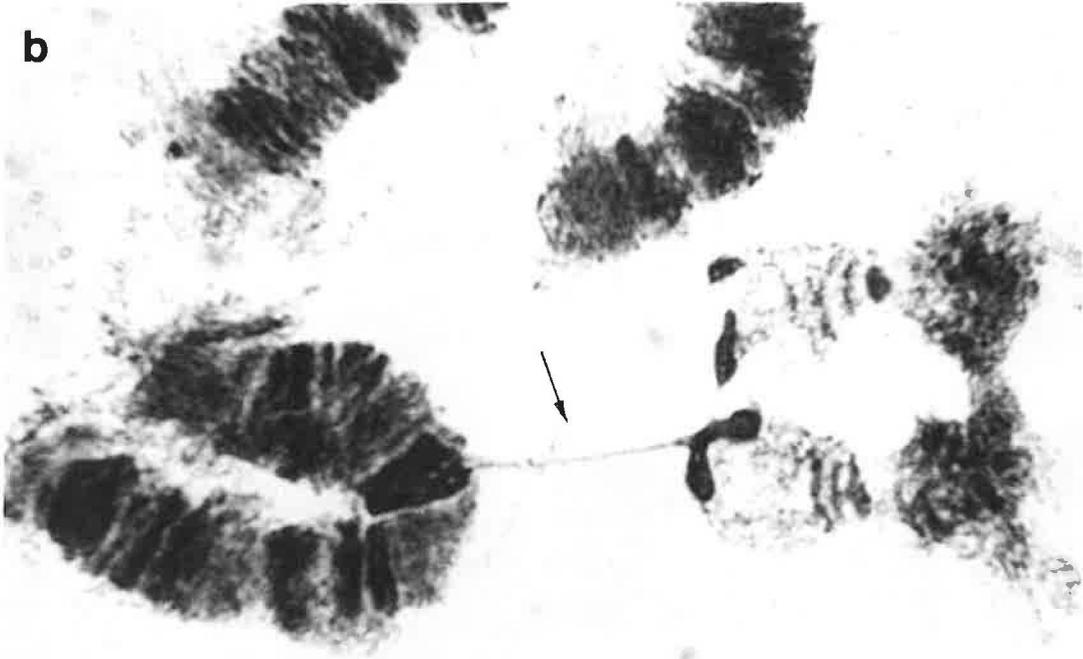
Fig. 3. *Chironomus jonmartini* Lindeberg. — a: Chromosome CD unpaired section, a heterozygous appearance of the centromere region. — b: Chromosome CD with a pericentric inversion.

Fig. 4 (Right). *Chironomus jonmartini* Lindeberg. — a: Chromosome AB with heterozygous paracentric inversion. — b: An ectopic pairing between arm G and the centromere region of chromosome AB.

a



b



10 μ m



Fig. 5. *Chironomus jonmartini* Lindeberg. Polytene chromosomes and "B" chromosome.

2.2.2. Male ($N = 6$)

Wing 3.1–4.6 mm. AR 3.4–4.3. Frontal tubercles 40–50 μm long. Palps (2–5): 60–80, 190–220, 200–280, 280–350 μm . LR: P_1 1.33–1.45, P_2 0.52–0.61, P_3 0.63–0.73. Number of sensilla chaetica: (distally in) P_2/Ta_1 15.8(10–25), P_3/Ta_1 14.8(9–22). BR: P_1 5.0(3.5–6.5), P_2 2.1(1.6–2.9), P_3 3.7(2.9–4.7). Legs in μm :

	Fore leg	Mid leg	Hind leg
Femur	1 200–1 550	1 200–1 700	1 400–1 950
Tibia	1 100–1 560	1 170–1 730	1 500–2 000
Tarsus 1	1 490–2 070	670–900	990–1 350
Tarsus 2	850–1 100	420–550	600–840
Tarsus 3	600–750	300–400	450–600
Tarsus 4	520–650	200–260	290–350
Tarsus 5	280–330	120–200	170–230

The hypopygium (Fig. 6A; cf. also Fig. 1 in Lindeberg 1960). Processus analis tapering towards the apex, width proximally 45–50 μm ; the relation between the width of the anal point/width of appendage 1 about 1.5 (cf. Lindeberg & Wie-

derholm 1979). Styli quite slender, the relation of its length/width 5.0–5.5; in appendage 2 relation length/width 3.3–4.5 (see Fig. 6B). The number of am setae 3–5.

2.2.3. Female ($N = 5$)

Wing 3.1–4.6 mm. Palps (2–5): 50–70, 200–270, 210–280 and 310–420 μm . LR: P_1 1.26–1.48, P_2 0.51–0.54, P_3 0.63–0.67. Number of sensilla chaetica: P_2/Ta_1 83.2(64–109), P_3/Ta_1 92.2(73–126). BR: P_1 1.7–2.1, P_2 1.4–2.2, P_3 1.7–2.9. Legs in μm :

	Fore leg	Mid leg	Hind leg
Femur	1 250–1 700	1 350–1 800	1 450–1 850
Tibia	1 110–1 600	1 300–1 750	1 500–2 100
Tarsus 1	1 590–2 010	660–920	1 000–1 400
Tarsus 2	810–1 000	380–530	600–800
Tarsus 3	600–710	290–360	450–600
Tarsus 4	510–650	190–250	250–350
Tarsus 5	290–340	150–200	170–200

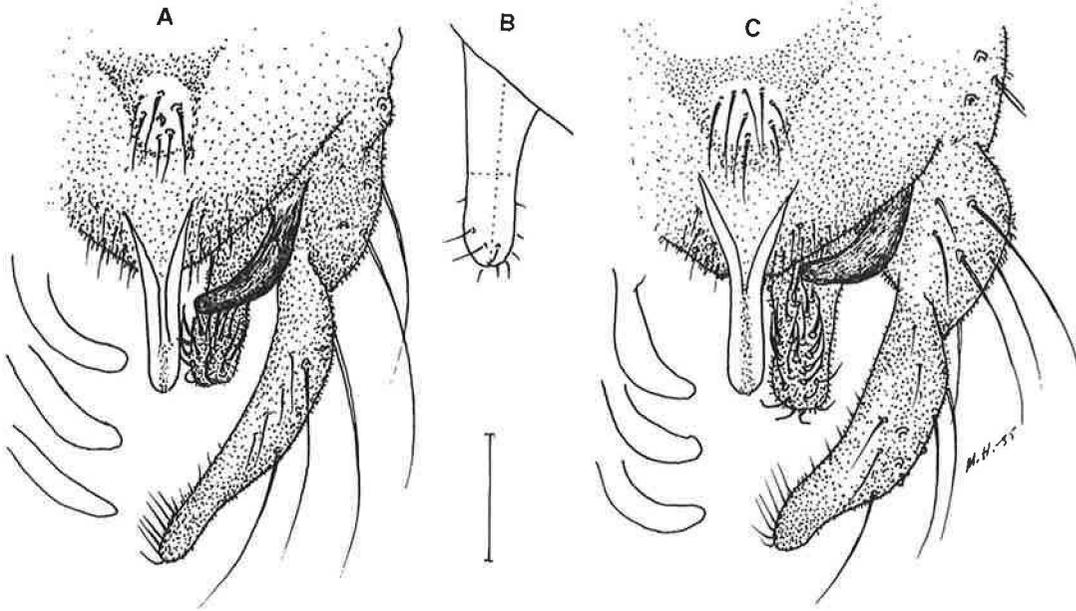


Fig. 6. The hypopygium of *Chironomus jonmartini* Lindeberg (A) and *Chironomus* sp. "Seitajärvi" (C) with variation of appendage 1 (= 1a). Figure B shows the lines used to measure the relation length/width of appendage 2. — Scale 100 μ m.

Spermathecae oval, 120–160 μ m long; 29–39 setae on both sides of the sternite 8 (Fig. 7).

2.2.4. Pupa

Exuviae 8–9 mm long, abdomen quite pale, thorax darker and antero-dorsally clearly granulated to the base of the wing sheaths. Cephalic tubercles up to 150 μ m long and 100 μ m broad, each with a subapical seta and separated proximally from each other by a distance approximately equal to their breadth. Basal ring about 150–160 \times 60–70 μ m, its tracheal patch with < 10–12 tracheoles across, about 3 μ m in diameter.

The presence of shagreen on the tergites is typical of the genus; on tergites 2–6 somewhat in the X form, extending antero-laterally not over the antero-medial group of the adhesion marks (Langton 1994; "Fensterflecken" Thienemann 1944, "Muskelmale" Fittkau 1962), or over D₁; the shagreen on tergites 2 and 6 may be narrower than on 3–5 and the points become larger posteriorly at the level of the setae D₃₋₅. The shagreen of the tergite 3–5 ends anal-lateral rounded around D₄

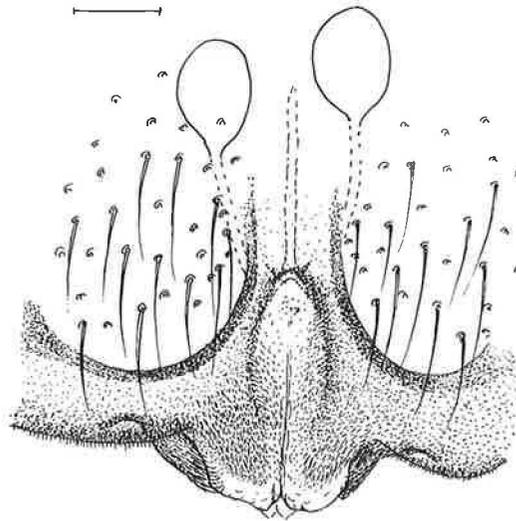


Fig. 7. *Chironomus jonmartini* Lindeberg. Genitalia of female. — Scale 100 μ m.

or D₃₋₄, on segment 6 around D₅; 5–8 points behind the seta and the posterior margin of the point patch. Points on tergite 8 may be irregularly arranged or form indistinct rows of 2–3 points, in the anal-lateral corner of the segment even rows

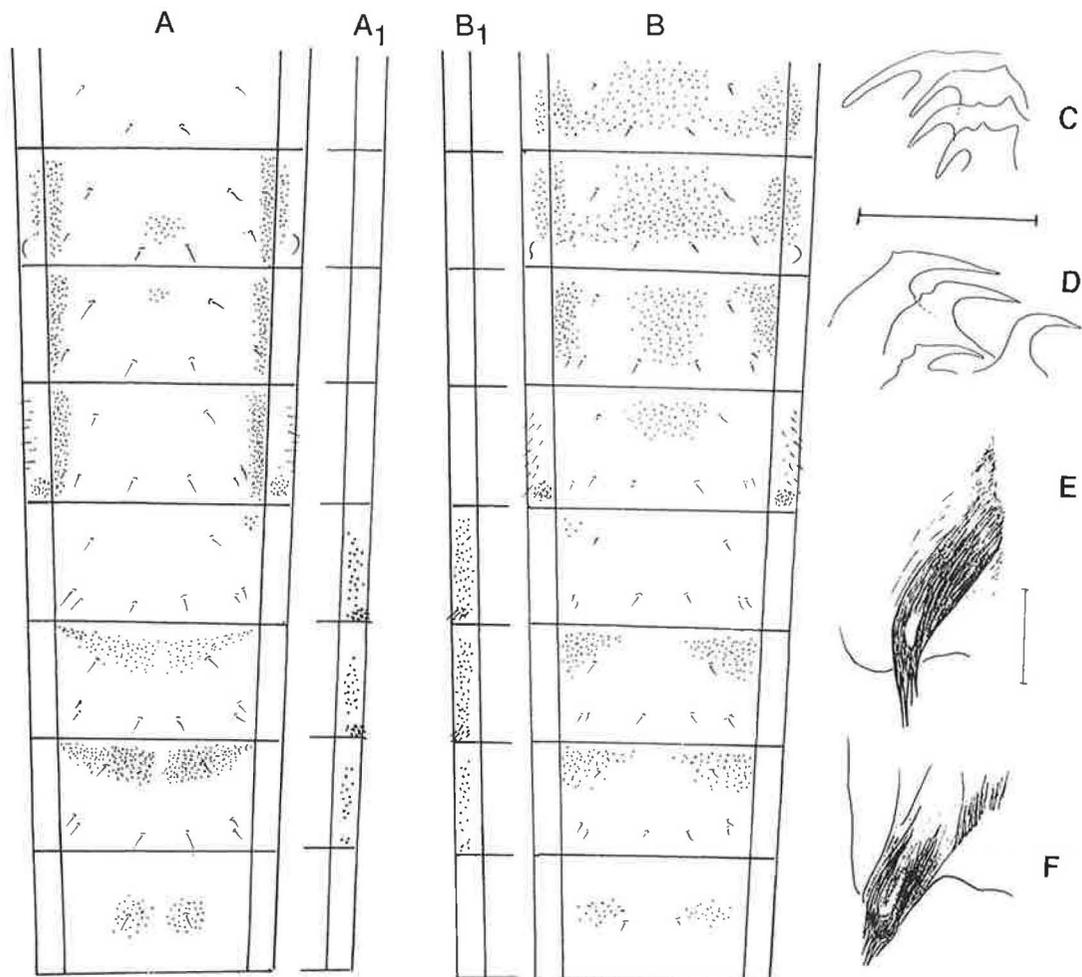


Fig. 8. Pupa. Schemes of the armament on the sternites and paratergites in the pupal exuviae of *Chironomus jonmartini* Lindeberg (A_1 , A_2) and *Chironomus* sp. "Seitajärvi" (B_1 , B_2); the hairlike points on the pleurae of segment 4, PB and PA (= "vortex") are also drawn. Examples from the variation of the hooks of the hookrow and the analsporn drawn from *C. jonmartini* (C, E) and *Chironomus* sp. "Seitajärvi" (D, F). — Scales for C–F 50 μ m.

with some more points. The setae V_{3-4} show a tendency to stand one behind the other.

On segments 5–6(7) there are spinules on paratergites (Fig. 8 A_2), or on some of them; in some exuviae no or only single spines have been observed on paratergites of segment 7, very often, however, a complete row is present. (The same is to be seen in a slide of the original material of Lindeberg (1960).) Spinule patches are present on the anal corners of segments 5–7, but they are strongest on segment 5 and very indistinct on segment 7. On segment 2 there are 2 quite large pedes spurii and 51–84 hooklets, the hooklets in the mid-

dle of the row have a few minute dorsal denticles (Fig. 8C). Intersegmental orally directed minute spinules are present close behind the armament of tergites 4–5 or also behind that of the 6th; the intersegmental spinules are quite small, not very numerous and if present also behind the armament of the tergite 6, their number is relatively low (70–80).

Several < 20 μ m long spinules are present on the pleural region on segment 4. On sternites 1 and 5 usually no spinules have been observed, except in one exuviae, where a small group was found on the oral corner of segment 5 (Fig. 8A).

Lateral longitudinal rows of spinules on sternites 2–4 are present and parasternite 2 is also spinulated. Medial small patches of spinules are present on sternite 2 nearer the anal part and on sternite 3 nearer the oral part of the sternite present. Unusual large patches of spinules are present on the anterior part of sternites 6–7, if fused in the midline, they form transverse rows, which broaden towards the middle of the sternites; small patches are present near seta V_1 on segment 8.

The number of lateral setae on segments 1–8: 0, 3, 3 + 1, 3 + 1, (and taeniated) 4, 4, 4, 4–5. The spurs on segment 8 have 1–5 fine points apically. The anal lobe fringe of taeniae (filaments; see Langton & Armitage 1995) is multiserial, but proximally it is often uniserial, 73–97 in number.

2.2.5. Larva

The longest larvae used in the present study were up to 11.5 mm in length. The lateral tubules (Fig. 9I) on abdominal segment 7 were about 250 μm , constricted in the middle; the ventral tubules on abdominal segment 8 strongly curved about 1.1–1.3 mm long (then this segment about 0.8 mm); the anal tubules were about 450 μm . The claws of the anterior parapods were smooth or partly serrated with a serration lower than the stem across. The head capsules were up to 800–850 μm long, brunescent; in the middle of the frontoclypeal apotome (especially in the live and unprepared larvae) with a longitudinal dark stripe. The ventral wall of the head capsule is darker; the dark area may laterally reach along the foramen occipitale fast over the posterior tentorial pits. The area of the hypochilum behind the dark teeth is pale.

The dark area on the posterior ventral wall of the head capsule has been called a gula in some papers. The site of the gula should be behind the posterior tentorial pits, which in the genus *Chironomus* are at the foramen occipitale. The gula has not been shown to exist in any Diptera larval head. To avoid confusion in phylogenetical discussions this term should not be used in papers dealing with the chironomid midges.

In the sensory field of the labrum the seta S_1 (Fig. 9A) are 50–60 μm long, serrate on one side nearly for the entire length, but only on the apical half of the other side; the most apical strong “hairs” seem to be equal in size, but the hairs weaken

towards the proximal part of S_1 . The setae S_{II} are smooth, 60–70 μm long. The 3 long Ch setae, which stand near S_1 , are clearly serrate, more laterally there are a few very short smooth Ch. Pecten epipharyngis with 13–17 teeth; some of the teeth are tapering and apically pointed (conical), but most are parallel sided and apically rounded.

The mandibles (Fig. 8L, M) are relatively pale except for the apical tooth and the inner teeth; the smallest proximal (6th) tooth may be more or less darker or (especially in the summer generation) pale, about 1/2 of the breadth of the 5th tooth, but it is not fused to the inner edge of the mandible; the “dorsal” teeth (1st and 2nd) are more or less paler, the rudimentary 1st tooth (see the numbers in Fig. 9L, M) is very fused or clearly visible in certain positions of the mandible. The premandibles are a little darker, two apical teeth are present, of these the inner is narrower, but only a little more pointed than the outer (ventral) tooth. The front border of the paralabials is smooth, there are 47–51 striae on the paralabials; most striation is found in about the half the breadth of the paralabials (Fig. 9H). The shape of the hypochilum can be seen in Fig 9H; the third tooth — counting from the outer margin — is a little narrower and also not much higher than the second.

The antennae are 190–230 μm long; the antennal blade extends to the 4th segment; LO are visible, but not very large; RO from the base of the basal segment is set at a distance of about 2/5 the length of this segment; the proportions of the segments (1–5; Fig. 9J) are:

100 : 26 : 14 : 9 : 4
 100 : 30 : 12 : 11 : 6
 100 : 30 : 11 : 11 : 4
 100 : 30 : 8 : 11 : 7
 100 : 32 : 11 : 13 : 7
 100 : 36 : 13 : 13 : 5

3. *Chironomus* sp. “Seitajärvi”

3.1. Material

Numerous males, females, pupal and larval exuviae were preserved in alcohol from funnel trap samples 29.V.–04.VI.1960 (M. Hirvenoja leg.) from the outlet of the lake Seitajärvi, Lapland (recent area of the Lokka reservoir). The material has been used only to a limited extent in the measurements as mentioned (N) in the text. Many features of the prepared 12 pupae and 19 larvae were infrequently observed.

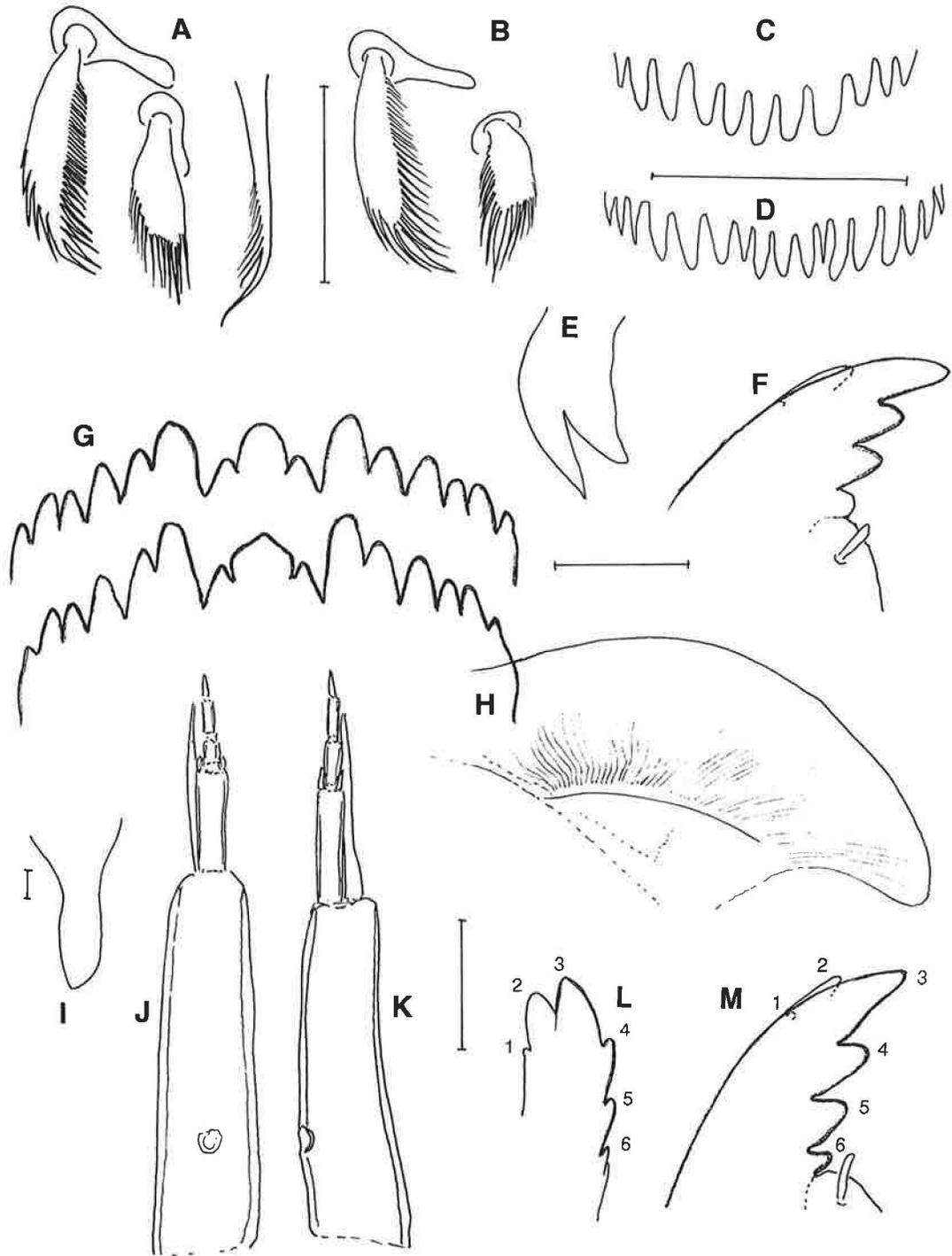


Fig. 9. *Chironomus jonmartini* Lindeberg: Larva. Aspects of seta S_1 and Ch on the labrum (A), pecten epipharyngis (D), hypochilum and paralabialplate (H), lateral tubulus of the abdominal segment 7 (I), antenna (J), apex of mandible seen towards the inner side (L) and laterally (M) with the numbers of the teeth. — *Chironomus* sp. "Seitajärvi": Larva: Aspects of seta S_1 (B), pecten epipharyngis (C), apex of premandible (E), apex of mandible (F), hypochilum (G), antenna (K). — Scales 50 μ m.

3.2. Male (N = 5)

A dark species. Wing 4.0–4.4 mm. AR 4.16–5.83. Frontal tubercles about 40 µm long. Palps (2–5): 60–70, 200–275, 220–270 and 280–310 µm. LR: P₁ 1.15–1.26, P₂ 0.53–0.56, P₃ 0.69–0.72. Number of sensilla chaetica (distally in): P₂/Ta₁ 10.5(9–13), P₃/Ta₁ 9.6(7–12). BR: P₁ 4.0(3.4–4.9), P₂ 2.6(2.3–3.1), P₃ 3.2(2.6–4.9). Legs in µm:

	Fore leg	Mid leg	Hind leg
Femur	1 450–1 550	1 550–1 600	1 820–1 850
Tibia	1 400–1 560	1 550–1 610	1 920–1 950
Tarsus 1	1 720–1950	820–900	1 340–1 400
Tarsus 2	1 100–1 150	550–620	850–940
Tarsus 3	650–700	400–450	600–610
Tarsus 4	480–540	260–310	350–380
Tarsus 5	250–300	200–220	210–220

The hypopygium is shown in Fig. 6C. The processus analis tapering towards the apex, has a proximal width of about 60–80 µm, in some cases the membranous part is clearly constricted (< 5 µm) in the middle. Appendage 1 is more or less broadening in the middle; the relation between the width of anal point/width of appendage 1 (see Lindeberg & Wiederholm 1979) is 1.2–1.5. The styli are less slender than in *C. jonmartini*, narrowing before the apex, the relation between length/width is 3.8–4.2; in appendage 2 the relation between length/width 2.7–3.3. The number of am setae is 3–8.

3.3. Female (N = 5)

Wing 4.4 mm. Palps (2–5): 60–75, 230–270, 210–240, 230–320 µm. LR: P₁ 1.16–1.30, P₂ 0.50–0.54, P₃ 0.66–0.68. Number of sensilla chaetica: P₂/Ta₁ 56.0(50–60), P₃/Ta₁ 68.8(58–75). BR: P₁ 1.2–2.1, P₂ 1.6–1.7, P₃ 2.5–3.3. Legs in µm:

	Fore leg	Mid leg	Hind leg
Femur	1 440–1 500	1 550–1 600	1 800–1 850
Tibia	1 280–1 400	1 510–1 600	1 900–1 950
Tarsus 1	1 630–1 750	800–830	1 260–1 300
Tarsus 2	940–1 000	500–510	750–800
Tarsus 3	590–600	350–350	540–580
Tarsus 4	410–500	250–280	310–350
Tarsus 5	250–300	150–200	190–240

Spermathecae oval, 140–160 µm long; 28–35 setae on both sides of sternite 8.

3.4. Pupa

The exuviae are 8.5–10 mm long, the abdomen is brunescent, the thorax darker and antero-dorsally granulated to the base of the wing sheaths. The cephalic tubercles are up to 150 µm long and 120 µm broad, each with a subapical seta and not separated proximally from each another or the distance is seemingly less than their breadth. The basal ring is about 120–150 × 70–90 µm, its tracheal patch has about < 20 tracheoles across it and is about 2.0–2.5 µm in diameter.

The presence of shagreen on the tergites is typical of the genus; on tergites 2–6 it is more or less in the X form, extending usually antero-laterally over the antero-medial group of the adhesion marks; the points become a little larger posteriorly at the level of D₃₋₅. The armament of the tergite 3–5 ends anal-lateral over the setae D₃₋₄; on segment 6 the shagreen reaches around the seta D₅ only; 3–7 points behind this seta and the posterior margin of the point patch. The points on tergite 8 are mainly isolated and irregularly arranged, but in the anal-lateral corner of this segment a few groups of 2–3 or more points may be present. On segments 5–6 and in most exuviae on segment 7 were numerous spinules on paratergites observed. Groups of small spines exist on the anal-lateral corners of these segments, but on segment 7 these spines are very small or ?absent and also only a few single spinules may be on the paratergites of this segment present. On segment 2 there are quite large pedes spurii and 79–119 hooklets, the latter with some minute dorsal denticles (Fig. 8D). There are (other) intersegmental orally directed minute spinules present close behind the armament of tergites 4 and 5, in one exuviae some minute spines were found also behind that of tergite 6. The setae V₃ and V₄ show a tendency to stand side by side.

There are 10–15 µm long spinules which are often difficult to find on the pleural region on segment 4. Sternites (Fig. 8B) 1 and 2 are widely spinulated except in the area around V₁; the parasternites 1–2 are also spinulated. The lateral longitudinal rows of spinules on sternite 3 are separated from the median patch of spinules. A short medial patch of spinules on sternite 4 is present in the oral half. None or very few spinules are present in the oral corners of sternite 5, but on sternites

6–7 the patches are quite large, but not fused; there are small patches near seta V_1 on segment 8.

The number of lateral setae on segments 1–8 are: 0, 3, 3 + 1, 3 + 1, (and taeniated) 4, 4, 4, 5. The spurs on segment 8 have 2–6 fine points apically. The anal lobe fringe of the taeniae are apically multiserial, but proximally they are mostly uniserial, and are 63–101 in number.

3.5. Larva

Only the head capsules, often with the more or less complete last cast skins of the segments are available; some of them are still fast around the pupal exuviae (obviously because of the very loose bottom mud). Because the anal end of the skins is very crumpled, the possible lateral tubules of abdominal segment 7 have unfortunately not been observed. The length of the fully grown larvae has obviously been about the same size or a little larger than the larva of *C. jonmartini*; the cast skins found are up to about 12 mm long. The claws of the anterior parapods are smooth or shortly serrated. The head capsule is up to 850–900 μm long and brunescens; the frontoclypeal apotome seems to be darker than the genae (the material has been preserved in alcohol for 35 years, but also in the prepared specimens of *C. jonmartini* the dark stripe is not clear); the ventral wall of the head capsule is dark between the posterior tentorial pits; orally there is a light area behind the dark teeth of the hypochilum.

In the sensory field of the labrum the seta S_I (Fig. 9B) is about 60 μm long, it is serrate on one side of its total length, but on the other side it is serrate on the apical 1/3 only; if the seta S_I is in a particular position on the slide, the most apical "hair" appears to be clearly stronger (broader) than the others; S_{II} is obviously smooth and 60–70 μm in length; the 3 long Ch setae, near S_I , are clearly serrate as in *C. jonmartini*, more laterally there are a few short smooth or serrate Ch. Pecten epipharyngis (Fig. 9C) with 10–11 teeth, which are parallel sided, apically rounded and quite equal in size.

The mandibles are relatively pale except for the dark teeth 3–5. The smallest proximal, pale 6th tooth is nearly 1/2 of the breadth of the 5th tooth (Fig. 9F), it is always discernible, but in the

majority of the mandibles studied the 6th tooth is nearly totally fused to the inner edge of the mandible; the minute 1st tooth is very rudimentary, but it is possible to recognize it in certain positions of the mandible. The premandibles are apically darker; two apical teeth are present, of these the inner one is narrower, but only a little more pointed than the outer (ventral) tooth; in one preparation, where the premandible is visible from the apex (Fig. 9E), the inner tooth is clearly pointed. The front border of the paralabials is smooth; there are 40–55 striae on it, most striation is found in about the half the breadth of the paralabials. The hypochilum, shown in Fig. 9G, probably cannot be differentiated from that of *C. jonmartini* with certainty; the third tooth — counting from the outer margins — is a little narrower and also not much higher than the second.

The antennae are 190–235 μm in length; the antennal blade extends to the 4th segment; LO are visible, but not very large; RO from the base of the basal segment are set at a distance about 2/5 the length of this segment; the proportions of the segments are as follows (1–5; Fig. 9K):

100 : 30 : 9 : 10 : 4
 100 : 36 : 12 : 14 : 4
 100 : 37 : 11 : 12 : 6
 100 : 38 : 12 : 12 : 7
 100 : 39 : 11 : 11 : 7
 100 : 41 : 11 : 11 : 6

5. Discussion

5.1. Taxonomy

Wülker (1991b) included in the *aberratus* group the following species: *C. jonmartini*, *C. aberratus* Keyl, *C. sororius* Wülker, *C. fraternus* Wülker and *C. beljaninae* Wülker. The karyotype of *C. jonmartini* is very similar to the karyotype of the species incorporated in the *aberratus* group. The A arm is identical with *C. aberratus* and *C. sororius*. It is distinguishable from those of *C. beljaninae* (A3) by a small homozygous inversion in section 4–9. Arm B is identical with those of *C. aberratus*, *C. sororius*, *C. fraternus* and *C. beljaninae* in section 8b–28. However, the banding pattern in the distal part is very similar to *C. aberratus* only. Arm C is identical with those

of *C. aberratus*, *C. fraternus* and *C. beljaninae*; it can be distinguished from *C. sororius* by a homozygous inversion in 10-7c. Arm D is identical with other species of the *aberratus* group. Arms E and F are identical with *C. aberratus*, *C. sororius* and *C. fraternus*. In *C. beljaninae* heterozygous inversions have been described in these arms by Wülker (1991b). Arm G is very active and specific for this species. That's why this arm could be used for the identification of *C. jonmartini*.

A morphological *aberratus* group has not been delimited in any instar. The known larvae of this group all have a hypochilum, which has sometimes been adopted to the "anthracinus larval type". As well as in *C. anthracinus* Zetterstedt, a similar structure is known also for instance in *C. melanotus* Keyl, *C. riihimakiensis* Wülker and in the *staegeri*, *obtusidens* and *salinarius* groups. Wülker (1973) gives some examples of the possible smaller differences in the teeth of the hypochilum between some species. The differences are probably insufficient for determination of the species or species groups with certainty. Because the karyotype is unknown, we also do not know if *Chironomus* sp. "Seitajärvi" belongs with certainty to the karyological *aberratus* group.

The anal end of the larvae in the species (or groups) mentioned above may be different, which helps the determination. The anal ends of larvae of the species belonging to the *aberratus* group are perhaps very similar for instance to *C. riihimakiensis* Wülker. In the latter species (cf. Hirvenoja & Michailova 1991, Fig. 7) the shape of seta S_1 is different at least in comparison to both larvae described in the present paper, which may help with its identification. In the somewhat triangular S_1 of *C. riihimakiensis* a stronger, rye-corn shaped apical "hair" can be seen in this seta (if it is not damaged) and otherwise the seta is fine feathered on both sides. In the larvae described in the present paper the apical "hairs" of S_1 become gradually stronger towards the apex of S_1 and these hairs have been observed on the other side of the apical half only. The paper by Kiknaze *et al.* (1992) on the Siberian species of the *riihimakiensis* group does not give any information on this characteristic, which is for us the only known real morphological difference between the larvae of *C. riihimakiensis* and the two larvae described in the present paper. The antennae of *C. riihimakiensis* resem-

ble those of *C. jonmartini*, but the mandibles are quite identical with those of *Chironomus* sp. "Seitajärvi". The other species of the *aberratus* group are also in this respect unknown to us.

The Nearctic species of the *staegeri* group have morphological similarities in many respects with the larvae and adults discussed in the present paper. According to the illustration given by Sublette and Sublette (in: Wülker *et al.* 1971) the larvae of the *staegeri* group have, however, paralaial plates, where the striation extends more or less clearly up to the bluntly serrated front border of the plate. In the species discussed in the present paper or in *C. riihimakiensis* the front border of the paralaials is smooth and the anterior half of the plate is without striation or the striation is only very weakly distinguishable. Further, the seta S_1 in the figure given by Sublette and Sublette is different at least in *C. staegeri*. The descriptions on the *staegeri* group are inadequate for comparing the pupae.

The shape of the labral seta S_1 may perhaps give some possibilities for interspecific differentiation of the larvae in the *aberratus* group. The S_1 of the other species in the *aberratus* group are, however, in this respect unknown to us. Many species of the chironomids have obviously very similar S_1 , but too few examples are known from the shape of this seta to evaluate its importance in the determination of the species or species groups. Many features in *C. anthracinus*, among others the shape of the seta S_1 , resemble those of the larvae illustrated in the present paper. In the present species the number of epipharyngeal teeth may also be important (*C. jonmartini* 13-17, "*Chironomus* sp. Seitajärvi" 10-11), but the intraspecific variation between the populations is for the present unknown. It is also not possible to ascertain with certainty the color of the frontoclypeal apotome in the living larva of the Seitajärvi population, but in *C. jonmartini* it has a clearly dark, quite broad stripe. According to Wülker (1991b: 103), *C. fraternus* and *C. beljaninae* have also more or less dark markings on this region, but dark frontoclypeal apotomes may occur in the members of other species groups, for instance in *C. tenuistylus* Brundin (sensu Wülker 1991a: 235-236).

Wülker (1991b: 104, cf. p. 108) has given measurements for all larvae, which were included by him in the *aberratus* group, but mentions that

"no clear morphometric differences exist between the species". There is, in the lengths of the antennal segments, a similar relation between *C. jonmartini* and *Chironomus* sp. "Seitajärvi" which has been found between *C. jonmartini* and other members of the *aberratus* group obtained in Wülker's measurements.

The quite reduced, apomorphous armament of the anterior sternites in the pupal exuviae of *C. jonmartini* is different in comparison to many other known pupal exuviae of the genus *Chironomus*. According to the keys of Langton (1991, 1995), the species of the *aberratus* group show obviously quite different degrees of the reduction of spinules in the sternites. They all seem however to have, for instance, hairlike spinules on the pleurae of segment 4 and longitudinal lateral rows at least on sternite 3, which both belong obviously to the plesiomorphous structures of the exuviae. *C. beljaninae* has (obviously also plesiomorphously) anterior transverse rows of spinules (cf. Langton 1991, 1995) on sternites 3 and 4, these are obviously lacking on the other species; there is, however, some resemblance to the exuviae of *Chironomus* sp. "Seitajärvi", which has a large median patch of spinules on each of the sternite mentioned.

C. jonmartini, with plesiotypical longitudinal rows of spinules also on sternite 4, shows on the contrary in the reduction of the other patches of spinules a quite apotypical grade in comparison to the exuviae of "*Chironomus* sp. Seitajärvi", but perhaps also to the other known species of the *aberratus* group. The discussed species from lake Seitajärvi has exuviae, which perhaps resemble up to the points of tergite 8 those of *C. fraternus* (Pe 16) as described by Langton (1991, 1995). These points, are in the population of Seitajärvi, nearly all irregularly arranged, not forming rows as they do in *C. fraternus*. Because there are in some exuviae of the Seitajärvi population some rows of the points to be seen, this would be a population difference, if the species in question could be shown to be *C. fraternus*. Very little is known about the intraspecific variation of the armament of the exuviae between the populations.

The pupae described in the present paper show instability in the presence of the (plesiomorphous) spinules on the paratergites of segment 7 and of the intersegmental spinules behind the armament of tergite 6. In "*Chironomus* sp. Seitajärvi" these

spinules are more regularly found than in *C. jonmartini*. Because the observation of the minute spinules also depends on the quality of the preparations, there is some uncertainty as to the true frequency of the variation. The phenomenon diminishes the taxonomical value of these structures as the key characters. Ways of delimiting the pupae to an *aberratus* group are thus not known. For methods of identifying the pupae of this group we refer to the key of Langton (1991, 1995).

Some adult specimens of *C. jonmartini* measured for the present paper belong to the 2nd (summer) generation (cf. Lindeberg 1960: 73). These adults are smaller (have shorter wings), the AR value is lower, but LR higher than in those mentioned in the original description of Lindeberg (1960: 70). This corresponds also with the shorter pupal exuviae. Also the "tarsal beard" (BR) values seem to be usually in the present study much lower than that obtained from the longest setae in the individuals described originally by Lindeberg and mentioned later in the key by Lindeberg and Wiederholm (1979). The longest tarsal hairs seem not to be very numerous in the studied individuals. If these hairs are easily loosened, the observation may give misleading results (similar legs with a few hairs are also in a slide of Lindeberg's original material).

To get more morphometrical information about the adults, some larvae were taken before the winter freeze of 15.X.1995 by our colleague V. I. Pajunen from the pools of the island Bränskärr, Tvärminne. The first individuals emerged about four weeks later at room temperature and were approximately as large as the specimens described originally by Lindeberg (1963). The highest values for the measurements given in the present paper belong to these individuals.

In the key of Lindeberg and Wiederholm (1979) describing the European species, the male adults of *C. staegeri* Lundbeck (karyological *staegeri* group, Wülker *et al.* 1971) form, because of the similarities with *C. jonmartini*, a taxonomical couple. This species has not been karyologically shown in Europe (Wülker 1991b: 104), but as mentioned before in the present paper, *C. staegeri* also seems to have larvae, which are easily separable at least from the European species discussed here.

Up to the present there are in Europe thus perhaps only two species (*C. jonmartini* and *C. fraternus*) which have roughly similar combinations of male characters. If in Europe there are only these two species with an easy key character, i.e. the relatively long tarsal beard (BR) in the fore leg of the male, the morphological differentiation of the adults would be easy to confirm with the aid of

the information obtained from their pupal exuviae. The LR value in the studied population of the male *C. jonmartini* is higher than that given by Wülker (1991b: 104) for *C. fraternus*, but also clearly higher in comparison to the studied population of *Chironomus* sp. "Seitajärvi". All other species of the karyological *aberratus* group on the contrary show a short BR value (cf. Lindeberg & Wiederholm 1979: 105, Wülker 1991b: 104), but the available data in the literature obviously does not allow delimitation with a key character, a morphological *aberratus* group of the adults.

The population of *Chironomus* sp. "Seitajärvi" is univoltine at least in the studied locality and therefore the possible seasonal morphological differences cannot be observed. Individua emerged on 29.V.–04.VI.1960 quite soon after the melting of the ice, which happened at about 14–15.V.1960. The adult individuals of this population are as large as the large individuals of *C. jonmartini*, but the LR values are lower, corresponding better with those given by Wülker (1991b: 104) for *C. fraternus*. The number of the tarsale sensilla chaetica is higher in *C. jonmartini*; also in the female specimens there is an overlap in the variation of their number.

Especially in the external morphology the differences in the pupal exuviae of the *aberratus* group appear to be taxonomically very important. Holomorphological characters (= all instars if possible) should be observed when determining species without karyological evidence. In the present case the differences between the studied populations (species) can be summarized as follows:

Males

- 1(2)LR 1.33–1.45; BR(P_1) 3.5–6.5; sensilla chaetica on P_{2-3} 9–25 in number; anal point proximally 45–50 μ m; styli slender, relation length/width 5.0–5.5; in appendage 2 relation length/width 3.3–4.5 *C. jonmartini*
 2(1)LR 1.15–1.26; BR(P_1) 3.4–4.9; sensilla chaetica on P_{2-3} 7–13 in number; anal point proximally 60–80 μ m; styli less slender narrowing abruptly near the apex, the relation length/width 3.8–4.2; in appendage 2 relation length/width 2.7–3.3 *Chironomus* sp. "Seitajärvi"

Females

- 1(2)LR 1.26–1.48; sensilla chaetica on P_{2-3} 64–126 in number *C. jonmartini*
 2(1)LR 1.16–1.30; sensilla chaetica on P_{2-3} 50–75 in number *Chironomus* sp. "Seitajärvi"

Pupae

- 1(2)Sternites 1–4 medially at most with small patches; sternite 2–4 with lateral longitudinal rows of spinules; sternites 6–7 anteriorly with patches of spinules, which are nearly fused *C. jonmartini*
 2(1)Sternites 1–3(4) medially broadly spinulated; sternite 1–3 with lateral longitudinal rows of spinules, which are joined together with the medial patches in the posterior part of the sternites 1–2. Parasternites 1–2 also spinulated. Patches of spinules on the sternites 6–7 clearly separated *Chironomus* sp. "Seitajärvi"

Larvae

- 1(2)The proximal (6th) tooth of the mandible is dark or pale, small, but not fused to the inner edge of the mandible. Pecten epipharyngis with 13–17 teeth. In the antenna the relation 1st segment : 2nd segment = 100 : 26–36. In the sensory field of the labrum the seta S_1 apically coarsely serrate with "hairs" equal in size; one side nearly completely and only the apical half of the other side is serrated *C. jonmartini*
 2(1)The proximal (6th) tooth of the mandible is usually pale, small, but in most individuals nearly in its total length fused to the inner edge of the mandible. Pecten epipharyngis with 10–11 teeth. In the antenna the relation 1st segment : 2nd segment = 100 : 30–41. Seta S_1 apically coarsely serrate, but usually with one "hair" stronger than the others; one side nearly completely and the other side 1/3 apically serrated .. *Chironomus* sp. "Seitajärvi"

5.2 Distribution and ecology

Tuiskunen and Lindeberg (1986) reported *C. jonmartini* from Lapland. The distribution pattern of certain other aquatic species of the SW archipelago of Finland allow such a determination pattern (cf. for instance, the distribution of *Callicorixa producta* in the rockpools, coexisting with *C. jonmartini*, in Jansson 1986: 32, cf. also Jansson 1980). In the Zoological Museum of Helsinki there is a male from Kilpisjärvi, which is one of the most northern parts of Finland, 16.VII.1969, B. Lindeberg leg. & det. This specimen agrees in all respects with the males of *C. jonmartini* described in the present paper. Because the males seem, however, to be most difficult to identify and no exuviae are present, the occurrence of *C. jonmartini* in Lapland is obviously in need of confirmatory evidence. According to Wülker (1991b: 108), the observations on *C. jonmartini* by Koskenniemi and Paasivirta (1987) and Paasivirta *et al.* (1988) may have concerned *C. fraternus* Wülker.

C. jonmartini seems thus up to now to be with full certainty known only from the area of the type locality. This includes a zone containing more or less saline or occasionally fresh water in the rockpools of the Gulf of Finland archipelago in Tvärminne (see Fig. 1 in Lindeberg 1958). The present material originates from some shallow (depth < 0.25 m) pools on the islands, which are about 2–3 km from the continent. *C. jonmartini* is a quite constant and predominant species in some of them. (In some samples, V. I. Pajunen leg., determined by the present writer M. H., 70–90% of the emerged adults belonged to this species.) Lindeberg (1958) gave some preliminary examples of the species, which emerged in a type of funnel trap, developed by him for the studies of these biotopes. A coexisting, characteristic chironomid species for the rockpools, which is also with certainty known in Finland from the rockpools of the Tvärminne area only, is *Procladius breviatus* Remmert (cf. Remmert 1953; ? = *Procladius* sp. in Lindeberg 1958, Fig. 4).

Lake Seitajärvi was a small, 200–300-m broad and about 1.5-km long polyhumic, partly paludified littoral lake (sensu Brundin 1956: 196) with a loose mud (dy) bottom (depth < 2.5 m; colour 60 Pt mg/l and pH 5.4–6.9; its conductivity on 01.VII.1961 was 5.0 mS/m). The about 1.5-m broad and about 1-m deep outlet was without a visible or measurable flow of current. The brook soaked into the moss bed about 10 m from the lake behind a weir of wood. Obviously the same brook, Tupalehdonoja (0.3 m, later < 2 m broad), then opened again somewhere after the peatland. Perhaps it was joined also by other waters when it flowed in a forest into the river Luuro, about one kilometre away. In the outlet at Seitajärvi, just before the weir, was the site of the funnel trap where the species "*Chironomus* sp. Seitajärvi" emerged and also predominated. It was not found in the 1960 studies in Lake Seitajärvi proper. The water in the outlet was obviously the same as in the lake but the influence of the small flow of current on the species combination (among others *Microtendipes lugubris* Kieffer) may have been important. The predominating chironomid species of the deep parts of the lake proper was, on the contrary, *Microtendipes nigellus* Hirvenoja (1963).

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